Lower Cow Creek Watershed Analysis and Water Quality Restoration Plan

Roseburg District
South River Resource Area

Second Iteration
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Lower Cow Creek WAU

Characterization

The Lower Cow Creek WAU covers approximately 102,447 acres. Approximately 11,445 acres (11 percent) of the WAU is in nonforested conditions, mainly agricultural. About four percent (approximately 3,619 acres) of the WAU are dominated by hardwoods. The rest of the WAU is considered to be conifer forests.

The Bureau of Land Management administers approximately 39,945 acres (39 percent) of the WAU. The South River Resource Area manages approximately 39,533 acres and the Glendale Resource Area manages approximately 395 acres of the BLM-administered lands. Approximately 6,960 acres (17 percent) of BLM-administered lands are in the Matrix Land Use Allocation. This is about seven percent of the WAU.

Timber harvesting, agriculture, transportation, mining, recreation, service-related activities, and residential dwellings have been some of the human uses in the WAU. The town of Riddle is located in the WAU.

The watershed analysis uses the format presented in the Ecosystem Analysis at the Watershed Scale, Federal Guide for Watershed Analysis. The Key Issues, Findings, and Recommendations and Restoration Opportunities summarize the information included in the watershed analysis.

Key Issues

The following issues and concerns were identified during the analysis.

Potential areas for timber harvesting on BLM-administered land in the WAU.

The amount of timber harvesting conducted in the past.

The amount of late-successional habitat in the WAU.

The distribution and condition of habitat used by Special Status Species.

Condition of Riparian Reserves (vegetation conditions and effects of roads).

Water quality.

The impacts roads have on streams due to sediment and road encroachment.

Restoration opportunities in the WAU.

Findings

Vegetation

Bureau of Land Management administered land comprises about 39 percent of the WAU.

About 17 percent of the BLM-administered land in the WAU is available for timber harvesting. It is estimated about six percent of the BLM-administered land in the WAU will be less than 30 years old in 2025.

Port-Orford-cedar does occur in the WAU.

Soils

Approximately 12,942 acres on BLM-administered land are considered to have Category 1 Soils that are highly sensitive to prescribed slash burning.

Approximately 12,682 acres on BLM-administered land have slopes less than 35 percent and could potentially be harvested with ground based equipment. Ground based harvesting equipment can compact the soil and affect soil productivity.

Hydrology and Fisheries

Road densities in the WAU range from 1.75 to 6.93 miles per square mile. The average road density in the WAU is 4.89 miles per square mile.

Road densities on BLM-administered land range from 0.53 to 6.93 miles per square mile. The average road density on BLM-administered land in the WAU is 4.17 miles per square mile.

Cow Creek and Middle Creek were on the water quality limited list for habitat modification. Cow Creek, Cattle Creek, Iron Mountain Creek, Martin Creek, Middle Creek, and the South Fork of Middle Creek were on the water quality limited list for temperature. Cow Creek through portions of the WAU was on the water quality limited list for toxics and pH.

Two stream reaches surveyed in the Aquatic Habitat Inventory were rated as being in good condition, 52 stream reaches were rated as being in fair condition, and seven stream reaches were rated as being in poor condition.

Pfankuch surveys indicate stream channel stability has not been affected by increased peak flows. Galesville Reservoir, which is located about 54 miles upstream from the mouth of Cow Creek, affects the flow in Cow Creek, decreasing annual peak flows and increasing the average mean daily low flow.

The lack of large woody debris is the limiting factor in most stream reaches surveyed by ODFW. Large woody debris is an important component in stream function and aquatic habitat.

Wildlife

The Northern Spotted Owl

The northern spotted owl is the only Federally listed wildlife species known to occur in the Lower Cow Creek WAU.

There are approximately 8,846 acres of suitable northern spotted owl nesting, roosting, and foraging habitat in the WAU. This is about 22 percent of the Federally-administered land and nine percent of the WAU.

There are 42 known spotted owl centers in the Lower Cow Creek WAU.

Survey and Manage Species

There is habitat within the WAU that some Survey and Manage species may use.

Northwestern Pond Turtle

The northwestern pond turtle is a Bureau Sensitive Species occurring along Cow Creek in the WAU. Recreation activities along Cow Creek may disturb habitat or cause mortality of northwestern pond turtles.

Recommendations and Restoration Opportunities

Vegetation

Conduct regeneration harvests on the Matrix Land Use Allocation in conformance with the RMP.

Manage young stands, including those in Riparian Reserves, to maintain or improve growth and vigor and improve stand structure and composition.

Follow management guidelines to reduce or prevent the spread of the Port-Orford-cedar root disease to healthy Port-Orford-cedar.

Soils

Appropriate methods should be used for reducing vegetative competition on Category 1 Soils. Consider using methods other than prescribed burning on Category 1 Soils unless considered essential for resource management, such as habitat improvement, tree seedling establishment, or reducing fire risks.

Best Management Practices (BMPs) should be applied during all ground and vegetation disturbing activities. See Appendix D, Roseburg District Record of Decision and Resource Management Plan (USDI 1995) for a list and explanation of BMPs. Along with the BMPs, the Standards and Guidelines in the SEIS Record of Decision (USDA and USDI 1994b) should be implemented in order to achieve proper soil management. Best Management Practices should be monitored for implementation and effectiveness to document that soil goals are being achieved.

Maintain or enhance long term soil productivity while meeting management objectives.

Hydrology

Continue restoration and monitoring activities associated with the Formosa mine.

Consider conducting density management activities in Riparian Reserves to maintain or improve tree growth for future stream side shade, channel stability, and potential large woody debris.

Consider placing large woody debris in the stream channel to manipulate channel form and improve aquatic diversity.

Decommission, obliterate, or improve roads causing or having the potential to cause sediment being delivered to streams.

Fisheries

Consider replacing human-made (culvert) barriers to fish passage.

Continue restoration and monitoring activities associated with the Formosa mine.

Consider conducting surveys in upper Middle, Martin, Peavine, Iron Mountain, and Union Creeks to identify instream restoration opportunities.

Monitor and maintain culverts placed in Iron Mountain, Cattle, and Council Creeks in 1995.

Remove the failed instream structures in Martin Creek and replace with other structures, such as rock weirs.

Continue operating a smolt trap at the mouth of Cow Creek, if Douglas County stops operating one, to provide life history and population size information for anadromous species and resident salmonids, as well as the species diversity in Cow Creek.

Wildlife

The American Bald Eagle

Manage forest stands on BLM-administered land within one mile of and facing Cow Creek to provide habitat characteristics used by bald eagles.

The Northern Spotted Owl

Density management activities could be conducted to accelerate development of late-successional habitat to benefit northern spotted owl productivity and survival. Stands occurring near northern spotted owl sites with the poorest suitable northern spotted owl habitat, occupation, and reproduction would be areas to consider first.

Fender's Blue Butterfly

Survey the two documented Kincaid's lupine sites to determine if the Fender's blue butterfly occurs in the WAU.

Northwestern Pond Turtle

Provide a 50 meter protective buffer around areas occupied be northwestern pond turtles to decrease nesting habitat disturbance. Refer to northwestern pond turtle conservation strategy when it is completed.

The Peregrine Falcon

Follow management guidelines for the peregrine falcon.

Invasive Species in Ponds

Consider controlling non-native fish species in ponds to benefit native amphibians.

Consider restoration activities in ponds to benefit native aquatic species.

Neotropical Bird Species

Consider implementing projects impacting nesting habitat before April 1 or after July 30 in any given year.

Consider retaining brush and non-commercial tree species that are not competing with the desired tree species.

Consider including different prescriptions when brushing or thinning in Riparian Reserves.

I. Introduction

The area covered by this watershed analysis was analyzed in the Cow Creek Watershed Analysis completed in September 1997. This watershed analysis is intended to update information in the previous analysis.

A number of changes have occurred since the previous watershed analysis was written. The watershed boundary has changed since the Cow Creek Watershed Analysis was written and the name of the watershed established by the Regional Ecosystem Office (REO) to be consistent between agencies is the Lower Cow Creek Watershed. Other information, such as the roads and streams, has been updated in the Bureau of Land Management Geographic Information System (GIS) and is used in this watershed analysis.

This document is also different from the previous watershed analysis, since it includes a Water Quality Restoration Plan. The Water Quality Restoration Plan is intended to address the prevention and control of water pollution from Bureau of Land Management (BLM) activities in the Lower Cow Creek Fifth Field Watershed.

II. Characterization of the Watershed Analysis Unit

Watershed analysis is a systematic procedure to characterize a watershed. The information would be used for making management decisions to meet ecosystem management objectives. This watershed analysis follows the format presented in the Ecosystem Analysis at the Watershed Scale, Federal Guide for Watershed Analysis.

Watershed analysis is one component of the Aquatic Conservation Strategy (ACS). The other components of the Aquatic Conservation Strategy are Key Watersheds, Riparian Reserves, and Watershed Restoration. These components are designed to operate together to maintain and restore the productivity and resiliency of riparian and aquatic ecosystems. The Lower Cow Creek Watershed Analysis Unit (WAU) includes the Middle Creek Tier 1 Key Watershed. The Key Watershed includes the Lower Middle Creek and Upper Middle Creek Subwatersheds. Riparian Reserves are portions of the landscape where riparian-dependent and stream resources receive primary emphasis. Riparian Reserves help meet the Aquatic Conservation Strategy by maintaining streambank integrity, large woody debris (LWD), riparian shade and microclimate, and surface and groundwater systems (see Appendix H). Riparian Reserves also provide sediment filtration, travel and dispersal corridors, nutrient sources, pool habitat, and drainage network connections. Watershed Restoration would help in the recovery of fish habitat, riparian habitat, and water quality.

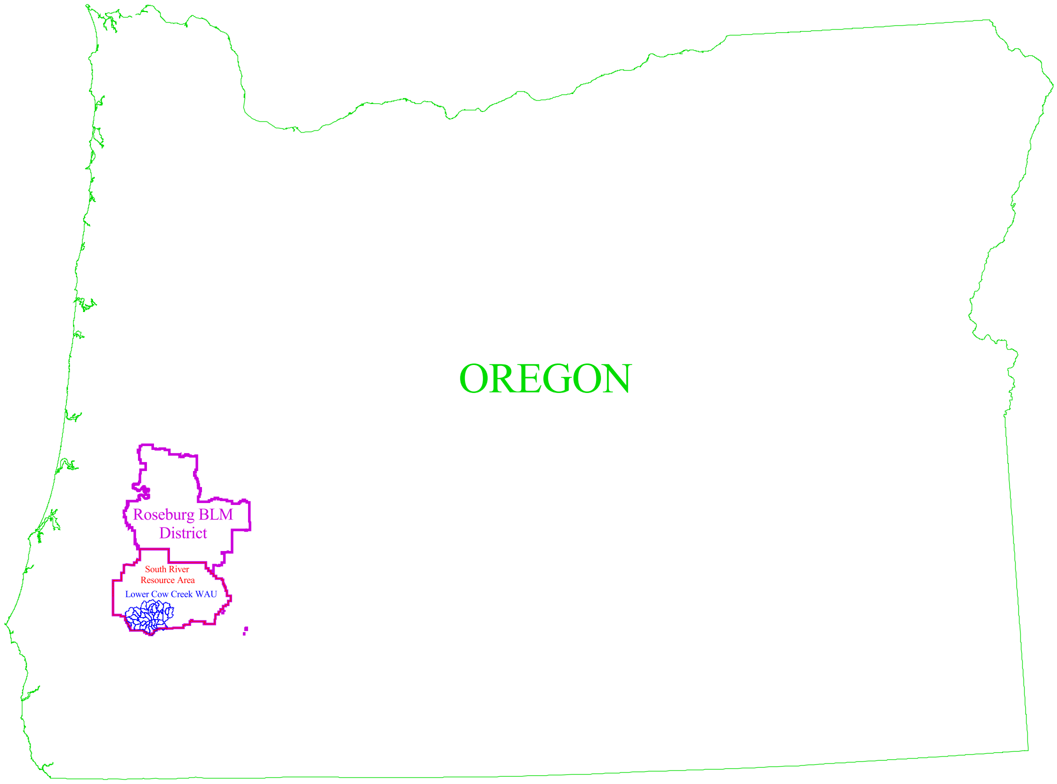
The Lower Cow Creek Watershed Analysis Unit is located approximately 20 miles southwest of Roseburg in the southwest portion of the South River Resource Area on the Roseburg Bureau of Land Management District (see Map 1). The Lower Cow Creek WAU also includes land managed by the Glendale Resource Area on the Medford Bureau of Land Management District. The Watershed Analysis Unit covers approximately 102,447 acres. Elevation ranges from about 640 feet where Cow Creek flows into the South Umpqua River in the northeast part of the WAU to about 4,020 feet at Grayback in the southern portion of the WAU. The town of Riddle is located in the WAU.

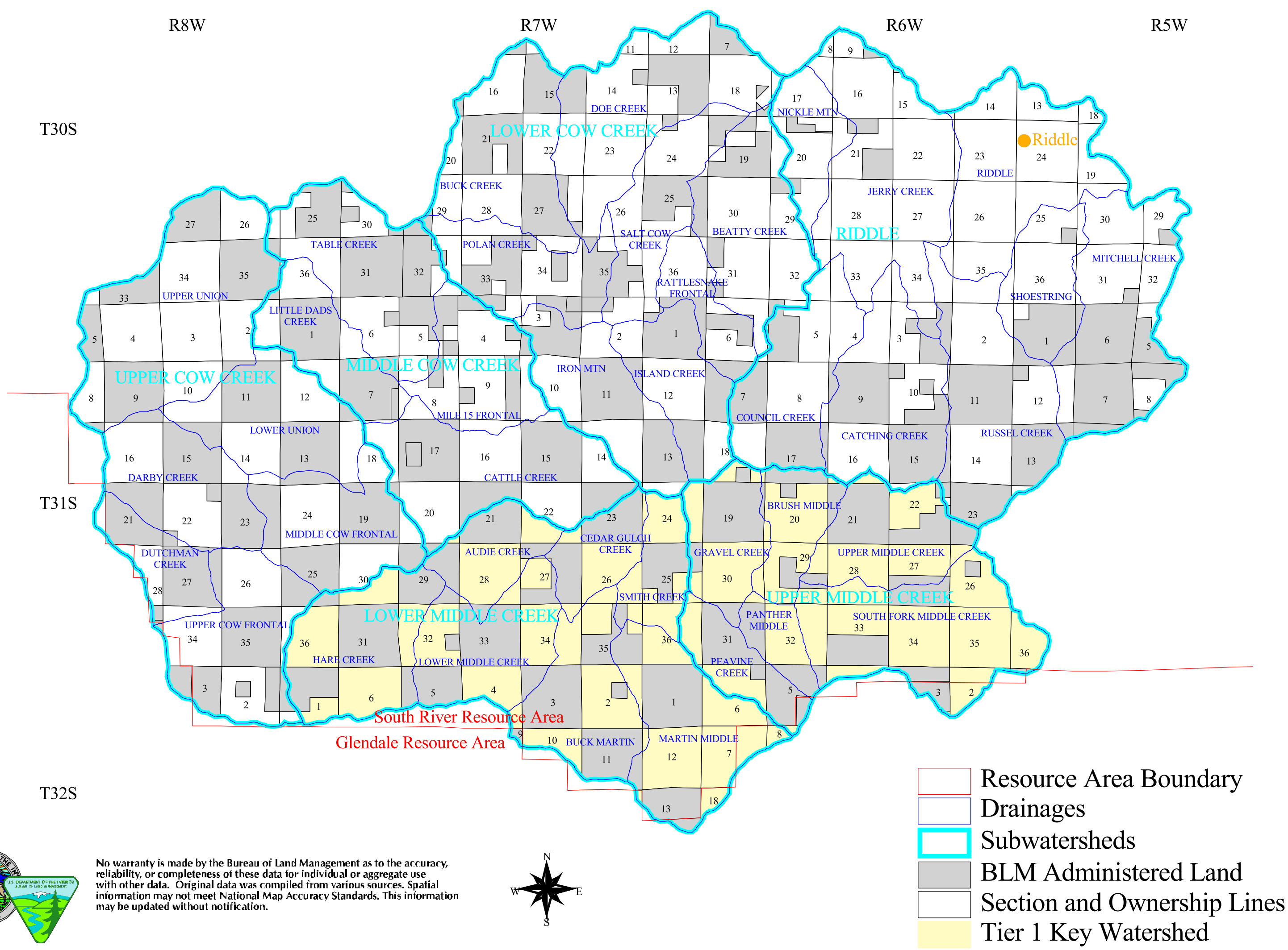
The Lower Cow Creek Watershed Analysis Unit is interchangeable with the Lower Cow Creek Watershed, which is a fifth field watershed. The fifth field watershed is the scale of analysis used when determining whether activities retard or prevent attainment of Aquatic Conservation Strategy objectives (USDI 1995). The Lower Cow Creek Watershed Analysis Unit includes six subwatersheds, which are further divided into 39 drainages. The subwatersheds and their drainages are shown on Map 2 and the acres of each are listed in Table 1.

The Bureau of Land Management (BLM) administers approximately 39,945 acres (39 percent) of the Lower Cow Creek WAU. The South River Resource Area manages approximately 39,533 acres and the Glendale Resource Area manages approximately 395 acres of the BLM-administered lands. Privately owned lands cover approximately 62,500 acres (61 percent) of the WAU.

Federally administered lands are composed of Matrix, Late-Successional Reserve (LSR), and Riparian Reserve Land Use Allocations established in the Northwest Forest Plan (USDA and USDI 1994b) and the Roseburg and Medford District Resource Management Plans (RMP). The Matrix Land Use Allocation on BLM-administered land is further delineated as General Forest Management Areas (GFMA), Northern General Forest Management Areas (NGFMA) in the Medford BLM District, and Connectivity/Diversity Blocks (CONN). The GFMA and NGFMA will be grouped and considered as GFMA in this watershed analysis since the management directions are the same. Map 3 and Chart 1 show the percentage of GFMA, Connectivity/Diversity Blocks, LSR, and Riparian and Other Reserves and how they are distributed in the WAU. Chart 2 and Table 2 show the number of acres by Land Use Allocation.

Map 1. Vicinity Map
Lower Cow Creek Watershed Analysis Unit





No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data was compiled from various sources. Spatial information may not meet National Map Accuracy Standards. This information may be updated without notification.

Map 2. Lower Cow Creek Watershed Analysis Unit
Subwatersheds and Drainages

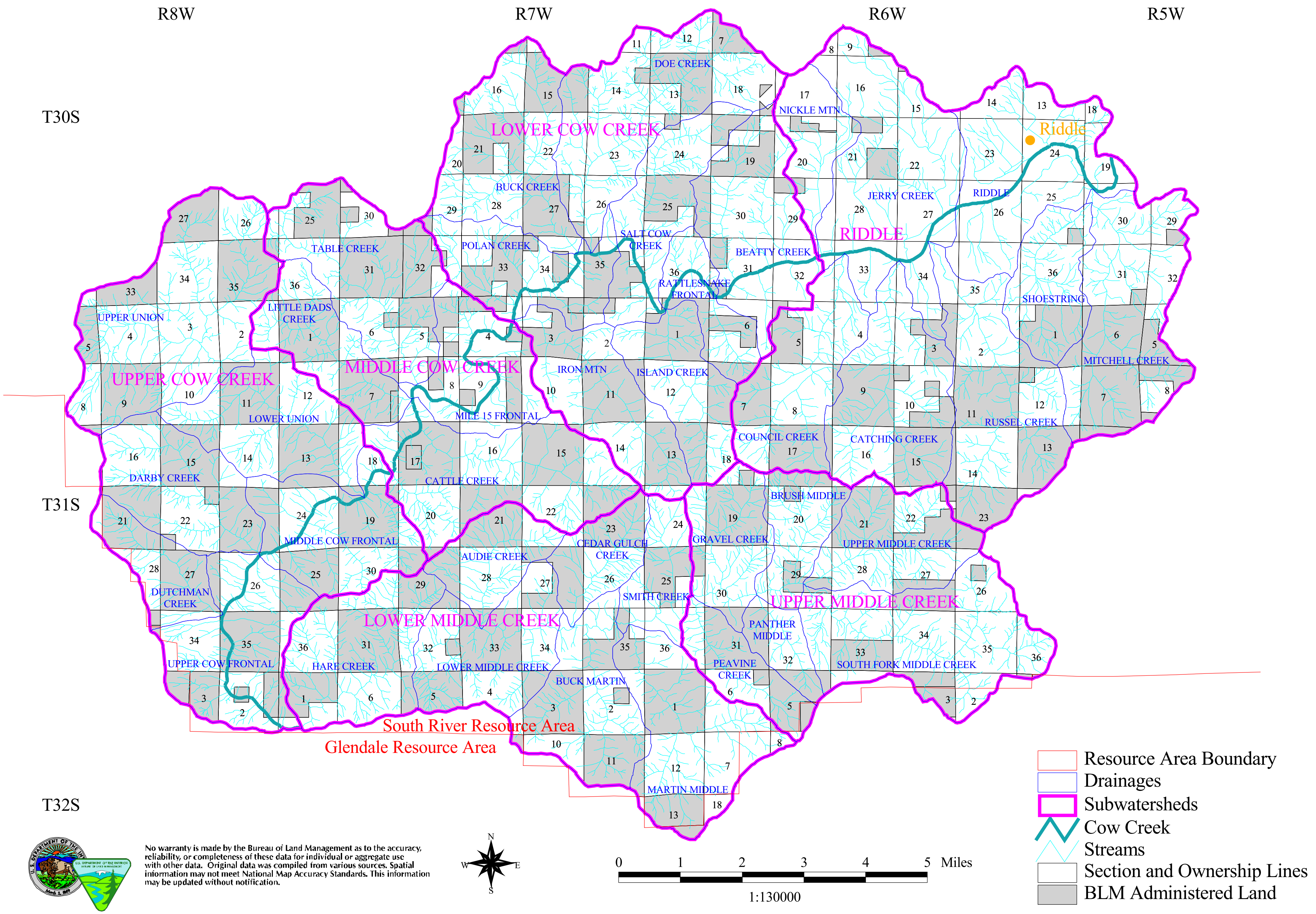


Table 1. Acres and Percent Ownership by Drainage and Subwatershed.

Drainage Name **Subwatershed Name**	BLM		Private		Total Acres
	Acres	Percent	Acres	Percent	
Catching Creek*	1,567	47	1,752	53	3,320
Council Creek*	1,065	38	1,755	62	2,820
Jerry Creek	328	7	4,388	93	4,716
Mitchell Creek*	1,839	47	2,091	53	3,930
Nickle Mountain*	107	8	1,208	92	1,315
Riddle	0	0	3,740	100	3,740
Russell Creek*	1,818	47	2,059	53	3,877
Shoestring*	533	31	1,175	69	1,708
Riddle Subwatershed	7,257	29	18,168	71	25,426
Beatty Creek	740	24	2,367	76	3,107
Buck Creek*	1,373	43	1,853	57	3,226
Doe Creek*	1,030	25	3,072	75	4,102
Iron Mountain*	1,325	51	1,261	49	2,586
Island Creek*	1,016	50	1,014	50	2,029
Polan Creek	1,082	47	1,230	53	2,312
Rattlesnake Frontal	422	35	776	65	1,198
Salt Cow Creek	713	31	1,570	69	2,283
Lower Cow Creek Subwatershed	7,701	37	13,143	63	20,843
Cattle Creek	1,814	47	2,080	53	3,894
Little Dads Creek*	1,134	58	824	42	1,958
Mile 15 Frontal	621	28	1,589	72	2,210
Table Creek*	1,864	54	1,608	46	3,472
Middle Cow Creek Subwatershed	5,433	47	6,101	53	11,534

Drainage Name **Subwatershed Name**	BLM		Private		Total Acres
	Acres	Percent	Acres	Percent	
Darby Creek*	1,321	52	1,244	48	2,565
Dutchman Creek*	886	68	426	32	1,312
Lower Union	1,325	48	1,450	52	2,775
Middle Cow Frontal	1,392	50	1,383	50	2,775
Upper Cow Frontal	1,455	48	1,593	52	3,048
Upper Union*	2,040	39	3,206	61	5,246
Upper Cow Creek Subwatershed	8,419	48	9,302	52	17,721
Audie Creek*	669	46	772	54	1,441
Buck Martin	1,277	49	1,304	51	2,581
Cedar Gulch Creek*	686	56	537	44	1,223
Hare Creek	1,357	46	1,614	54	2,971
Lower Middle Creek	1,229	47	1,376	53	2,605
Martin Middle*	1,236	38	2,033	62	3,269
Smith Creek	403	33	828	67	1,231
Lower Middle Creek Subwatershed	6,857	45	8,464	55	15,321
Brush Middle	401	29	959	71	1,360
Gravel Creek	781	45	936	55	1,717
Panther Middle*	341	45	416	55	757
Peavine Creek*	770	59	528	41	1,298
South Fork Middle Creek*	918	22	3,239	78	4,157
Upper Middle Creek*	1,067	46	1,243	54	2,310
Upper Middle Creek Subwatershed	4,278	37	7,321	63	11,599
Lower Cow Creek WAU	39,945	39	62,499	61	102,444

* = Discrete drainage.

Map 3. Lower Cow Creek Watershed Anaysis Unit
Land Use Allocations

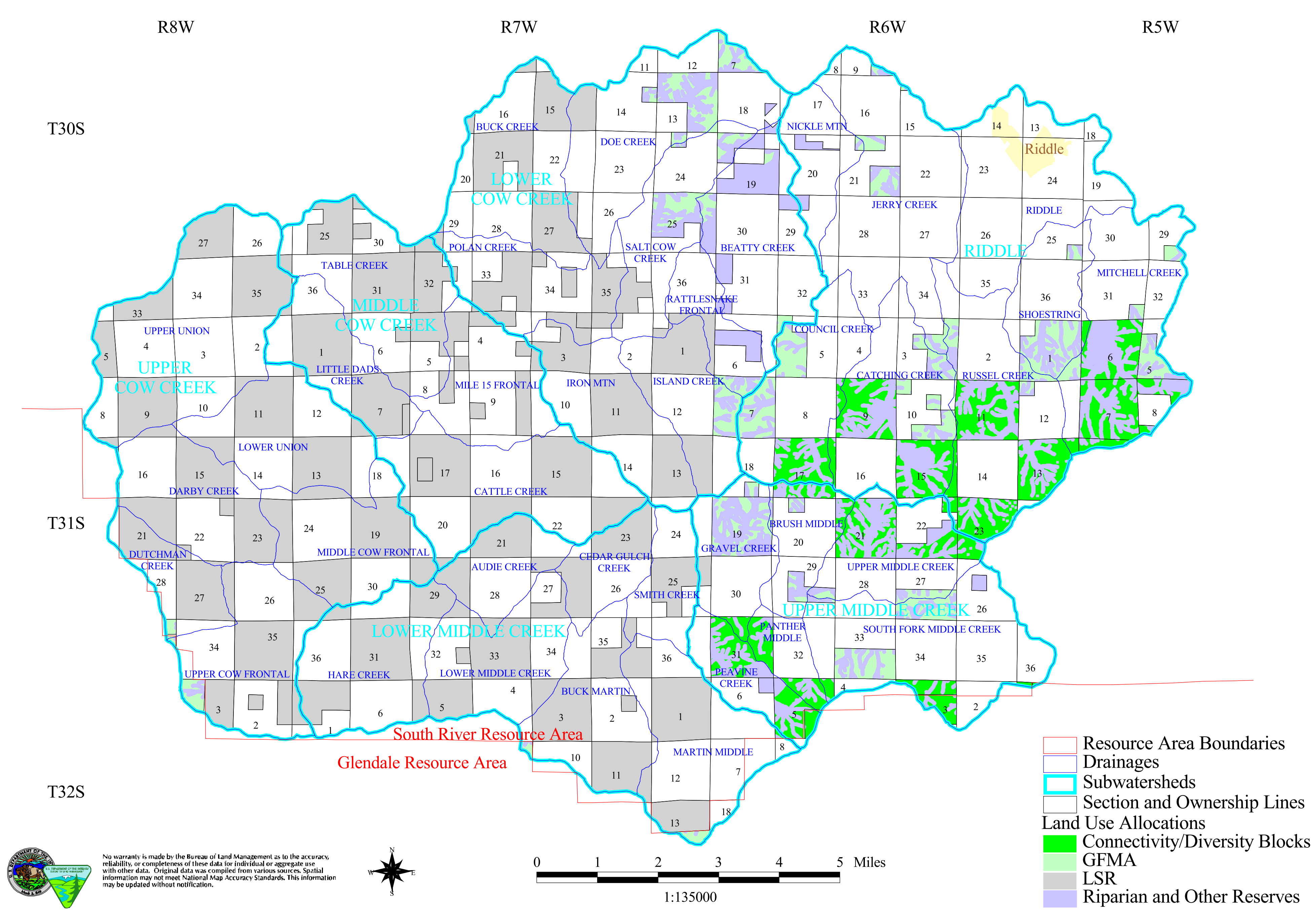


Chart 1. Lower Cow Creek WAU

Land Use in the WAU

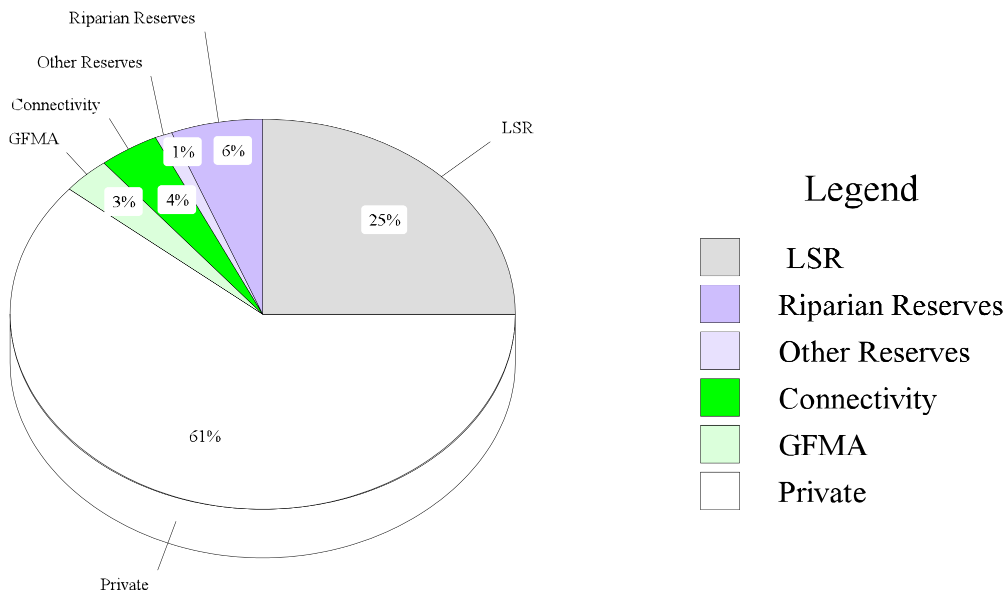


Chart 2. Lower Cow Creek WAU

Federal Land Use Allocations

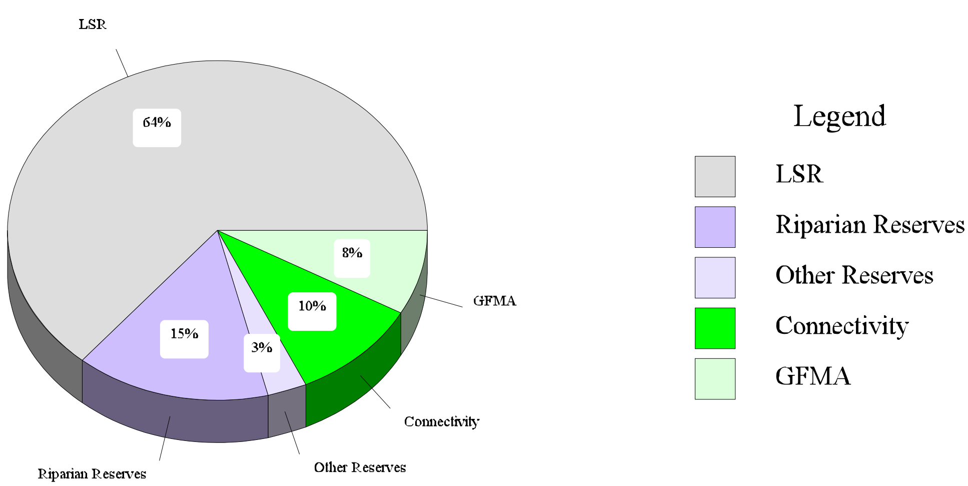


Table 2. Acres and Percentage of Federally Managed Lands by Land Use Allocation.

Land Use Allocation	Acres in Roseburg District	Acres in Medford District	Total Acres of Federally Managed Lands	Percent of Federally Managed Lands	Percent of Watershed Analysis Unit
Late-Successional Reserve	25,742	0	25,742	64	25
Riparian Reserves (Outside of LSR)	5,799	74	5,873	15	6
Other Reserved Areas (Owl Core Areas and TPCC Withdrawn Areas)	1,349	2	1,351	3	1
Connectivity/Diversity Blocks	3,680	157	3,837	10	4
General Forest Management Area (GFMA)	2,963	162	3,125	8	3
Total	39,533	395	39,928	100	39

III. Issues and Key Questions

The purpose of developing issues is to focus the analysis on the key elements of the ecosystem that are relevant to the management questions, human values, or resource conditions within the WAU. Areas covered by this watershed analysis receive more in-depth analysis during project development and the National Environmental Policy Act (NEPA) process. New information gathered during the Interdisciplinary (ID) team process would be appended to the watershed analysis document as an update.

A. Issue 1 - Late-Successional Reserves

Late-Successional Reserves are to be managed to maintain a functional and interacting late-successional and old-growth ecosystem. The South Coast - Northern Klamath Late-Successional Reserve Assessment was developed to help facilitate implementation of appropriate management activities for the Late-Successional Reserve included in this WAU.

Key Questions

Vegetation Patterns

Where are the late-successional/old-growth stands within the LSR? See Map 7 on page 39.

Where are the stands that may be treated to maintain or promote late-successional habitat within the LSR? See Map 7 on page 39, Map 34 on page 210, Map 36 on page 212, Map 37 on page 219, Map I-1 in Appendix I, pages 209 through 212, pages 218 and 219, and Appendix F.

Are there risk reduction activities that could occur in the WAU to protect late-successional/old-growth forests? See pages 209 through 214.

B. Issue 2 - Harvest Potential

Matrix lands are responsible for contributing to the Probable Sale Quantity (PSQ). Objectives in the Matrix include producing a sustainable supply of timber and other forest commodities, providing connectivity (along with other Land Use Allocations, such as Riparian Reserves) between Late-Successional Reserves, providing habitat for a variety of organisms associated with both late-successional and younger forests, providing for important ecological functions such as dispersal of organisms, carryover of some species from one stand to the next, maintenance of ecologically valuable structural components such as down logs, snags, and large trees, and providing early-successional habitat.

Key Questions

Vegetation Patterns

What are the historic and current vegetation conditions? See pages 22 through 75.

What is the current age class distribution in the WAU? Where are the early and mid seral stands in the WAU? Where are the late-successional/old-growth stands within the WAU? See table 9 on page 40 and Map 8 on page 43.

Where are the stands of harvestable age (at least 40 years old) within the Matrix Land Use Allocation? See Map 7 on page 39 and Map I-1 in Appendix I.

Can the scale, timing, and spacing of timber harvest areas be adjusted to minimize fragmentation and the effects on other resources while meeting the objectives for the Matrix Land Use Allocation established in the SEIS ROD and the Roseburg District RMP? See pages 75 through 95, pages 218 and 219, Map 16 on page 82, Map 37 on page 219, and Appendix E and Appendix I.

C. Issue 3 - Watershed Health and Restoration

Tier 1 Key Watersheds have been identified as priority areas for watershed restoration. Watershed restoration is an integral part of a program to aid recovery of fish habitat, riparian habitat, and water quality. One component of a watershed restoration program involves road treatments (such as decommissioning or upgrading), which would reduce sedimentation and erosion and improve water quality. A second component deals with riparian vegetation. Silvicultural treatments in Riparian Reserves, such as planting unstable areas along streams, thinning densely-stocked young stands, releasing young conifers overtopped by hardwoods, and reforesting shrub and hardwood dominated stands with conifers, would improve bank stabilization, increase shade, and accelerate recruitment of large wood desirable for future in-stream structure. A third watershed restoration component involves the design and placement of in-stream habitat structure in an effort to increase channel complexity and the number of pools. Other restoration opportunities may include mine reclamation or meadow or wetland restoration.

Opportunities may exist to promote the long-term health on lands outside of riparian areas. Management activities would be designed so forests remain productive, resilient, and stable over time to withstand the effects of periodic natural or human-caused stresses such as drought, insect attack, disease, climatic changes, flood, resource management practices, and resource demands.

Key Questions

a. Vegetation Patterns

What processes created the vegetation patterns? See pages 14, 16 and 74.

Where are the opportunities to maintain or restore stand health or vigor in the upland areas of the WAU? See pages 85 through 95, pages 204 through 214, page 218, Map 34 on page 210, Map 35 on page 211, Map 36 on page 212, and Map 37 on page 219.

What is the current condition of Riparian Reserves in the WAU? See pages 64 through 69.

What and where are the opportunities to restore late-successional conditions in Riparian Reserves? See pages 92 through 95, Map 14 on page 68, and Map 17 on page93

b. Soils / Erosion

What are the dominant erosion processes within the WAU? Where have these erosion processes occurred in the past? Where might they occur in the future? See pages 97 through 119, Map 21 on page 116, and Map 22 on page 119.

Where are the soils that management activities could reduce soil productivity? See pages 117 through 122, Map 22 on page 119, and Map 23 on page 122.

c. Hydrology / Channel Processes

What are the dominant hydrologic characteristics (e.g. total discharge, and peak, base, and low flows) and other notable hydrologic features and processes in the WAU? See pages 123 through 161.

d. Water Quality

What beneficial uses dependant on aquatic resources occur in the WAU and which water quality parameters are critical to these uses? See pages 147 through159 and Appendix K.

What are the effects of management activities on hydrologic processes? See pages 123 through 161.

Where are the opportunities to improve water quality and hydrologic conditions? See pages 147 through 161 and Appendix K.

e. Fisheries

Where are the historic and current locations of fish populations? See pages 162 through 169, Map 26 on page 164, and Appendix C.

How have fish habitat and populations been affected by hydrologic processes and human activities? See pages 162 through 172 and Appendix C.

What and where are the restoration opportunities that would benefit the fisheries resource? See pages 216 and 217, Appendix G, and Appendix K.

f. Roads

What are the current conditions and distribution of roads in the WAU? See pages 123 through 134 and Appendix G.

How are roads impacting other resources within the WAU? See pages 123 through 134, 170, and 172, Appendix C, and Appendix K.

Are there road decommissioning or improvement opportunities in the WAU? Where are the road treatment opportunities? See page 213, Appendix G, and Appendix K.

D. Issue 4 - Special Status Species

Key Questions

Special Status Species and Their Habitats

What are the species of concern important in the WAU (e.g. threatened or endangered species, special status species, or species emphasized in other plans)? See pages 162 through 206.

What is the distribution and character of their habitats? See pages 162 through 206.

IV. Human Uses

A. Reference Conditions

The Lower Cow Creek Watershed Analysis Unit has been used by humans for probably thousands of years. Uses in the WAU have included hunting and gathering, fur trapping, subsistence and commercial agriculture, mining, transportation, logging and lumbering, service related activities, residential dwellings, and recreation.

1. Pre-European Settlement

Little knowledge exists of prehistoric use in the WAU prior to European-American settlement. Eight archaeological sites have been identified on BLM-administered land in the WAU, with the majority located in the area around Middle Creek. Three sites have been identified on private land near the town of Riddle including potential village sites. George Riddle mentioned a large Indian encampment near where the town of Riddle is now located (Riddle 1964).

The Cow Creek Indians followed a seasonal way of life hunting deer and elk, gathering nuts, berries, seeds, and roots, and fishing. They fished for salmon and gathered camas (which provided a large portion of their diet) in the WAU. The Cow Creek Indians changed the landscape very little. Although, George Riddle described how the Indians burned areas to control brush making hunting and the gathering of tar weeds seeds for food easier.

2. European-American Exploration and Settlement

Fur trappers and settlers arrived in the Cow Creek Valley in the 1800s. Fur trappers from the Hudson Bay and Northwest Fur companies began exploring the Umpqua Valley in the 1820s. Both companies sent brigades of fur trappers into the WAU.

Jesse and Lindsay Applegate, along with Levi Scott, surveyed the area for a new emigrant trail into Oregon from the south. By the fall of 1846, the Applegate Trail opened a new route for emigrants into the Willamette Valley through southern Oregon. This event, along with the passage of the Donation Land Claim Act in 1850, opened the region to settlers. William Riddle and W.G. Hern were the first to acquire claims in the Cow Creek Valley near where the town of Riddle is now located.

The discovery of gold brought miners to southern Oregon by 1851. Gold was first discovered in California and then Josephine and Jackson Counties in southern Oregon. This encouraged miners to search for gold in the Lower Cow Creek WAU. Herman and Charles Reinhart both filed donation land claims. Herman Reinhart mentioned the yellow and red cedar trees were the finest he had ever seen (Reinhart 1962). Gold mining developed from the earlier claims to placer mining and the construction of hydraulic ditches to help in the process. Eight hydrologic ditches were constructed in the WAU.

In 1882, the mining of nickel ore from Nickel Mountain began but was very modest. The Hanna Company began a major commercial operation in 1947. Nickel ore from Nickel Mountain was the most important mineral resource in Douglas County during the 1950s. The mine provided a major source of employment for Riddle and Myrtle Creek. Foreign competition made the mining of nickel unprofitable causing the mine to be closed.

As hostilities grew between the settlers and miners and the Native American Indians, wars broke out in southern Oregon. Joel Palmer negotiated a peace treaty with the Cow Creek Indians near Council Creek on September 19, 1853. The treaty was ratified on April 12, 1854 and created a reservation for the Cow Creek Indians on Council Creek. The reservation was closed two years later.

3. Agriculture/Grazing

George Riddle mentioned the Cow Creek Valley looked like a great wheat field in 1851 (Riddle 1964). Early settlers indicated the valley bottoms needed minimal clearing and logs had to be skidded in to build log homes probably because the Cow Creek Indians burned the valley bottoms.

Early settlers maintained a subsistence lifestyle until markets were established for grain and livestock. These agricultural products became the main sources of income throughout the 1880s and 1890s. Products were transported to markets by pack animals or wagons and the cattle were driven to market. A variety of grain and fruit crops were important until the 1930s when sheep and cattle grazing became more prominent.

4. Transportation

The earliest trails through the region were created by the seasonal migrations of the native people. The Applegate Trail allowed emigrants to travel to the Willamette Valley through southern Oregon.

Construction of the Oregon and California (O and C) railroad was completed to the community of Riddle in 1882, allowing transportation of goods and people to the north. In 1889, completion of a rail line south of Riddle through the Cow Creek canyon allowed access to markets in southern Oregon and California (Beckham 1986). The introduction of rail service allowed agriculture to have more influence on the local economy.

In the 1950s, the BLM and private timber companies built roads into their timbered lands. The construction of access roads into the Cow Creek watershed opened the area to intensive timber harvesting and management on private and BLM-administered lands. The Cow Creek Access road was constructed to Doe Creek in 1958. The segment to the West Fork of Cow Creek was completed in1961. The Council Creek road was constructed in 1955. A portion of the Middle Creek road was built in 1959. The transportation system improvements allowed faster transportation of commodities and year round timber harvesting. Receipts from BLM-administered lands contributed to the improvement of roads throughout Douglas County (Beckham 1986).

5. Timber Harvesting/Logging

Cadastral survey notes from the mid-nineteenth century indicated the vegetation consisted of grasslands in the valleys, oak openings on the mid-slopes, and timber on the upper slopes of the WAU. The vegetation mosaic described appears to be similar to what occurred in the WAU in 1936 (see Map 4).

In 1897, Judge Riddle maintained a lumber mill on Doe Creek, which produced ties and fuel for the railroad. The mill encouraged a store and post office to be built at the site. By 1906, small scale lumber mills were constructed in the Riddle area. The Dunbar and Ross mill produced 600,000 board feet of lumber from 1906 to 1917 (Beckham 1986). Timber harvesting became the major influence on the WAU landscape in the 1950s. The increased demand for lumber to build houses and the transportation system improvements generated a marked increase in timber harvesting in the WAU.

B. Current Conditions

The dominant human uses in the WAU have been timber production, transportation, agriculture, recreation, and service-related activities. There are no treaty rights or tribal uses in the WAU. Although, individual tribal members may use the area.

1. Timber

Timber harvesting has been a major influence in the WAU. Spurred by the demand for lumber after World War II, timber harvesting became the major influence within the WAU. Both private and Federally-administered lands have contributed to the timber harvest and lumber production over the last 45 years.

2. Agriculture

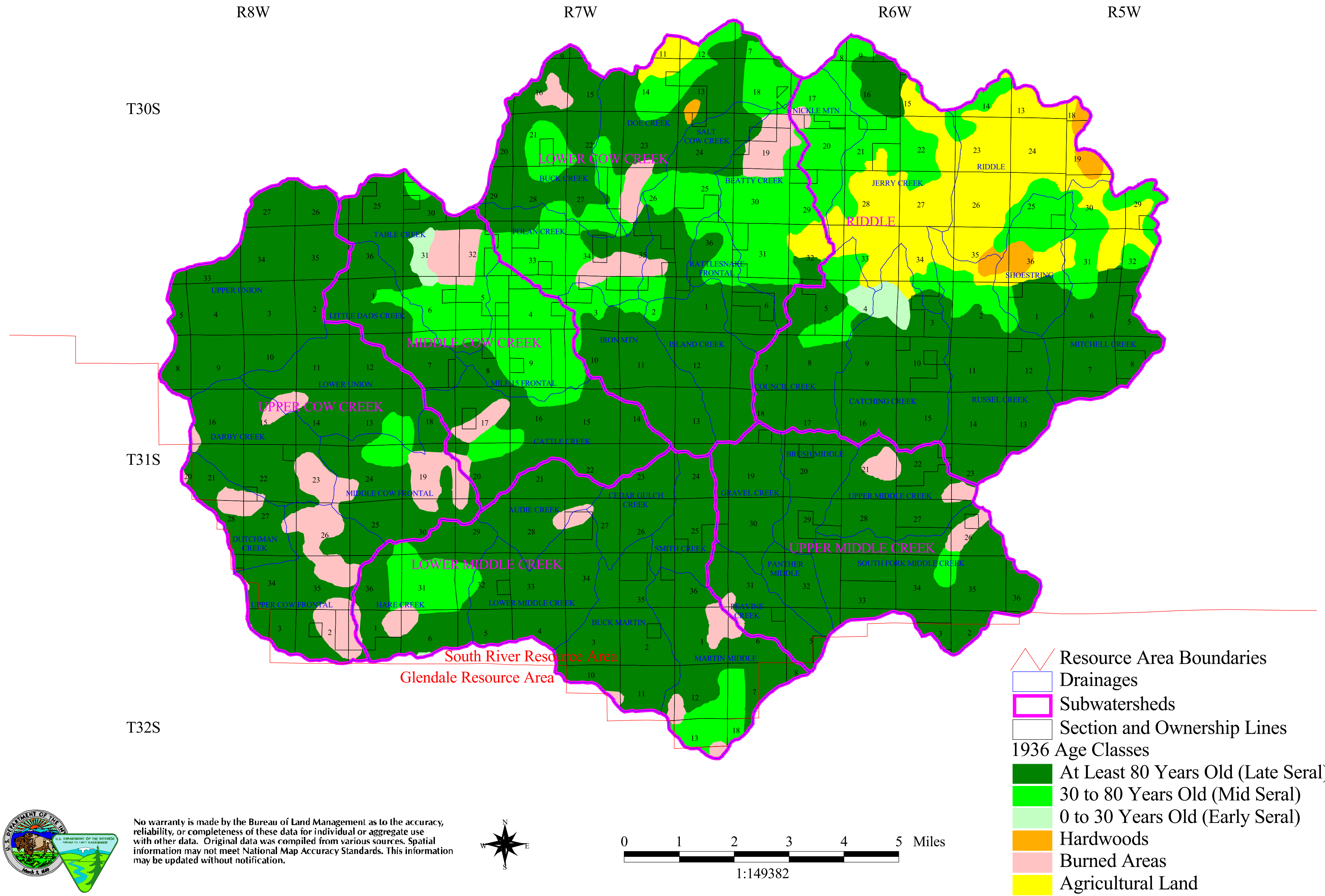
There are approximately 15,459 acres (11 percent) of agriculture/pasture lands in the WAU. A variety of grain and fruit crops were important agricultural products in the past. The production of livestock, both sheep and cattle, are the primary agricultural commodities now.

3. Mining and Minerals

In the past mining for gold and nickel was of major interest. The Nickel Mine on Nickel Mountain and the Formosa Mine on Silver Butte are located in the WAU. There are still some small mining operations occurring in the WAU. Foreign competition has made the mining of nickel unprofitable at this time.

The Formosa Mine was discovered in 1910, mining operations continued until 1936. In 1990, the Oregon Department of Geology and Mineral Industries (DOGAMI) issued an operating permit to

Map 4. Lower Cow Creek Watershed Analysis Unit
1936 Age Class Distribution



Formosa Exploration, Inc. for the Silver Butte Mine. The mine produced gold, silver, copper, and zinc. The mine was Oregon's only operating copper mine and only significant producing underground mine.

Patented lands cover 1,460 acres in three blocks. The blocks are located in T31S, R6W, sections 13, 23, 26, and 27 and in T32S, R6W, sections 5 and 8.

Discharges from the Formosa Mine probably have been negatively affecting Middle Creek for approximately 80 years. Baseline data was collected, concerning metals and pH levels in Middle Creek and the South Fork of Middle Creek, before Formosa started operations in 1990. In May 1988, tests found metal levels below or near detection limits in the South Fork of Middle Creek, but the copper level in Middle Creek exceeded the Oregon State water quality standards. The pH levels in Middle Creek were 7.0 and 7.4 in the South Fork of Middle Creek. A survey indicated the presence of fish in Middle Creek prior to Formosa starting operations.

Production at the mine ceased in August 1993 after Formosa Exploration received a Closure Order from the Oregon Department of Geology and Mineral Industries and a Notice of Noncompliance from the Oregon Department of Environmental Quality.

A spill contaminated Middle Creek with an estimated 20 tons of pyrite and other metal-bearing sulfide minerals. Most of the contaminated material was contained behind the first road crossing below the mine but was spread over about 4,000 feet of stream length. While most of the sulfide contaminants were trapped behind the 31-6-28.0 road, small quantities were readily visible one mile down stream from the culvert and the creek was effectively "dead" with no signs of life farther down stream. A fish survey in the summer of 1993 showed no fish in Middle Creek above the confluence with the South Fork of Middle Creek.

An inspection by DOGAMI on March 14, 1994 detected no fish or aquatic insects in approximately two miles of stream between the end of the sulfide materials and where the South Fork of Middle Creek and Middle Creek join. Three dead fish were found fifty feet below the confluence of Middle Creek and the South Fork of Middle Creek on March 17, 1994.

The sulfides were removed from Middle Creek, the process also removed all organic material from the stream bed. The organic material may have filtered metals from the stream. On May 11, 1994, after the cleanup, the pH in Middle Creek ranged from 7.2 to 7.5 and 7.4 in the South Fork of Middle Creek. On June 8, 1994 one salamander was reported in Middle Creek, but there were no macro-invertebrates and the pH was 6.6 in Middle Creek.

Drainage pipes installed during reclamation of the mine failed and water drained into Middle Creek. Benthic invertebrate monitoring of Middle Creek in 1994 and 1995 indicated the macro-invertebrate community in the creek was severely impacted from metals. Recovery of intolerant or long-lived taxa was not evident in 1995. Compared to 1989 data there was a substantial drop in taxa richness in the invertebrate groups that could be compared between data sets.

Water from a mine adit was draining into Middle Creek according to a letter from DOGAMI on March 19, 1996. However, in a status update dated April 1996, no clear relationship had been established between zinc, copper, or pH values with stream cleanup, adit water, discharges, or precipitation. The data did show an annual fluctuation with higher metal values during the winter. Metal values were generally higher in the two winters after cleanup was completed, but the background values in the South Fork of Middle Creek also rose dramatically. After numerous years of abnormally dry weather, larger amounts of metals were probably being flushed from drainages which have anonymously high metal values. It may be that the mine is not the sole contributor of metals to Middle Creek.

The drain field was reconstructed in November 1996. On January 14, 1997 the water was clear in Middle Creek and there was no precipitate on rocks in the stream. The pipes and drain field appeared to be working. Water quality samples taken in January 1997 showed some of the lowest metal levels in Middle Creek since the mine closed.

Salable minerals in the WAU include sand, gravel, and quarry rock. Community Rock Pits are located throughout the WAU.

Road construction led to the development and mining of rock quarries to provide road surfacing material. Surfacing rock is used to reduce sediment and soil erosion by improving roads in the WAU. The rock from these quarries could be used to improve existing roads causing problems, which could help meet Aquatic Conservation Strategy objectives.

Some rock quarries in the WAU do not have useable amounts of rock remaining. These quarries could be closed and reclaimed.

4. Special Forest Products

Another use in the WAU is the collection of Special Forest Products. Cedar boughs, greenery, and firewood were the main Special Forest Products collected in the South River Resource Area in 1999. Special Forest Product sale prices are strongly influenced by product quality, which varies by product and the collection area. Salvaging dead and down trees for sawtimber near roads has been the Special Forest Product affecting the WAU the most. Areas where salvaging sawtimber has occurred often contain less large woody debris. Management direction in the RMP provides guidelines for the salvaging of sawtimber.

5. Recreation

Recreation use in the Lower Cow Creek Watershed Analysis Unit is determined by the land ownership, topography, forest types, and stand ages in the area. Three designated recreation sites occur on BLM-administered land in the WAU. Special Use Permits are not required for recreation use in the WAU unless the event is commercial or competitive.

a. Recreation Opportunity Spectrum (ROS)

The Recreation Opportunity Spectrum (ROS) considers the vast majority of the BLM-administered land in the WAU to be Roaded Natural. The WAU has a strong rural setting. The areas containing BLM-administered lands are characterized by predominantly natural appearing environments with moderate evidence of the sights and sounds of humans. Resource modification and utilization practices are evident but usually blend with the natural environment. Interaction between users may be low to moderate but with the evidence of other users prevalent. Rustic facilities are provided for user convenience as well as for safety and resource protection. Facilities are designed and constructed to provide for conventional motorized use.

b. Off Highway Vehicles (OHV)

The predominant OHV designation in the RMP for the Lower Cow Creek WAU is 'Limited' to existing roads and trails. Under this designation, existing roads and trails are open to motorized access unless otherwise identified (i.e., hiking trails). Licensed vehicles may use maintained roads and natural surface roads and trails. Registered OHVs, such as All Terrain Vehicles (ATVs), and motorcycles not licensed for the public roads may only use existing roads and trails that are not maintained (graveled). One hundred sixty acres of BLM-administered land known as the Beatty Creek Research Natural Area is Closed to OHV travel to protect the site because the site is considered to be fragile.

New roads and trails may be approved and constructed in limited areas, through the NEPA process. State funds from gas taxes and registrations may be available to BLM to develop OHV areas. If problems occur within road and trail systems, they may be closed on an emergency basis through 43 CFR 8341 and 8364.

c. Visual Resource Management (VRM)

Visual Resource Management classes are assigned through an inventory system and range from Class I through IV. Class I lands are reserved for their scenic quality and allow for very limited management. Class IV lands allow for major modifications to the existing character of the landscape. These classes are based on the combination of scenic quality, sensitivity level, and distance zones.

The WAU contains VRM Class II and Class IV lands. Under the Class II designation, low levels of change to the characteristics of the landscape would be allowed. A Class IV designation allows major modifications to the landscape. Class II lands occur within the Special Recreation Management Area (SRMA), which are the BLM-administered lands within 1/4 mile on either side of Cow Creek. The remainder of the WAU is designated as Class IV land.

Management activities within Class II lands may be seen but should not attract the attention of the casual observer. Changes should repeat the basic elements of form, line, color, texture, and scale found in the predominant natural features of the characteristic landscape.

Under the Class IV designation, the extent of change to the character of the landscape can be high. Management activities may dominate the view and may be the major focus of the viewer's attention. However, every attempt should be made to minimize the impact of activities through careful unit location, minimal disturbance, and repetition of the basic elements of form, line, and texture.

d. Recreation Management

The BLM-administered lands within 1/4 mile of Cow Creek are in a Special Recreation Management Area but the remainder of the WAU falls within the South River Extensive Recreation Management Area (ERMA). Within the SRMA, recreation is mainly at developed sites or areas offering interpretive opportunities with the intention of limiting impacts. Within the ERMA, recreation is mainly unstructured and dispersed requiring minimal managerial investment. The ERMA, which constitutes the bulk of the BLM-administered land, gives recreation visitors the freedom of choice with minimal regulatory constraints.

Forms of recreation commonly observed in the Lower Cow Creek WAU include driving for pleasure, hunting, photography, picnicking, camping, shooting or target practice, and gathering (berries, flowers, mushrooms, greens, and rocks). Some of the most popular areas used for these forms of recreation include driving for pleasure along the Cow Creek Road which is a Back Country Byway and an Oregon State Tour Route; public gold panning and picnicking at the Gold Panning Area in T31S, R8W, Section 35; public gold panning, picnicking and water play at Island Creek in T31S, R7W, Section 1; summer water play at Rattlesnake Creek in T30S, R6W, Section 31; and visiting the interpretive kiosk in T30S, R6W, Section 28.

Potential recreation developments include a trail head for the Cow Creek Bluffs Trail in T30S, R7W, Section 35 near Doe Creek; a public gold panning site and intermediate trail head for the Cow Creek Bluffs Trail and watchable wildlife site for salmonids near Iron Mountain Creek in T31S, R7W, Section 4; the Salt Creek Trail through Jeffrey Pine stands on serpentine-based soils in T30S, R6W, Section 19 and T30S, R7W, Sections 24, 25, 26, and 35; the Cow Creek Bluffs Trail through bluffs overlooking Cow Creek in T30S, R7W, Sections 27, 32, 33, 34, and 35, and T31S, R7W, Sections 4 and 5; numerous railroad interpretive opportunities; and some Native American interpretive opportunities.

The Cow Creek corridor has the most concentrated potential for recreation within the South River Resource Area. It currently contains the Back Country Byway and Oregon State Tour Route, an interpretive byway kiosk, public gold panning areas, the Island Creek Day-use area, a portion of the Glendale to Powers Bikeway, and numerous dispersed use areas. The scenery along Cow Creek and the asphalt surfaced road through forested lands is appealing to the general public.

V. Vegetation

A. Reference Conditions

Information used to characterize the reference (historic) vegetation conditions in the Lower Cow Creek WAU were from 1900, 1914, and 1936 data in the BLM Geographic Information System (GIS). The data from the three maps were collected at different degrees of accuracy and scale. Consequently, the data are not directly comparable from one map to another, since the vegetation was not classified in the same way.

The data indicates the amount of merchantable timber ranged from about 16 to 86 percent of the Lower Cow Creek WAU in the early 1900s (see Tables 3, 4, 5, and 6 and Maps 4, 5, and 6). The amount of land in nonforested or non-merchantable timber ranged from about eight to 84 percent of the WAU during the early 1900s. In 1900, 1914, and 1936, the early and mid seral stages occurred as small patches, probably as a result of fires, within the larger late seral blocks.

The BLM-administered land occurs mainly in the upper elevations of the WAU. About 97 acres or less than one percent of the BLM-administered land was in nonforested or non-merchantable timber in 1936 because of the location of these lands (see Table 7). Table 7 shows about 91 percent of the BLM-administered land was in merchantable timber (classified as mid or late seral) in 1936.

Table 3. 1900 Vegetation Data.

	Open (Nonforested)		Woodland (Hardwoods, Brush)		5 to 10 MBM per Acre (Merchantable Timber, Mid Seral)		
Area	Acres	%	Acres	%	Acres	%	Total Acres
Catching Creek	1,172	35	2,148	65	0	0	3,320
Council Creek	1,652	59	1,168	41	0	0	2,820
Jerry Creek	3,846	82	870	18	0	0	4,716
Mitchell Creek	1,743	44	2,187	56	0	0	3,930
Nickle Mountain	854	65	460	35	0	0	1,314
Riddle	2,950	79	790	21	0	0	3,740
Russell Creek	2,358	61	1,519	39	0	0	3,877
Shoestring	1,298	76	410	24	0	0	1,708
Riddle Subwatershed	15,873	62	9,552	38	0	0	25,425
Beatty Creek	1,908	61	1,199	39	0	0	3,107
Buck Creek	2,869	89	357	11	0	0	3,226
Doe Creek	1,033	25	3,069	75	0	0	4,102
Iron Mountain	2,255	87	331	13	0	0	2,586
Island Creek	698	34	1,331	66	0	0	2,029
Polan Creek	2,095	91	217	9	0	0	2,312
Rattlesnake Frontal	269	22	929	78	0	0	1,198
Salt Cow Creek	1,390	61	893	39	0	0	2,283
Lower Cow Creek Subwatershed	12,517	60	8,326	40	0	0	20,843
Cattle Creek	2,379	61	1,145	29	370	10	3,894
Little Dads Creek	1,265	65	0	0	694	35	1,959
Mile 15 Frontal	1,045	47	1,097	50	68	3	2,210
Table Creek	2,402	69	1,069	31	1	0	3,472
Middle Cow Creek Subwatershed	7,091	61	3,311	29	1,133	10	11,535
Darby Creek	0	0	0	0	2,564	100	2,564
Dutchman Creek	0	0	0	0	1,312	100	1,312
Lower Union	16	1	0	0	2,760	99	2,776
Middle Cow Frontal	1,823	66	0	0	952	34	2,775
Upper Cow Frontal	1,531	50	0	0	1,517	50	3,048
Upper Union	2,911	55	0	0	2,335	45	5,246
Upper Cow Creek Subwatershed	6,281	35	0	0	11,440	65	17,721

Table 3. 1900 Vegetation Data.

	Open (Nonforested)		Woodland (Hardwoods, Brush)		5 to 10 MBM per Acre (Merchantable Timber, Mid Seral)		
Area	Acres	%	Acres	%	Acres	%	Total Acres
Audie Creek	603	42	0	0	837	58	1,440
Buck Martin	2,330	90	0	0	251	10	2,581
Cedar Gulch Creek	1,178	96	0	0	45	4	1,223
Hare Creek	1,766	59	0	0	1,204	41	2,970
Lower Middle Creek	1,166	45	0	0	1,439	55	2,605
Martin Middle	3,034	93	0	0	235	7	3,269
Smith Creek	1,139	93	92	7	0	0	1,231
Lower Middle Creek Subwatershed	11,216	73	92	1	4,011	26	15,319
Brush Middle	881	65	479	35	0	0	1,360
Gravel Creek	1,432	83	286	17	0	0	1,718
Panther Middle	380	50	377	50	0	0	757
Peavine Creek	791	61	507	39	0	0	1,298
South Fork Middle Creek	1,069	26	3,088	74	0	0	4,157
Upper Middle Creek	1,626	70	685	30	0	0	2,311
Upper Middle Creek Subwatershed	6,179	53	5,422	47	0	0	11,601
Lower Cow Creek WAU	59,157	58	26,703	26	16,584	16	102,444

Map 5. Lower Cow Creek Watershed Analysis Unit
1900 Vegetation Classifications

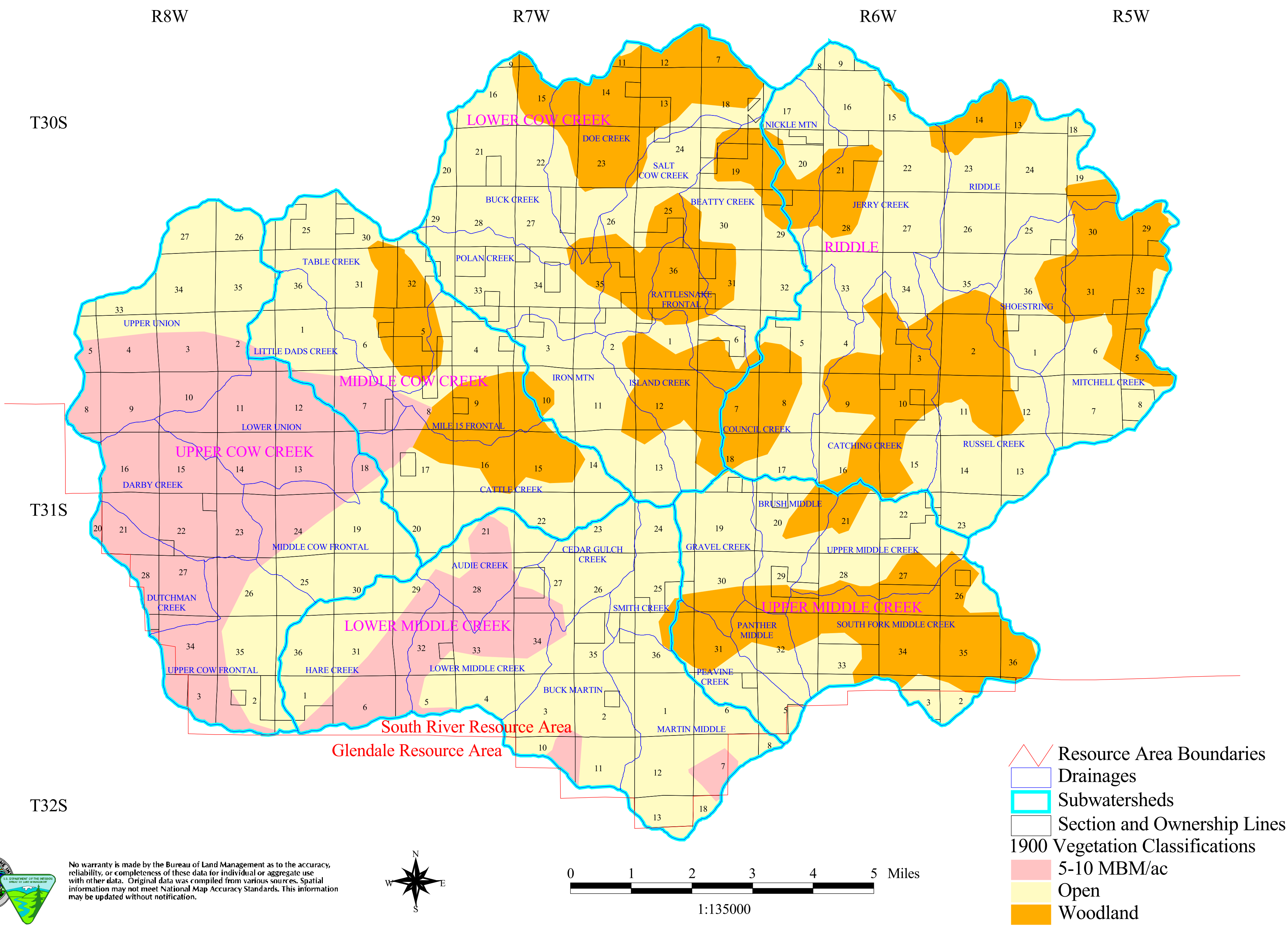


Table 4. 1914 Vegetation Data.

	Non-timber		Brush		Burned, not restocking		Burned, restocking		Cut Over, not restocking		Merchantable timber		
Area	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Total Acres
Catching Creek	179	5	1,355	41	0	0	0	0	0	0	1,786	54	3,320
Council Creek	288	10	1,059	38	0	0	0	0	0	0	1,473	52	2,820
Jerry Creek	1,756	37	1,977	42	0	0	0	0	0	0	983	21	4,716
Mitchell Creek	603	15	705	18	0	0	0	0	0	0	2,622	67	3,930
Nickle Mountain	0	0	171	13	0	0	0	0	0	0	1,144	87	1,315
Riddle	3,555	95	185	4.9	0	0	0	0	0	0	0	0	3,740
Russell Creek	79	2	1,191	31	0	0	0	0	106	3	2,501	65	3,877
Shoestring	245	14	568	33	0	0	0	0	0	0	895	52	1,708
Riddle Subwatershed	6,705	26	7,211	28	0	0	0	0	106	0	11,404	45	25,426
Beatty Creek	3	0	919	30	0	0	0	0	0	0	2,186	70	3,108
Buck Creek	0	0	438	14	0	0	2,534	79	0	0	254	8	3,226
Doe Creek	0	0	429	10	0	0	1,509	37	0	0	2,164	53	4,102
Iron Mountain	0	0	1,618	63	0	0	0	0	0	0	968	37	2,586
Island Creek	0	0	1,901	94	0	0	0	0	0	0	129	6	2,030
Polan Creek	0	0	1,754	76	0	0	434	19	0	0	124	5	2,312
Rattlesnake Frontal	0	0	610	51	0	0	0	0	0	0	588	49	1,198
Salt Cow Creek	0	0	419	18	0	0	183	8	0	0	1,681	74	2,283
Lower Cow Creek Subwatershed	3	0	8,088	39	0	0	4,660	22	0	0	8,094	39	20,845
Cattle Creek	0	0	466	12	0	0	0	0	0	0	3,428	88	3,894
Little Dads Creek	0	0	0	0	0	0	0	0	0	0	1,959	100	1,959
Mile 15 Frontal	0	0	1,553	70	0	0	157	7	0	0	499	23	2,209
Table Creek	0	0	0	0	0	0	1,508	43	0	0	1,963	57	3,471
Middle Cow Creek Subwatershed	0	0	2,019	18	0	0	1,665	14	0	0	7,849	68	11,533
Darby Creek	0	0	226	9	177	7	0	0	0	0	2,161	84	2,564
Dutchman Creek	0	0	0	0	0	0	0	0	0	0	1,312	100	1,312
Lower Union	0	0	324	12	153	6	0	0	0	0	2,299	83	2,776
Middle Cow Frontal	0	0	381	14	0	0	0	0	0	0	2,394	86	2,775
Upper Cow Frontal	0	0	480	16	0	0	0	0	0	0	2,568	84	3,048
Upper Union	0	0	0	0	41	1	0	0	0	0	5,204	99	5,245
Upper Cow Creek Subwatershed	0	0	1,411	8	371	2	0	0	0	0	15,938	90	17,720

Table 4. 1914 Vegetation Data.

	Non-timber		Brush		Burned, not restocking		Burned, restocking		Cut Over, not restocking		Merchantable timber		
Area	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Total Acres
Audie Creek	0	0	23	2	36	3	0	0	0	0	1,381	96	1,440
Buck Martin	0	0	317	12	0	0	0	0	0	0	2,263	88	2,580
Cedar Gulch Creek	0	0	0	0	170	14	0	0	0	0	1,053	86	1,223
Hare Creek	0	0	345	12	0	0	0	0	44	1	2,582	87	2,971
Lower Middle Creek	0	0	135	5	373	14	0	0	0	0	2,098	81	2,606
Martin Middle	0	0	396	12	0	0	0	0	109	3	2,764	85	3,269
Smith Creek	0	0	311	25	0	0	0	0	0	0	920	75	1,231
Lower Middle Creek Subwatershed	0	0	1,527	10	579	4	0	0	153	1	13,061	85	15,320
Brush Middle	0	0	498	37	0	0	0	0	0	0	862	63	1,360
Gravel Creek	0	0	675	39	0	0	0	0	0	0	1,042	61	1,717
Panther Middle	0	0	33	4	0	0	0	0	0	0	724	96	757
Peavine Creek	0	0	316	24	0	0	0	0	0	0	982	76	1,298
South Fork Middle Creek	0	0	576	14	0	0	0	0	529	13	3,051	73	4,156
Upper Middle Creek	0	0	379	16	0	0	0	0	332	14	1,599	69	2,310
Upper Middle Creek Subwatershed	0	0	2,477	21	0	0	0	0	861	7	8,260	71	11,598
Lower Cow Creek WAU	6,708	7	22,733	22	950	1	6,325	6	1,120	1	64,606	63	102,442

Map 6. Lower Cow Creek Watershed Analysis Unit
1914 Vegetation Classifications

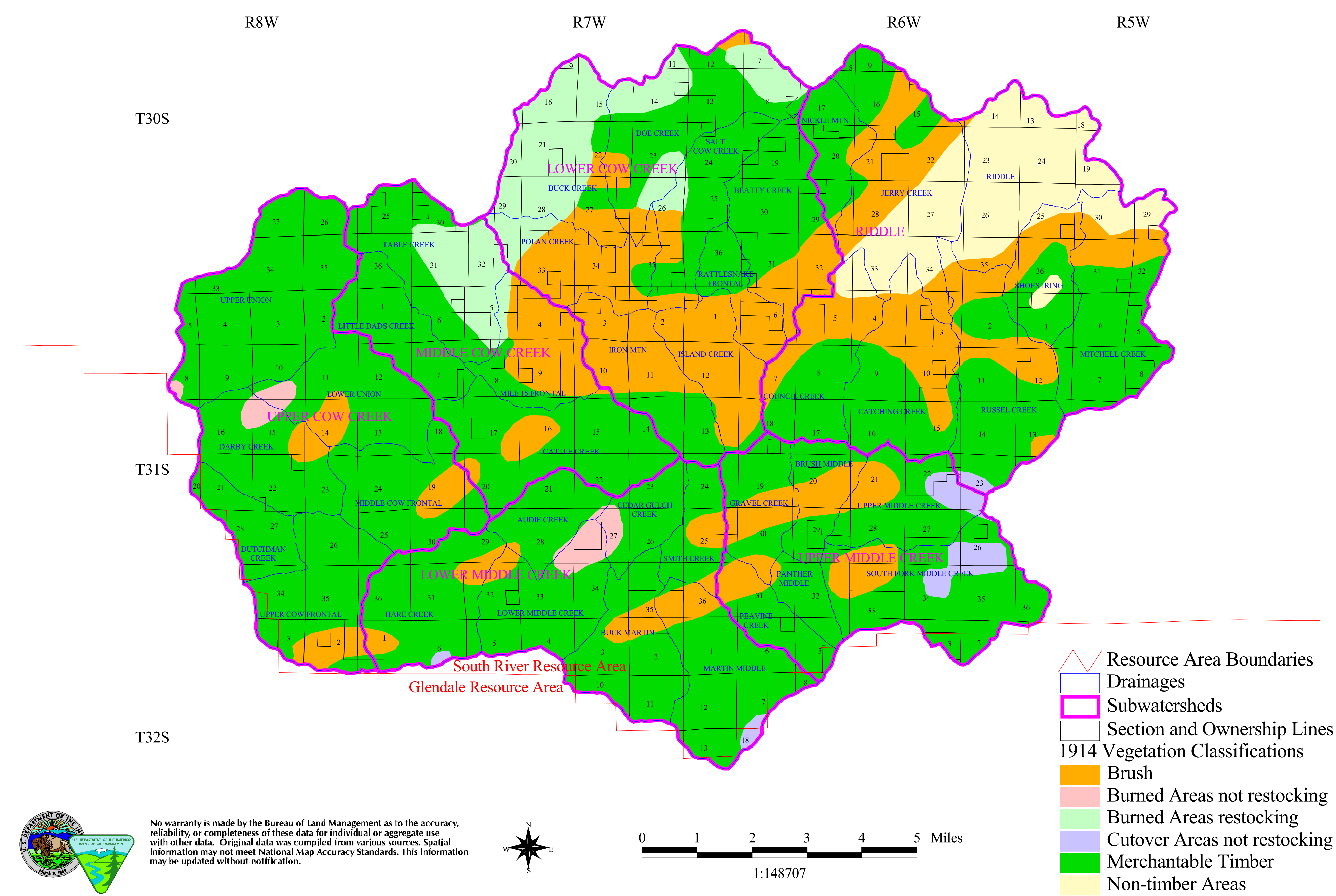


Table 5. 1936 Age Class Distribution in the Lower Cow Creek WAU.

	Nonforest		Early Seral (0 to 30 Years Old)		Mid Seral (30 to 80 Years Old)		Late Seral (At Least 80 Years Old)		Hardwoods		
Area	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Total Acres
Catching Creek	217	7	261	8	14	0	2,827	85	0	0	3,319
Council Creek	76	3	127	5	517	18	2,100	74	0	0	2,820
Jerry Creek	2,449	52	10	0	1,653	35	604	13	0	0	4,716
Mitchell Creek	744	19	0	0	982	25	2,205	56	0	0	3,931
Nickle Mountain	15	1	76	6	1,223	93	0	0	0	0	1,314
Riddle	3,006	80	0	0	486	13	0	0	248	7	3,740
Russell Creek	232	6	0	0	483	12	3,087	80	75	2	3,877
Shoestring	274	16	0	0	745	44	505	30	185	11	1,709
Riddle Subwatershed	7,013	28	474	2	6,103	24	11,328	45	508	2	25,426
Beatty Creek	265	9	520	17	1,872	60	450	14	0	0	3,107
Buck Creek	0	0	152	5	728	23	2,347	73	0	0	3,227
Doe Creek	325	8	256	6	1,563	38	1,905	46	53	1	4,102
Iron Mountain	0	0	12	0	357	14	2,217	86	0	0	2,586
Island Creek	0	0	0	0	77	4	1,953	96	0	0	2,030
Polan Creek	0	0	328	14	1,323	57	661	29	0	0	2,312
Rattlesnake Frontal	0	0	0	0	374	31	824	69	0	0	1,198
Salt Cow Creek	0	0	86	4	814	36	1,383	61	0	0	2,283
Lower Cow Creek Subwatershed	590	3	1,354	6	7,108	34	11,740	56	53	0	20,845
Cattle Creek	0	0	276	7	396	10	3,222	83	0	0	3,894
Little Dads Creek	0	0	0	0	227	12	1,732	88	0	0	1,959
Mile 15 Frontal	0	0	0	0	1,914	87	296	13	0	0	2,210
Table Creek	0	0	732	21	1,115	32	1,624	47	0	0	3,471
Middle Cow Creek Subwatershed	0	0	1,008	9	3,652	32	6,874	60	0	0	11,534

Table 5. 1936 Age Class Distribution in the Lower Cow Creek WAU.

	Nonforest		Early Seral (0 to 30 Years Old)		Mid Seral (30 to 80 Years Old)		Late Seral (At Least 80 Years Old)		Hardwoods		
Area	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Total Acres
Darby Creek	0	0	420	16	0	0	2,144	84	0	0	2,564
Dutchman Creek	0	0	235	18	0	0	1,078	82	0	0	1,313
Lower Union	0	0	107	4	163	6	2,506	90	0	0	2,776
Middle Cow Frontal	0	0	628	23	239	9	1,908	69	0	0	2,775
Upper Cow Frontal	0	0	1,077	35	0	0	1,971	65	0	0	3,048
Upper Union	0	0	0	0	0	0	5,245	100	0	0	5,245
Upper Cow Creek Subwatershed	0	0	2,467	14	402	2	14,852	84	0	0	17,721
Audie Creek	0	0	70	5	0	0	1,370	95	0	0	1,440
Buck Martin	0	0	34	1	0	0	2,547	99	0	0	2,581
Cedar Gulch Creek	0	0	8	1	0	0	1,215	99	0	0	1,223
Hare Creek	0	0	239	8	947	32	1,784	60	0	0	2,970
Lower Middle Creek	0	0	65	2	39	1	2,502	96	0	0	2,606
Martin Middle	0	0	347	11	748	23	2,175	67	0	0	3,270
Smith Creek	0	0	0	0	0	0	1,231	100	0	0	1,231
Lower Middle Creek Subwatershed	0	0	763	5	1,734	11	12,824	84	0	0	15,321
Brush Middle	0	0	0	0	0	0	1,360	100	0	0	1,360
Gravel Creek	0	0	0	0	0	0	1,717	100	0	0	1,717
Panther Middle	0	0	0	0	0	0	757	100	0	0	757
Peavine Creek	0	0	73	6	0	0	1,225	94	0	0	1,298
South Fork Middle Creek	0	0	186	4	148	4	3,823	92	0	0	4,157
Upper Middle Creek	0	0	297	13	0	0	2,014	87	0	0	2,311
Upper Middle Creek Subwatershed	0	0	556	5	148	1	10,896	94	0	0	11,600
Lower Cow Creek WAU	7,603	7	6,622	6	19,147	19	68,514	67	561	1	102,447

Table 6. Comparison of 1900, 1914, and 1936 Vegetation Type Percentages in the Lower Cow Creek WAU.

Vegetation Types	1900	1914	1936
Open, Non-timber, Brush and Hardwoods	84%	31%	8%
Burned, Early Seral	0%	6%	6%
Merchantable Timber, Mid and Late Seral	16%	63%	86%

Table 7. 1936 Vegetation Types on BLM Administered Land in the Lower Cow Creek WAU.

	Nonforest		Early Seral (0 to 30 Years Old)		Mid Seral (30 to 80 Years Old)		Late Seral (At Least 80 Years Old)		Hardwoods		
Area	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Total Acres
Catching Creek	0	0	0	0	1	0	1,565	100	0	0	1,566
Council Creek	0	0	0	0	31	3	1,034	97	0	0	1,065
Jerry Creek	59	18	0	0	173	53	96	29	0	0	328
Mitchell Creek	14	1	0	0	112	6	1,713	93	0	0	1,839
Nickle Mountain	0	0	17	16	90	84	0	0	0	0	107
Riddle	0	0	0	0	0	0	0	0	0	0	0
Russell Creek	0	0	0	0	70	4	1,748	96	0	0	1,818
Shoestring	0	0	0	0	88	17	445	83	0	0	533
Riddle Subwatershed	73	1	17	0	565	8	6,601	91	0	0	7,256
Beatty Creek	0	0	308	42	81	11	351	47	0	0	740
Buck Creek	0	0	11	1	404	29	958	70	0	0	1,373
Doe Creek	24	2	3	0	361	35	638	62	4	0	1,030
Iron Mountain	0	0	10	1	166	13	1,149	87	0	0	1,325
Island Creek	0	0	0	0	14	1	1,001	99	0	0	1,015
Polan Creek	0	0	169	16	707	65	205	19	0	0	1,081
Rattlesnake Frontal	0	0	0	0	60	14	362	86	0	0	422
Salt Cow Creek	0	0	74	10	321	45	318	45	0	0	713
Lower Cow Creek Subwatershed	24	0	575	7	2,114	27	4,982	65	4	0	7,699

Table 7. 1936 Vegetation Types on BLM Administered Land in the Lower Cow Creek WAU.

	Nonforest		Early Seral (0 to 30 Years Old)		Mid Seral (30 to 80 Years Old)		Late Seral (At Least 80 Years Old)		Hardwoods		
Area	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Total Acres
Cattle Creek	0	0	224	12	151	8	1,439	79	0	0	1,814
Little Dads Creek	0	0	0	0	137	12	997	88	0	0	1,134
Mile 15 Frontal	0	0	0	0	575	93	46	7	0	0	621
Table Creek	0	0	670	36	399	21	795	43	0	0	1,864
Middle Cow Creek Subwatershed	0	0	894	16	1,262	23	3,277	60	0	0	5,433
Darby Creek	0	0	380	29	0	0	941	71	0	0	1,321
Dutchman Creek	0	0	140	16	0	0	746	84	0	0	886
Lower Union	0	0	75	6	99	7	1,151	87	0	0	1,325
Middle Cow Frontal	0	0	453	33	75	5	864	62	0	0	1,392
Upper Cow Frontal	0	0	504	35	0	0	951	65	0	0	1,455
Upper Union	0	0	0	0	0	0	2,040	100	0	0	2,040
Upper Cow Creek Subwatershed	0	0	1,552	18	174	2	6,693	79	0	0	8,419

Table 7. 1936 Vegetation Types on BLM Administered Land in the Lower Cow Creek WAU.

	Nonforest		Early Seral (0 to 30 Years Old)		Mid Seral (30 to 80 Years Old)		Late Seral (At Least 80 Years Old)		Hardwoods		
Area	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Total Acres
Audie Creek	0	0	20	3	0	0	648	97	0	0	668
Buck Martin	0	0	5	0	0	0	1,272	100	0	0	1,277
Cedar Gulch Creek	0	0	6	1	0	0	680	99	0	0	686
Hare Creek	0	0	139	10	609	45	609	45	0	0	1,357
Lower Middle Creek	0	0	9	1	0	0	1,220	99	0	0	1,229
Martin Middle	0	0	236	19	298	24	701	57	0	0	1,235
Smith Creek	0	0	0	0	0	0	403	100	0	0	403
Lower Middle Creek Subwatershed	0	0	415	6	907	13	5,533	81	0	0	6,855
Brush Middle	0	0	0	0	0	0	401	100	0	0	401
Gravel Creek	0	0	0	0	0	0	781	100	0	0	781
Panther Middle	0	0	0	0	0	0	341	100	0	0	341
Peavine Creek	0	0	24	3	0	0	746	97	0	0	770
South Fork Middle Creek	0	0	51	6	11	1	856	93	0	0	918
Upper Middle Creek	0	0	272	25	0	0	796	75	0	0	1,068
Upper Middle Creek Subwatershed	0	0	347	8	11	0	3,921	92	0	0	4,279
Lower Cow Creek WAU	97	0	3,800	10	5,033	13	31,007	78	4	0	39,941

B. Current Vegetation Conditions

Various seral stages, plant communities, and landscape patterns occur in the Lower Cow Creek WAU. For this watershed analysis, 2001 vegetation conditions on BLM-administered land is described by the age of the dominant tree species in each stand (see Table 8 and Map 7). Agricultural uses and hardwood stands occur along the lower portion of Cow Creek in the WAU. In the forested areas, structural classes range from early to late seral (see Table 9 and Map 8).

Vegetation could also be determined using 1993 satellite imagery (from the Western Oregon Digital Image Project or WODIP). Table 10 and Map 9 show the vegetation data for the Lower Cow Creek WAU from the 1993 satellite imagery grouped into three forested age classes and nonforested classifications. Table 11 and Map 10 show the same data for BLM-administered land only. The satellite imagery data displays the information in cells called pixels. Comparing the 1993 and 2001 vegetation maps shows the 1993 data is separated into smaller areas than the 2001 data. Tables 12 and 13 compare the 1993 and 2001 vegetation data for the entire WAU and on BLM-administered land, respectively.

Table 8. 2001 BLM Age Class Distribution.

Area	Nonforest		0 to 10		10 to 20		20 to 30		30 to 50		50 to 80		80 to 120		120 to 200		200 +		Total
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	
Catching Creek	0	0	18	1	42	3	39	2	75	5	296	19	50	3	40	3	1,007	64	1,567
Council Creek	0	0	94	9	159	15	202	19	93	9	20	2	0	0	36	3	461	43	1,065
Jerry Creek	0	0	38	12	0	0	121	37	0	0	0	0	25	8	12	4	131	40	327
Mitchell Creek	65	4	0	0	64	3	107	6	298	16	251	14	47	3	111	6	897	49	1,840
Nickle Mountain	1	1	0	0	0	0	0	0	0	0	0	0	0	0	31	29	75	70	107
Riddle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Russell Creek	10	1	33	2	84	5	339	19	378	21	7	0	78	4	291	16	598	33	1,818
Shoestring	0	0	0	0	140	26	0	0	4	1	0	0	41	8	31	6	317	59	533
Riddle Subwatershed	76	1	183	3	489	7	808	11	848	12	574	8	241	3	552	8	3,486	48	7,257
Beatty Creek	19	3	0	0	2	0	2	0	0	0	0	0	0	0	699	94	19	3	741
Buck Creek	41	3	107	8	97	7	154	11	0	0	0	0	19	1	203	15	752	55	1,373
Doe Creek	33	3	149	14	16	2	254	25	167	16	0	0	14	1	65	6	334	32	1,032
Iron Mountain	93	7	148	11	28	2	83	6	0	0	4	0	0	0	0	0	970	73	1,326
Island Creek	95	9	0	0	115	11	207	20	0	0	105	10	0	0	0	0	494	49	1,016
Polan Creek	291	27	2	0	0	0	0	0	0	0	7	1	67	6	348	32	366	34	1,081
Rattlesnake Frontal	68	16	0	0	60	14	53	13	0	0	3	1	0	0	24	6	212	50	420
Salt Cow Creek	33	5	78	11	6	1	107	15	18	3	27	4	40	6	223	31	180	25	712
Lower Cow Creek Subwatershed	673	9	486	6	322	4	860	11	185	2	146	2	140	2	1,562	20	3,327	43	7,701

Note: the column header "Number of Acres by Age Class and Percent of Total" spans all age-class columns.

Table 8. 2001 BLM Age Class Distribution.

Area	Number of Acres by Age Class and Percent of Total									
	Nonforest		0 to 10		10 to 20		20 to 30		30 to 50	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Cattle Creek	77	4	131	7	83	5	172	9	137	8
Little Dads Creek	40	4	42	4	234	21	149	13	0	0
Mile 15 Frontal	121	19	0	0	0	0	0	0	0	0
Table Creek	270	14	107	6	8	0	55	3	147	8
Middle Cow Creek Subwatershed	508	9	280	5	325	6	376	7	284	5
Darby Creek	13	1	0	0	189	14	29	2	24	2
Dutchman Creek	0	0	2	0	74	8	0	0	0	0
Lower Union	5	0	0	0	300	23	133	10	137	10
Middle Cow Frontal	32	2	0	0	276	20	66	5	2	0
Upper Cow Frontal	55	4	1	0	115	8	0	0	11	1
Upper Union	7	0	60	3	381	19	428	21	401	20
Upper Cow Creek Subwatershed	112	1	63	1	1,335	16	656	8	575	7

Area	50 to 80		80 to 120		120 to 200		200 +		Total
	Acres	%	Acres	%	Acres	%	Acres	%	
Cattle Creek	0	0	201	11	176	10	838	46	1,815
Little Dads Creek	27	2	63	6	0	0	579	51	1,134
Mile 15 Frontal	0	0	95	15	235	38	170	27	621
Table Creek	46	2	268	14	171	9	792	42	1,864
Middle Cow Creek Subwatershed	73	1	627	12	582	11	2,379	44	5,434
Darby Creek	13	1	1	0	0	0	1,051	80	1,320
Dutchman Creek	0	0	1	0	0	0	810	91	887
Lower Union	0	0	109	8	0	0	641	48	1,325
Middle Cow Frontal	0	0	185	13	23	2	809	58	1,393
Upper Cow Frontal	0	0	178	12	250	17	845	58	1,455
Upper Union	37	2	110	5	85	4	530	26	2,039
Upper Cow Creek Subwatershed	50	1	584	7	358	4	4,686	56	8,419

Table 8. 2001 BLM Age Class Distribution.

Area	Number of Acres by Age Class and Percent of Total																		
	Nonforest		0 to 10		10 to 20		20 to 30		30 to 50		50 to 80		80 to 120		120 to 200		200 +		Total
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	
Audie Creek	0	0	0	0	241	36	28	4	82	12	0	0	73	11	32	5	213	32	669
Buck Martin	2	0	275	22	381	30	17	1	111	9	0	0	126	10	0	0	365	29	1,277
Cedar Gulch Creek	3	0	6	1	120	17	43	6	0	0	0	0	0	0	1	0	514	75	687
Hare Creek	2	0	207	15	117	9	3	0	78	6	0	0	302	22	176	13	472	35	1,357
Lower Middle Creek	0	0	39	3	232	19	131	11	162	13	0	0	24	2	93	8	548	45	1,229
Martin Middle	0	0	0	0	184	15	92	7	35	3	4	0	178	14	0	0	744	60	1,237
Smith Creek	0	0	0	0	45	11	9	2	0	0	0	0	112	28	20	5	218	54	404
Lower Middle Creek Subwatershed	7	0	527	8	1,320	19	323	5	468	7	4	0	815	12	322	5	3,074	45	6,860
Brush Middle	0	0	4	1	97	24	44	11	42	10	0	0	9	2	36	9	169	42	401
Gravel Creek	0	0	0	0	147	19	138	18	125	16	3	0	0	0	32	4	335	43	780
Panther Middle	0	0	33	10	64	19	24	7	63	18	0	0	0	0	1	0	156	46	341
Peavine Creek	0	0	30	4	132	17	0	0	0	0	0	0	113	15	113	15	382	50	770
South Fork Middle Creek	18	2	81	9	162	18	77	8	27	3	22	2	101	11	57	6	373	41	918
Upper Middle Creek	11	1	33	3	194	18	1	0	19	2	38	4	196	18	42	4	532	50	1,066
Upper Middle Creek Subwatershed	29	1	181	4	796	19	284	7	276	6	63	1	419	10	281	7	1,947	46	4,276
Lower Cow Creek WAU	1,405	4	1,720	4	4,587	11	3,307	8	2,636	7	910	2	2,826	7	3,657	9	18,899	47	39,947

Map 7. Lower Cow Creek Watershed Analysis Unit
2001 BLM Age Class Distribution

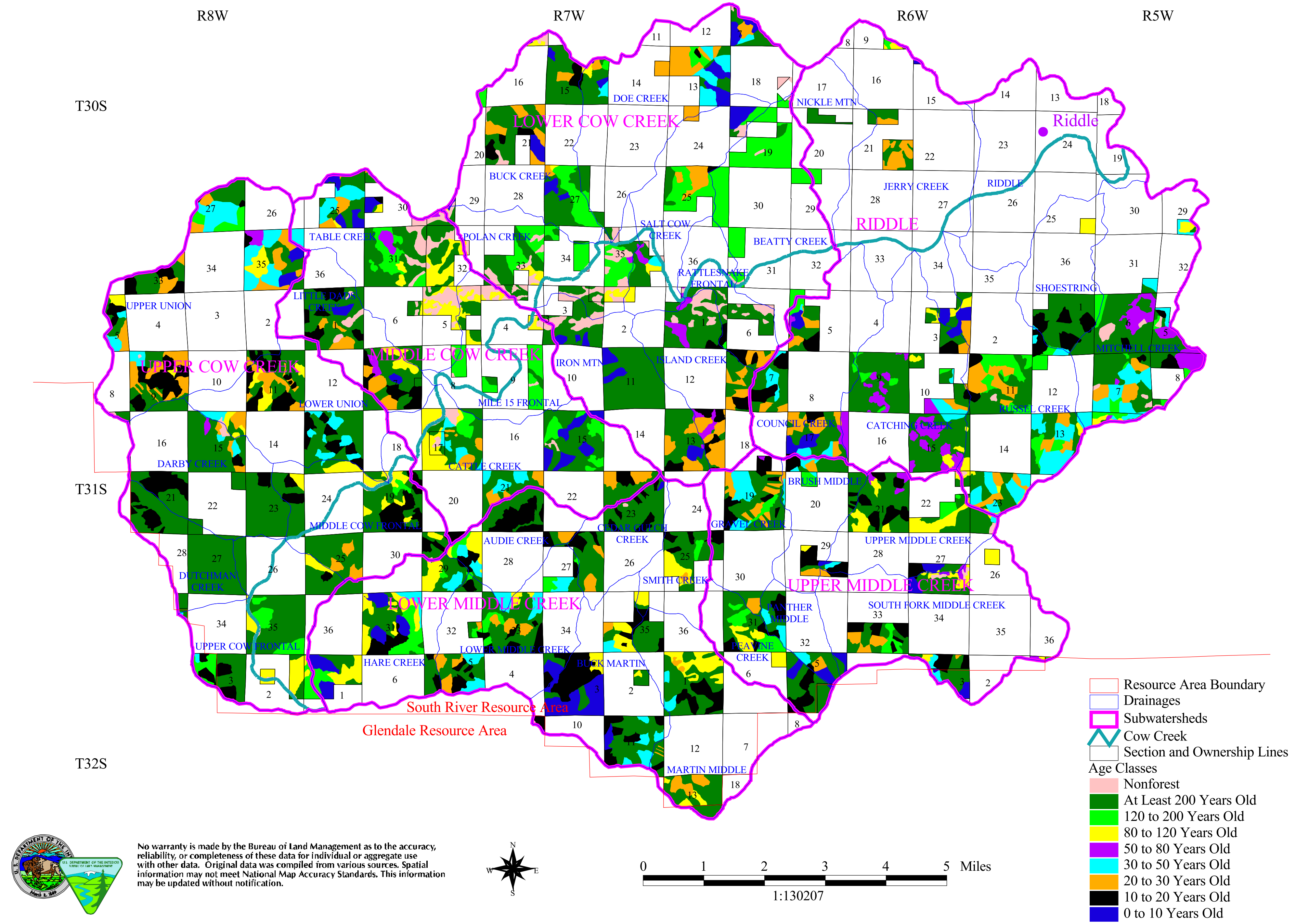


Table 9. 2001 Age Class Distribution in the Lower Cow Creek WAU.

Area	Number of Acres by Age Class and Percent of Total																				
	Nonforest		0 to 10		10 to 20		20 to 30		30 to 50		50 to 80		80 to 120		120 to 200		200 +		Hardwoods		Total
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	
Catching Creek	151	5	81	2	75	2	39	1	1,157	35	580	17	77	2	40	1	1,007	30	111	3	3,318
Council Creek	228	8	99	4	300	11	513	18	190	7	631	22	67	2	309	11	461	16	21	1	2,819
Jerry Creek	2,585	55	38	1	67	1	193	4	431	9	167	4	126	3	222	5	131	3	754	16	4,714
Mitchell Creek	830	21	41	1	121	3	177	5	992	25	616	16	47	1	111	3	897	23	100	3	3,932
Nickle Mountain	609	46	40	3	0	0	0	0	40	3	307	23	36	3	166	13	75	6	42	3	1,315
Riddle	2,708	72	0	0	0	0	0	0	113	3	41	1	0	0	2	0	0	0	877	23	3,741
Russell Creek	278	7	239	6	85	2	339	9	1,216	31	635	16	86	2	291	8	598	15	111	3	3,878
Shoestring	449	26	0	0	140	8	0	0	51	3	143	8	41	2	31	2	317	19	536	31	1,708
Riddle Subwatershed	7,838	31	538	2	788	3	1,261	5	4,190	16	3,120	12	480	2	1,172	5	3,486	14	2,552	10	25,425
Beatty Creek	499	16	167	5	101	3	2	0	56	2	322	10	153	5	1,691	54	20	1	97	3	3,108
Buck Creek	106	3	597	19	773	24	536	17	5	0	110	3	19	1	236	7	844	26	0	0	3,226
Doe Creek	341	8	417	10	587	14	1,238	30	621	15	176	4	14	0	150	4	558	14	1	0	4,103
Iron Mountain	138	5	441	17	331	13	646	25	4	0	24	1	20	1	5	0	977	38	0	0	2,586
Island Creek	95	5	29	1	168	8	794	39	25	1	321	16	80	4	23	1	494	24	0	0	2,029
Polan Creek	479	21	160	7	120	5	140	6	113	5	41	2	129	6	551	24	544	24	35	2	2,312
Rattlesnake Frontal	162	14	78	7	204	17	123	10	22	2	24	2	60	5	305	25	219	18	0	0	1,197
Salt Cow Creek	173	8	164	7	179	8	623	27	73	3	79	3	92	4	535	23	354	16	10	0	2,282
Lower Cow Creek Subwatershed	1,993	10	2,053	10	2,463	12	4,102	20	919	4	1,097	5	567	3	3,496	17	4,010	19	143	1	20,843

Table 9. 2001 Age Class Distribution in the Lower Cow Creek WAU.

Area	Number of Acres by Age Class and Percent of Total																				
	Nonforest		0 to 10		10 to 20		20 to 30		30 to 50		50 to 80		80 to 120		120 to 200		200 +		Hardwoods		Total
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	
Cattle Creek	114	3	359	9	851	22	808	21	188	5	109	3	279	7	231	6	925	24	31	1	3,895
Little Dads Creek	56	3	155	8	500	26	333	17	139	7	42	2	150	8	0	0	583	30	0	0	1,958
Mile 15 Frontal	526	24	330	15	97	4	24	1	38	2	61	3	174	8	662	30	273	12	26	1	2,211
Table Creek	528	15	345	10	533	15	60	2	517	15	87	3	366	11	203	6	832	24	0	0	3,471
Middle Cow Creek Subwatershed	1,224	11	1,189	10	1,981	17	1,225	11	882	8	299	3	969	8	1,096	10	2,613	23	57	0	11,535
Darby Creek	13	1	0	0	925	36	378	15	24	1	43	2	6	0	0	0	1,167	46	6	0	2,562
Dutchman Creek	0	0	45	3	365	28	0	0	51	4	4	0	1	0	0	0	844	64	3	0	1,313
Lower Union	5	0	9	0	625	23	930	34	207	7	133	5	143	5	13	0	710	26	0	0	2,775
Middle Cow Frontal	91	3	134	5	789	28	148	5	2	0	40	1	223	8	23	1	1,109	40	216	8	2,775
Upper Cow Frontal	147	5	298	10	471	15	34	1	39	1	0	0	230	8	277	9	1,205	40	347	11	3,048
Upper Union	7	0	258	5	476	9	907	17	2,595	49	42	1	168	3	85	2	707	13	0	0	5,245
Upper Cow Creek Subwatershed	263	1	744	4	3,651	21	2,397	14	2,918	16	262	1	771	4	398	2	5,742	32	572	3	17,718

Table 9. 2001 Age Class Distribution in the Lower Cow Creek WAU.

Area	Number of Acres by Age Class and Percent of Total																				
	Nonforest		0 to 10		10 to 20		20 to 30		30 to 50		50 to 80		80 to 120		120 to 200		200 +		Hardwoods		Total
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	
Audie Creek	0	0	101	7	448	31	111	8	87	6	67	5	73	5	53	4	465	32	36	2	1,441
Buck Martin	7	0	441	17	1,078	42	264	10	180	7	10	0	190	7	27	1	384	15	0	0	2,581
Cedar Gulch Creek	3	0	67	5	536	44	93	8	2	0	7	1	0	0	1	0	514	42	0	0	1,223
Hare Creek	17	1	472	16	537	18	174	6	83	3	0	0	414	14	276	9	875	29	121	4	2,969
Lower Middle Creek	3	0	330	13	825	32	430	17	178	7	4	0	24	1	102	4	709	27	0	0	2,605
Martin Middle	5	0	183	6	432	13	412	13	113	3	89	3	299	9	160	5	1,482	45	95	3	3,270
Smith Creek	5	0	172	14	228	19	169	14	0	0	82	7	162	13	105	9	308	25	0	0	1,231
Lower Middle Creek Subwatershed	40	0	1,766	12	4,084	27	1,653	11	643	4	259	2	1,162	8	724	5	4,737	31	252	2	15,320
Brush Middle	0	0	58	4	421	31	293	22	131	10	226	17	24	2	36	3	169	12	0	0	1,358
Gravel Creek	4	0	73	4	546	32	476	28	221	13	14	1	15	1	32	2	335	20	0	0	1,716
Panther Middle	0	0	33	4	249	33	253	33	66	9	0	0	0	0	1	0	156	21	0	0	758
Peavine Creek	0	0	31	2	227	18	122	9	19	1	0	0	162	13	113	9	622	48	0	0	1,296
South Fork Middle Creek	23	1	560	13	1,300	31	581	14	691	17	134	3	119	3	57	1	663	16	29	1	4,157
Upper Middle Creek	60	3	386	17	585	25	153	7	105	5	45	2	340	15	42	2	579	25	14	1	2,309
Upper Middle Creek Subwatershed	87	1	1,141	10	3,328	29	1,878	16	1,233	11	419	4	660	6	281	2	2,524	22	43	0	11,594
Lower Cow Creek WAU	11,445	11	7,431	7	16,295	16	12,516	12	10,785	11	5,456	5	4,609	4	7,167	7	23,112	23	3,619	4	102,435

Map 8. Lower Cow Creek Watershed Analysis Unit
2001 Age Class Distribution

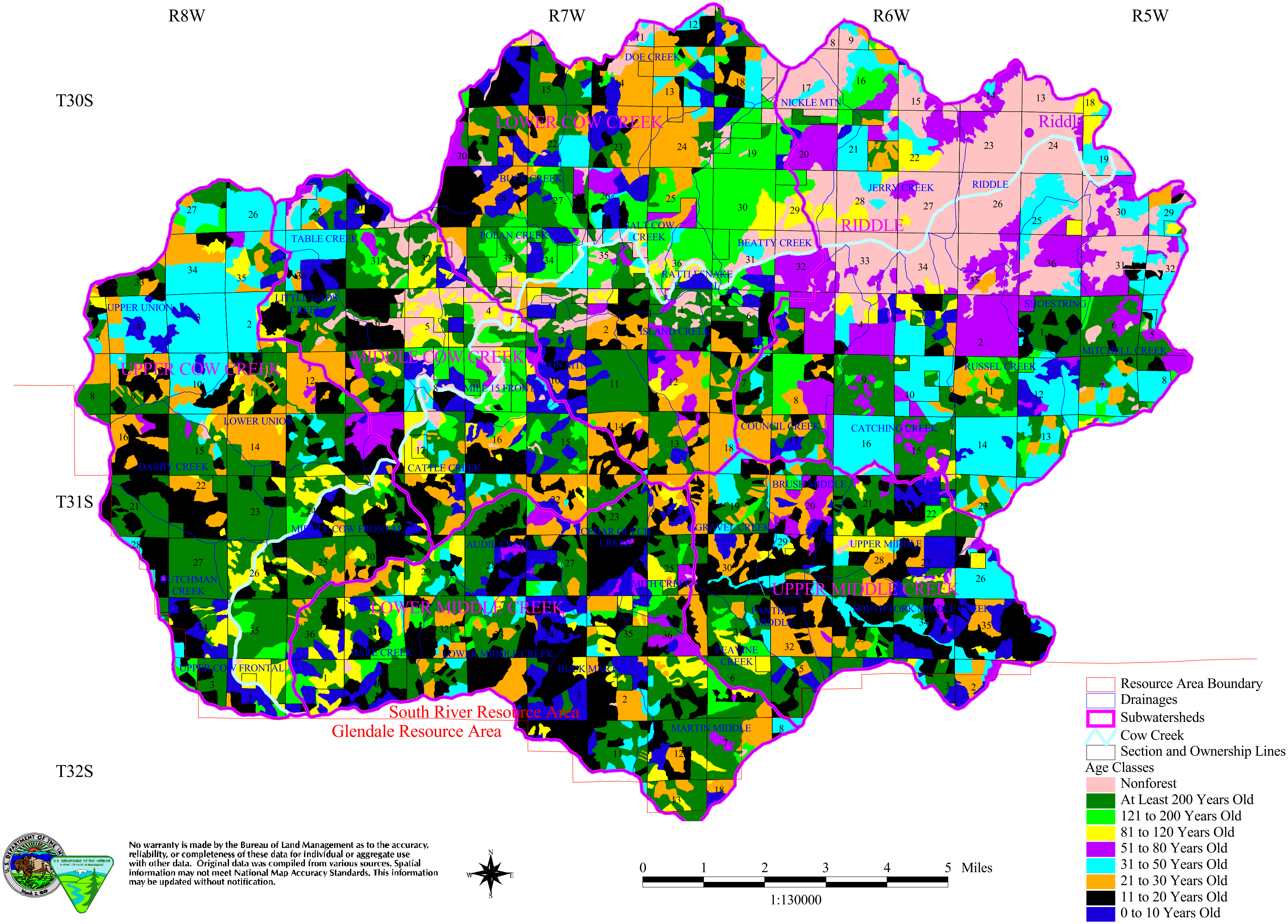


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Table 10. 1993 Age Class Distribution in the Lower Cow Creek WAU (Using Satellite Imagery Data).

	Nonforest		Early Seral (0 to 30 Years Old)		Mid Seral (31 to 80 Years Old)		Late Seral (80 + Years Old)		
Area	Acres	%	Acres	%	Acres	%	Acres	%	Total Acres
Catching Creek	178	5	517	16	996	30	1,608	49	3,299
Council Creek	243	9	913	33	614	22	1,030	37	2,800
Jerry Creek	2,794	59	1,350	29	251	5	311	7	4,706
Mitchell Creek	632	16	993	25	807	21	1,477	38	3,909
Nickle Mountain	732	56	460	35	38	3	83	6	1,313
Riddle	2,582	69	740	20	157	4	255	7	3,734
Russell Creek	341	9	831	22	1,048	27	1,632	42	3,852
Shoestring	451	27	554	33	195	11	499	29	1,699
Riddle Subwatershed	7,953	31	6,358	25	4,106	16	6,895	27	25,312
Beatty Creek	522	17	1,612	52	282	9	680	22	3,096
Buck Creek	77	2	1,743	54	467	15	923	29	3,210
Doe Creek	316	8	2,271	56	616	15	882	22	4,085
Iron Mountain	51	2	1,239	48	319	12	962	37	2,571
Island Creek	52	4	767	59	438	34	33.929	3	1,291
Polan Creek	102	4	964	42	387	17	846	37	2,299
Rattlesnake Frontal	95	8	680	57	102	9	316	26	1,193
Salt Cow Creek	128	6	1,330	59	250	11	564	25	2,272
Lower Cow Creek Subwatershed	1,343	7	10,606	53	2,861	14	5,207	26	20,017

Table 10. 1993 Age Class Distribution in the Lower Cow Creek WAU (Using Satellite Imagery Data).

	Nonforest		Early Seral (0 to 30 Years Old)		Mid Seral (31 to 80 Years Old)		Late Seral (80 + Years Old)		
Area	Acres	%	Acres	%	Acres	%	Acres	%	Total Acres
Cattle Creek	115	3	1,966	51	565	15	1,226	32	3,872
Little Dads Creek	45	2	973	50	459	24	470	24	1,947
Mile 15 Frontal	173	8	860	39	319	15	845	38	2,197
Table Creek	66	2	1,539	45	910	26	939	27	3,454
Middle Cow Creek Subwatershed	399	3	5,338	47	2,253	20	3,480	30	11,470
Darby Creek	58	2	1,427	56	393	15	672	26	2,550
Dutchman Creek	20	2	584	45	284	22	417	32	1,305
Lower Union	51	2	1,345	49	680	25	679	25	2,755
Middle Cow Frontal	59	2	1,119	41	521	19	1,058	38	2,757
Upper Cow Frontal	42	1	1,229	41	607	20	1,152	38	3,030
Upper Union	84	2	1,742	33	2,330	45	1,059	20	5,215
Upper Cow Creek Subwatershed	314	2	7,446	42	4,815	27	5,037	29	17,612
Audie Creek	36	3	635	44	397	28	362	25	1,430
Buck Martin	55	2	1,663	65	313	12	540	21	2,571
Cedar Gulch Creek	61	5	718	59	145	12	294	24	1,218
Hare Creek	70	2	1,406	48	625	21	853	29	2,954
Lower Middle Creek	59	2	1,335	52	439	17	758	29	2,591
Martin Middle	73	2	895	28	530	16	1,752	54	3,250
Smith Creek	21	2	568	46	233	19	403	33	1,225
Lower Middle Creek Subwatershed	375	2	7,220	47	2,682	18	4,962	33	15,239

Table 10. 1993 Age Class Distribution in the Lower Cow Creek WAU (Using Satellite Imagery Data).

	Nonforest		Early Seral (0 to 30 Years Old)		Mid Seral (31 to 80 Years Old)		Late Seral (80 + Years Old)		
Area	Acres	%	Acres	%	Acres	%	Acres	%	Total Acres
Brush Middle	39	3	739	55	263	19	311	23	1,352
Gravel Creek	33	2	967	57	320	19	387	23	1,707
Panther Middle	19	3	438	58	134	18	161	21	752
Peavine Creek	31	2	402	31	169	13	687	53	1,289
South Fork Middle Creek	145	4	2,325	56	575	14	1,091	26	4,136
Upper Middle Creek	58	3	917	40	372	16	951	41	2,298
Upper Middle Creek Subwatershed	325	3	5,788	50	1,833	16	3,588	31	11,534
Lower Cow Creek WAU	10,709	11	42,756	42	18,550	18	29,169	29	101,184

Map 9. Lower Cow Creek Watershed Analysis Unit
1993 Age Class Distribution (Using Satellite Imagery)

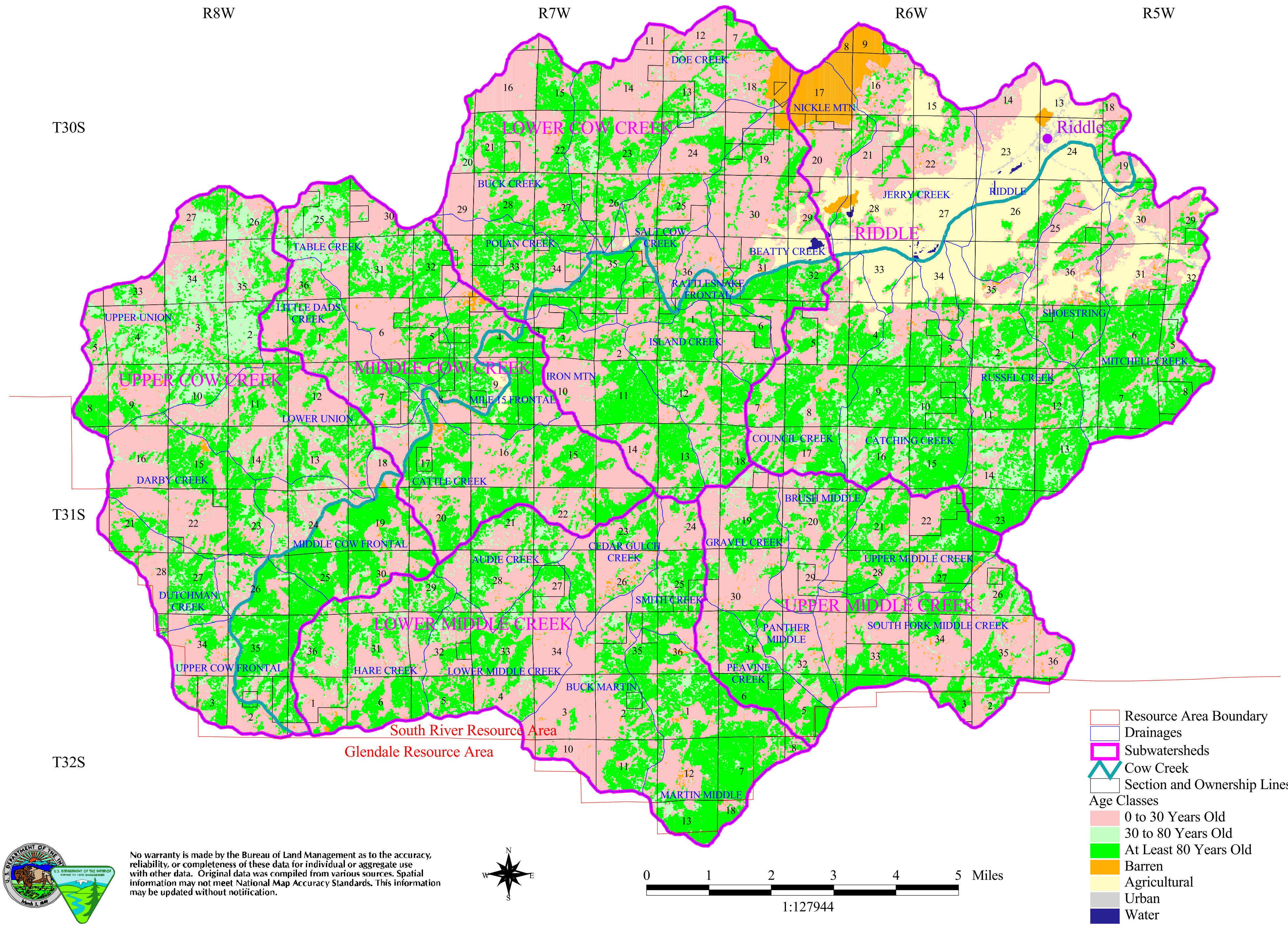


Table 11. 1993 BLM Age Class Distribution in the Lower Cow Creek WAU (Using Satellite Imagery Data).

	Nonforest		Early Seral (0 to 30 Years Old)		Mid Seral (31 to 80 Years Old)		Late Seral (80 + Years Old)		
Area	Acres	%	Acres	%	Acres	%	Acres	%	Total Acres
Catching Creek	10	1	141	9	398	26	1,007	65	1,556
Council Creek	18	2	362	34	240	23	438	41	1,058
Jerry Creek	15	5	194	60	35	11	82	25	326
Mitchell Creek	22	1	271	15	422	23	1,111	61	1,826
Nickle Mountain	30	28	61	57	4	4	12	11	107
Riddle	0	0	0	0	0	0	0	0	0
Russell Creek	18	1	329	18	463	26	995	55	1,805
Shoestring	13	2	111	21	67	13	338	64	529
Riddle Subwatershed	126	2	1,469	20	1,629	23	3,983	55	7,207
Beatty Creek	40	5	498	67	57	8	143	19	738
Buck Creek	36	3	490	36	242	18	596	44	1,364
Doe Creek	47	5	442	43	237	23	298	29	1,024
Iron Mountain	19	1	328	25	181	14	787	60	1,315
Island Creek	15	1	349	35	223	22	421	42	1,008
Polan Creek	44	4	404	38	182	17	445	41	1,075
Rattlesnake Frontal	18	4	155	37	62	15	184	44	419
Salt Cow Creek	36	5	377	53	97	14	199	28	709
Lower Cow Creek Subwatershed	255	3	3,043	40	1,281	17	3,073	40	7,652

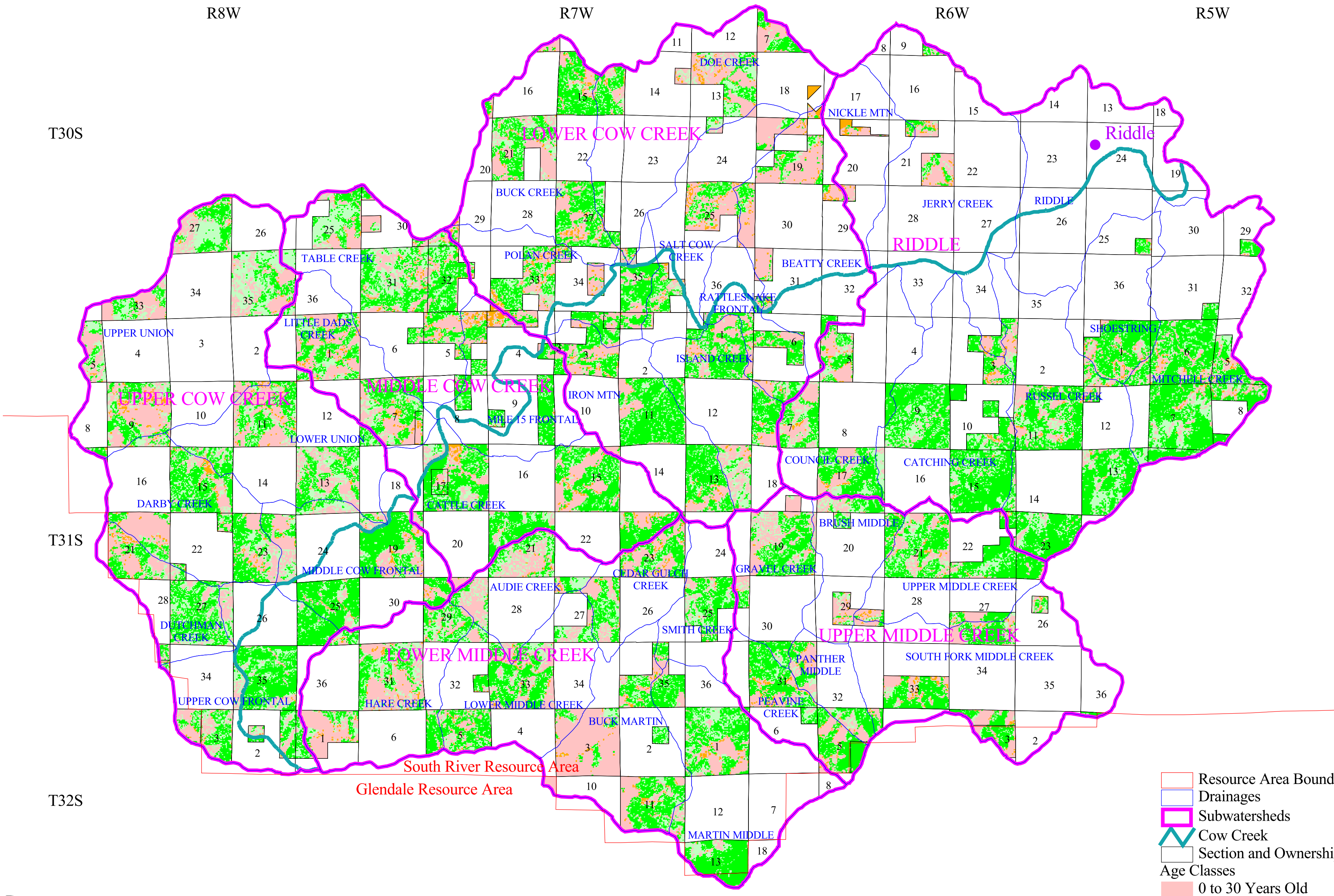
Table 11. 1993 BLM Age Class Distribution in the Lower Cow Creek WAU (Using Satellite Imagery Data).

	Nonforest		Early Seral (0 to 30 Years Old)		Mid Seral (31 to 80 Years Old)		Late Seral (80 + Years Old)		
Area	Acres	%	Acres	%	Acres	%	Acres	%	Total Acres
Cattle Creek	48	3	521	29	318	18	915	51	1,802
Little Dads Creek	32	3	493	44	248	22	354	31	1,127
Mile 15 Frontal	50	8	129	21	99	16	340	55	618
Table Creek	32	2	530	29	587	32	702	38	1,851
Middle Cow Creek Subwatershed	162	3	1,673	31	1,252	23	2,311	43	5,398
Darby Creek	36	3	491	37	266	20	519	40	1,312
Dutchman Creek	12	1	252	29	244	28	371	42	879
Lower Union	20	2	486	37	348	26	460	35	1,314
Middle Cow Frontal	23	2	421	30	243	18	695	50	1,382
Upper Cow Frontal	10	1	328	23	369	26	738	51	1,445
Upper Union	40	2	873	43	650	32	464	23	2,027
Upper Cow Creek Subwatershed	141	2	2,851	34	2,120	25	3,247	39	8,359
Audie Creek	10	2	291	44	210	32	153	23	664
Buck Martin	25	2	740	58	160	13	347	27	1,272
Cedar Gulch Creek	17	2	278	41	124	18	263	39	682
Hare Creek	29	2	606	45	327	24	387	29	1,349
Lower Middle Creek	19	2	426	35	265	22	510	42	1,220
Martin Middle	17	1	276	22	269	22	667	54	1,229
Smith Creek	4	1	81	20	116	29	199	50	400
Lower Middle Creek Subwatershed	121	2	2,698	40	1,471	22	2,526	37	6,816

Table 11. 1993 BLM Age Class Distribution in the Lower Cow Creek WAU (Using Satellite Imagery Data).

	Nonforest		Early Seral (0 to 30 Years Old)		Mid Seral (31 to 80 Years Old)		Late Seral (80 + Years Old)		
Area	Acres	%	Acres	%	Acres	%	Acres	%	Total Acres
Brush Middle	6	2	159	40	102	26	130	33	397
Gravel Creek	6	1	271	35	188	24	310	40	775
Panther Middle	6	2	152	45	58	17	123	36	339
Peavine Creek	21	3	210	27	109	14	425	56	765
South Fork Middle Creek	26	3	334	37	113	12	440	48	913
Upper Middle Creek	18	2	269	25	224	21	550	52	1,061
Upper Middle Creek Subwatershed	83	2	1,395	33	794	19	1,978	47	4,250
Lower Cow Creek WAU	888	2	13,129	33	8,547	22	17,118	43	39,682

Map 10. Lower Cow Creek Watershed Analysis Unit
1993 BLM Age Class Distribution (Using Satellite Imagery)



Resource Area Boundary
Drainages
Subwatersheds
Cow Creek
Section and Ownership Lines

Age Classes
0 to 30 Years Old
30 to 80 Years Old
At Least 80 Years Old
Barren
Agricultural
Urban

No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data was compiled from various sources. Spatial information may not meet National Map Accuracy Standards. This information may be updated without notification.

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Table 12. Comparison of 1993 Satellite Imagery and 2001 Operations Inventory Vegetation Data in the Lower Cow Creek WAU.

Seral Stage	Age Class	1993		2001	
		Acres	Percent	Acres	Percent
Early	0 to 30 Years Old	42,756	42	36,242	35
Mid	30 to 80 Years Old	18,550	18	16,241	16
Late	At Least 80 Years Old	29,894	29	34,888	34
Nonforested	Nonforested	10,709	11	11,445	11
Hardwoods	Hardwoods	Not Determined	Not Determined	3,619	4
Total		101,909	100	102,435	100

Table 13. Comparison of 1993 Satellite Imagery and 2001 Operations Inventory Vegetation Data on BLM Administered Land in the Lower Cow Creek WAU.

Seral Stage	Age Class	1993		2001	
		Acres	Percent	Acres	Percent
Early	0 to 30 Years Old	13,129	33	9,614	24
Mid	30 to 80 Years Old	8,547	22	3,546	9
Late	At Least 80 Years Old	17,118	43	25,382	64
Nonforested	Nonforested	888	2	1,405	4
Total		39,682	100	39,947	100

1. Vegetative Characterization

There is a wide diversity of plant communities within the Lower Cow Creek WAU. Vegetative diversity is partially the result of dramatic climatic gradients. A wide variety of soils and related geologic features directly affect local plant distribution and the resulting plant communities. The Lower Cow Creek WAU is in an area of climatic transition between the mild Willamette Valley and hot Mediterranean climate of northern California within the Klamath Mountain Physiographic Province described by Franklin and Dyrness (Hickman 1994).

Vegetation zones are distinct geographical subdivisions within broader regional delineations. Using vegetation zones allows a person to focus on specific geographical differences in climate or vegetation and to generalize complex local vegetation patterns. Vegetation zones in the Lower Cow Creek Watershed Analysis Unit were characterized from the Natural Resources Conservation Service Soil Survey report by Gene Hickman (Hickman 1994). Vegetation zones may cover large geographical areas but always have a single set of potential native plant communities repeated throughout the zone. The patterns are predictable since they are related to local landscape features such as aspect, soil, and landform. Microclimate would be relatively similar throughout a given zone. Vegetation zones give an approximate guide to complex local vegetation patterns, natural plant succession, and stand development processes. A wide variety of soils and related geologic features directly affect local plant distribution and the resulting plant communities.

Six vegetation zones occur in the Lower Cow Creek WAU (see Map 11). The Grand Fir, Tanoak, Douglas-fir/Chinkapin, Interior Valleys and Foothills, Cool Douglas-fir/Hemlock, and Western Hemlock Zones are displayed on Map 11. The Grand Fir, Tanoak, Douglas-fir/Chinkapin, and Interior Valleys and Foothills Zones contain about 91 percent of the WAU.

a. Grand Fir Zone

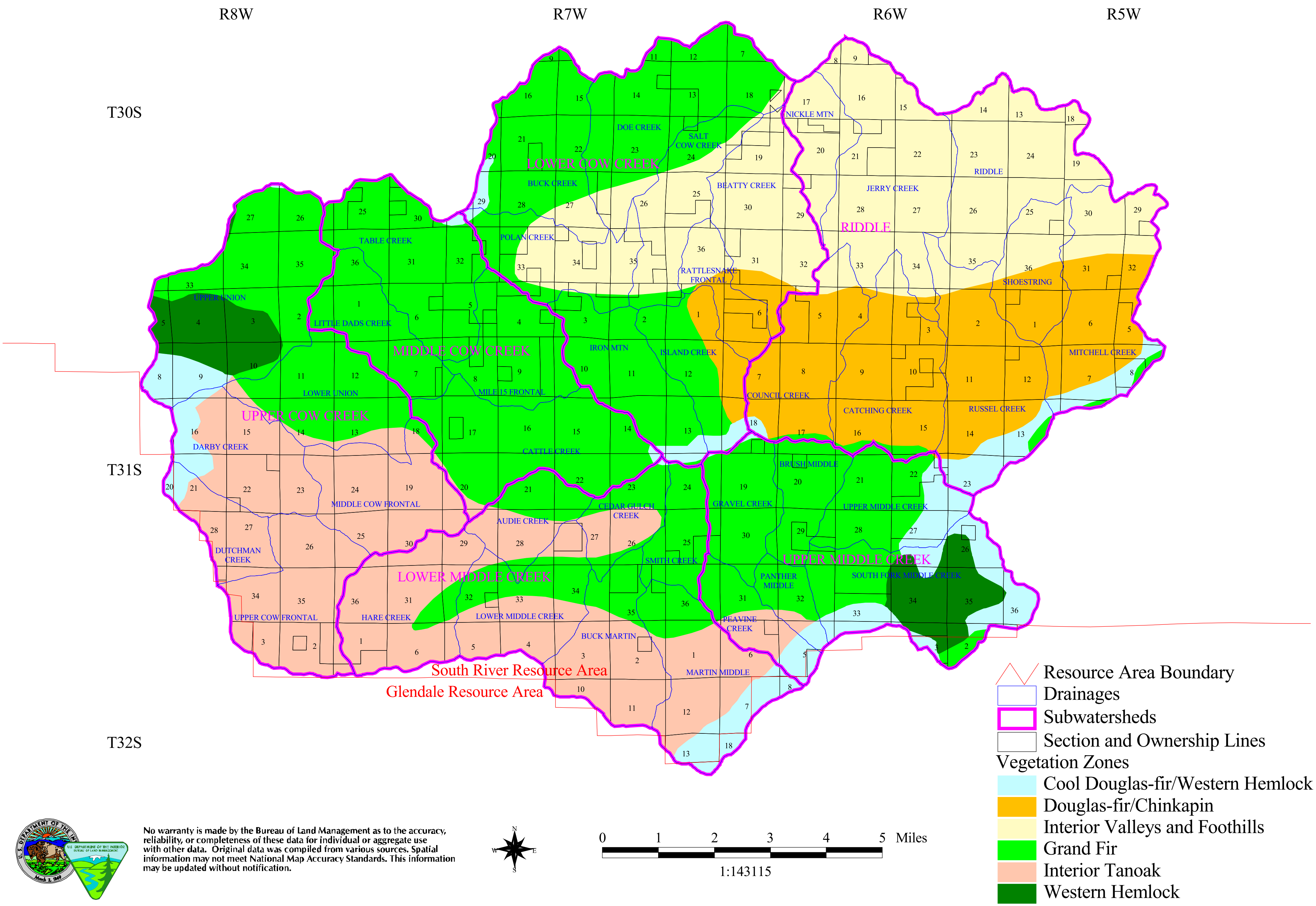
The Grand Fir Zone forms a transition between moist hemlock forests and the drier central valleys. This zone makes up about 40 percent of the Lower Cow Creek WAU. This area of mountains and foothills receives from 40 to 55 inches average annual precipitation. Elevation remains below about 3,200 feet.

Douglas-fir dominates the older stands, with grand fir being common on the northern aspects and minor or absent on the southern aspects. Golden chinkapin occurs regularly on north aspects, with Pacific madrone and occasionally California black oak occurring on south aspects. Incense cedar and big leaf maple are often present. Western redcedar and red alder are more common in very moist areas. The area is generally too dry for western hemlock except in some drainages or on very moist north aspects. Serpentine soils present in the area are unique and the vegetation is not necessarily consistent with the Grand Fir Zone criteria.

There are numerous valleys, south aspects, and foothill areas in the zone where droughty, clayey, or wet soils support white oak savannas and restrict the development of coniferous forests. This probably explains the history of tree clearing and farming that occurred in these areas.

Understory shrubs on north aspects include salal, cascade Oregon grape, western hazel, creambush oceanspray, red huckleberry, western prince's pine, whipplevine, yerba buena, and hairy honeysuckle. South aspects support any of the shrubs mentioned above, although red huckleberry, cascade Oregon grape, and salal, which require more moisture, have minor species occurrence. Grasses and poison oak also become more abundant on south aspects. Where the drier edge of the zone approaches the Interior Valleys and Foothills Zone, salal, red huckleberry, and even grand fir may drop out. Some key indicator species for the zone, such as cascade Oregon grape, golden chinkapin, wild ginger, and inside-out-flower, remain present.

Map 11. Lower Cow Creek Watershed Analysis Unit Vegetation Zones



The Grand Fir Zone in the Lower Cow Creek WAU resembles forests in Josephine and Jackson counties. Geological differences and climatic changes result in more species diversity and the increasing importance of California black oak, sugar pine, ponderosa pine, canyon live oak, incense cedar, and grasses in the southern portion of the WAU.

b. Tanoak Zone

The Tanoak Zone occurs in the southwest portion of the Lower Cow Creek WAU. It occupies about 19 percent of the WAU. This represents the northern portion of the Tanoak Zone that extends south into northern California. The average annual precipitation ranges from about 45 to 75 inches. The elevation ranges up to 3,200 feet. The Tanoak Zone appears to occupy a warmer position with greater growing season moisture stress than the Grand Fir Zone.

Douglas-fir is the dominate species. The tree form of tanoak is abundant on the north aspects while the shrub form occurs on south aspects. The Tanoak Zone is similar to the Grand Fir Zone in species composition, except for the presence of tanoak. However, sugar pine, ponderosa pine, incense cedar, California black oak, Pacific madrone, and canyon live oak are more important in the Tanoak Zone.

c. Interior Valleys and Foothills Zone

The Interior Valleys and Foothills Zone occurs in the northern portion of the Lower Cow Creek WAU. It occupies about 19 percent of the WAU. Much of the zone is composed of hills and low mountains extending into the interior from both the Cascade and Coast Range Mountains. The average annual precipitation ranges from about 35 to 50 inches.

This zone is separated ecologically from the adjacent vegetative zones by its dry, warm climate, the high proportion of hardwoods in the uplands, and the absence of indicator species from the Grand Fir Zone. Much of the natural vegetation of this zone has been affected by settlement, grazing, or converted to crop lands.

Uplands with the most favorable soils have coniferous forests of Douglas-fir and subordinate species, such as Pacific madrone, bigleaf maple, California black oak, ponderosa pine, incense cedar and sometimes Oregon white oak. More droughty soils in the uplands support hardwood dominated stands of Pacific madrone, Oregon white oak, some California black oak, and minor amounts of Douglas-fir, ponderosa pine, and incense cedar. Some hillsides, with shallow soils, support only scattered Oregon white oak and grass or shrubs, such as wedgeleaf ceanothus and Pacific poison oak.

Bottomland vegetation varies with soil texture, drainage class, terrace level, and geographic location. Overstories range from black cottonwood on deep sandy, gravelly floodplains to Oregon white oak and Oregon ash dominated stands on poorly drained, clayey floodplains and terraces. Understories vary with soil conditions but usually contain common snowberry and Pacific poison oak. Vine maple, mockorange, viburnum, Pacific ninebark, blue elderberry, creambush oceanspray, and western hazel may occur, depending on site conditions. Some areas were naturally treeless meadows where species such as sedge, rush, and tufted hairgrass probably dominated very wet soil conditions.

Serpentine soils present in this area are unique and the vegetation is not necessarily characteristic of the Interior Valleys and Foothills Zone. The overstory vegetation on serpentine soils consists mainly of Jeffrey pine, Incense-cedar, and some Douglas-fir and ponderosa pine. Dwarf ceanothus, coffeeberry, rock fern, huckleberry, oak, and grasses grow in the understory. The stocking capacity of serpentine soils is severely limited resulting in very low productivity.

d. Douglas-fir/Chinkapin Zone

The Douglas-fir/Chinkapin Zone occurs east of the Tanoak Zone in the southern portion of the Lower Cow Creek WAU. It occupies about 13 percent of the WAU. This zone extends south into northern California. The average annual precipitation ranges between 35 and 60 inches. The elevation ranges up to 3,200 feet.

Douglas-fir is the dominant climax species on upland slopes except for shallow soils and soils with high amounts of rock fragments where Oregon white oak, canyon live oak, or drought tolerant shrubs occur. On south aspects, Douglas-fir and Pacific madrone may be found with California black oak, canyon live oak, sugar pine, ponderosa pine, and incense cedar. Grand fir is generally absent in the uplands but frequently occurs in the valleys. This is not typical of the zone and probably represents a transition from the Grand Fir Zone.

e. Cool Douglas-fir/Hemlock Zone

The Cool Douglas-fir/Hemlock Zone occupies about six percent of the Lower Cow Creek WAU. This zone occupies high elevations on mountain peaks and ridges, generally above 3,000 feet in elevation. The average annual precipitation ranges from 50 to 120 inches with a major portion coming in the form of snow.

The Cool Douglas-fir/Hemlock Zone occurs near Silver Butte where soils support western hemlock as well as Douglas-fir. Some areas also include sporadic occurrences of western redcedar, incense cedar, sugar pine, Pacific yew, and white fir. Canyon live oak is found on soils with high amounts of rock fragments. Rhododendron, cascade Oregon grape, salal, chinkapin, and red huckleberry occur in the understory.

Forest managers can expect lower tree growth rates, climatic limitations for regeneration, and severe competition from evergreen shrubs in this zone. Areas burned or with the overstory removed develop dense brush fields. The brush fields may contain Pacific rhododendron, salal, cascade Oregon grape, red huckleberry, or golden chinkapin.

f. Western Hemlock Zone

The Western Hemlock Zone occupies about three percent of the Lower Cow Creek WAU. Elevations range up to 3,200 feet. The average annual precipitation is estimated to range from 55 to 120 inches.

Douglas-fir is the dominant species. Western hemlock is a significant understory or dominant overstory species in older stands on north aspects. It may be present in minor amounts on south aspects. Grand fir, western redcedar, and chinkapin may also occur. Red alder, bigleaf maple, and cascara buckthorn occur in favorable locations. Understory species include western sword fern, oxalis, vine maple, currant, western hazel, creambush oceanspray, Pacific rhododendron, salal, red huckleberry, cascade Oregon grape, and evergreen huckleberry.

Forest managers encounter a variety of competitive evergreen and deciduous shrubs in tree regeneration efforts. Red alder is especially aggressive after fires or overstory removal on many north aspects.

2. Fire History and Natural Fire Regimes

Fire has been an important disturbance factor in Pacific Northwest forests for thousands of years. The "unmanaged" or "natural" forests, those that developed before widespread logging or fire protection existed, were initiated by fire and most have been altered by fire since establishment. Early accounts suggest that fires were highly variable, occurring frequently or infrequently and killed all of the trees at times or left the mature trees unscathed (Agee 1990).

Fire regimes of the Pacific Northwest have been described by Agee (1981). Fire regimes are broad, artificially grouped categories, which overlap considerably with one another. Forests are considered to have a similar fire regime when fires occur with similar frequency, severity, and extent. Effects of forest fires can be more precisely described if forest types can be grouped by fire regimes. Because fire regimes are based on unmanaged forests the affects of fire suppression, timber harvesting, and human introduced fire (prescribed or accidental fire) need to be considered when using fire regimes as the basis for altering the structure of existing forests. Numerous and periodic forest management treatments may be necessary to restore or maintain a forest stand in a condition considered to be within the natural range of variability for a particular fire regime.

Fire regimes are influenced by elevation, aspect, distance from the coast, annual rainfall, and soil types. Generally, fire regimes would progress from low severity in the lower elevations to high severity fire regimes in the higher elevations of the WAU.

Forest series and plant association groups are used by Agee to discuss fire regimes in southwestern Oregon (Agee and Huff 2000). Broader vegetation zones are used to discuss fire regimes in the WAU to remain consistent with other discussions in this watershed analysis. The percentage each vegetation zone covers in the WAU and on BLM-administered land is shown in Table 14. The corresponding forest series and fire regimes are based on the methodology used by Agee and Huff (2000).

Table 14. Percentage of Vegetation Zone in the Lower Cow Creek WAU and on BLM Administered Land and the Relationship to Fire Regimes.

Vegetation Zone	Forest Series	Fire Regime	Percent of WAU	Percent of BLM Administered Land
Interior Valleys and Foothills	Pine/Oak	Low Severity	19	7
Douglas-fir/Chinkapin	Douglas-fir	Low to Moderate Severity	13	16
Tanoak	Tanoak	Low to Moderate Severity	19	24
Grand Fir	White Fir	Moderate Severity	40	43
Cool Douglas-fir/Hemlock	Western Hemlock	High Severity	6	8
Western Hemlock	Western Hemlock	High Severity	3	2

a. Low Severity Fire Regime

Fires occur frequently with low intensity in a low severity fire regime. The driest areas might burn annually. Areas where pine and oak intermix may have an average fire return interval of ten years (Agee and Huff 2000). The vegetation in the Interior Valleys and Foothills Zone would gradually transition from grassland, to Oregon white oak, to oak mixed with ponderosa pine and Douglas-fir without human influence. Because these areas occur primarily in the populated valleys and foothills, most of the natural vegetation has been affected by agricultural or residential uses. The Interior Valleys and Foothills Zone is the hottest and driest area of the WAU. The Interior Valleys and Foothills Zone comprises approximately 19 percent of the WAU. About seven percent of the BLM-administered land occurs in this zone.

b. Low to Moderate Severity Fire Regime

Moderate severity fire regimes have quite variable fires. Some fires burn under the tree canopy and thin stands and others burn as stand replacing fires (Agee and Huff 2000). Fires ranging from low to high severity create a complex mosaic of forest age classes across the landscape in a moderate severity fire regime. A fire occurring in a low to moderate severity fire regime may leave large diameter trees unharmed while burning surface and ladder fuels on one occasion and be a stand replacing fire if it occurred during extremely hot, dry, and windy weather conditions.

Substantial differences exist between the wet and dry forest series included in the moderate severity fire regime. The vegetation transitions gradually along climatic gradients and abruptly along geologic boundaries in the Lower Cow Creek WAU, making mapping of vegetation types difficult. The fire regimes are also difficult to map. Stands on serpentine soils have very low productivity and tend to be more open, dominated by Jeffrey pine, incense-cedar, and some Douglas-fir. Some serpentine sites (especially on south aspects) might be considered to have a low severity or low to moderate severity fire regime.

Fires occur less frequently in the wetter White Fir and Grand Fir vegetation types. These vegetation types transition between the Douglas-fir series in the lower elevations and the cool, wet, western hemlock series in the higher elevations of the WAU.

Approximately 13 percent of the Lower Cow Creek WAU is in the Douglas-fir/Chinkapin Zone and would be considered to have a low to moderate severity fire regime. The Tanoak Zone occupies approximately 19 percent of the WAU. The Grand Fir Zone (White Fir Series), which comprises approximately 40 percent of the WAU, is the wettest forest series classified as having a low to moderate fire regime (Agee and Huff 2000). The Grand Fir Zone would transition from a low to moderate severity fire regime at low elevations through a moderate severity fire regime at middle elevations to a moderate to high severity fire regime at the highest elevations. Forest management activities to restore or maintain ecosystem health, if based on the natural fire regime, need to consider the variable fire regimes that may occur throughout the Grand Fir Zone.

c. High Severity Fire Regime

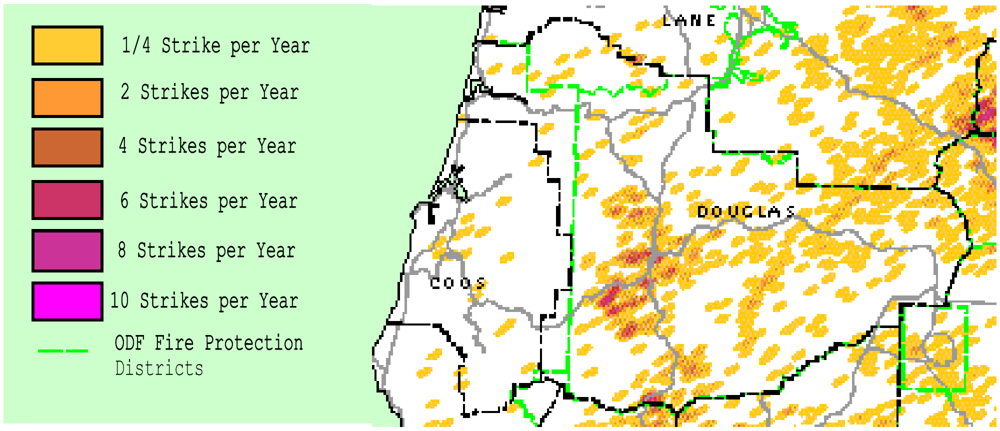
High severity fire regimes have infrequent fires (more than 100 years between fires). Fires are usually high intensity, stand replacing fires. High severity fire regimes typically occur in moist and cool areas. Fires in a high severity fire regime occur under unusual conditions, such as during drought years, hot and dry wind weather events (east foehn winds), and have an ignition source, such as lightning.

The Western Hemlock Zone occupies about three percent of the Lower Cow Creek WAU and the Cool Douglas-fir/Hemlock Zone occupies about six percent. The western hemlock series is well distributed in western Oregon and Washington, coastal Canada and Alaska, and certain cool, moist locations east of the Cascade Mountain Range (Franklin and Dryness 1984).

3. Recent Fire History

Lightning is the primary natural source of forest fires in the world. The Pacific Northwest has relatively mild thunderstorm activity compared to the southeastern United States. Although, the average annual number of lightning caused fires is greater in the West because less precipitation accompanies the thunderstorms (Agee 1993). Considerable variation in thunderstorm tracking patterns exists from year to year and from storm to storm. Some thunderstorms are widespread and others consist of localized events (Morris 1934). The lightning strike frequency map (see Map 12) shows less than one lightning strike per year occurred over most of Douglas County between 1992 and 1996. Map 12 graphically displays the widespread and random distribution of lightning across Douglas County but gives no indication which lightning strikes may have ignited wildfires.

Map 12. Number of Lightning Strikes in Douglas County from 1992 to 1996.



Nineteen eighty-seven was considered to be a year of severe fires in Oregon. However, only 30 percent of the average number of acres historically burned by wildfire in Oregon were burned in 1987. Modern fire suppression and fire management strategies have had a profound effect on natural fire frequency, intensity, species composition, vegetation density, and forest structure in many Pacific Northwest forests (Norris 1990). From 1980 to 1995, 32 fires burned approximately 2,415 acres in the Lower Cow Creek WAU (see Map 13). Most of the fires were caused by lightning. The 18 fires started by lightning burned approximately 1,768 acres with approximately 1,755 acres burned in 1987. The lightning caused fires burned about two percent of the WAU in the summer of 1987. The 14 human caused fires burned approximately 648 acres.

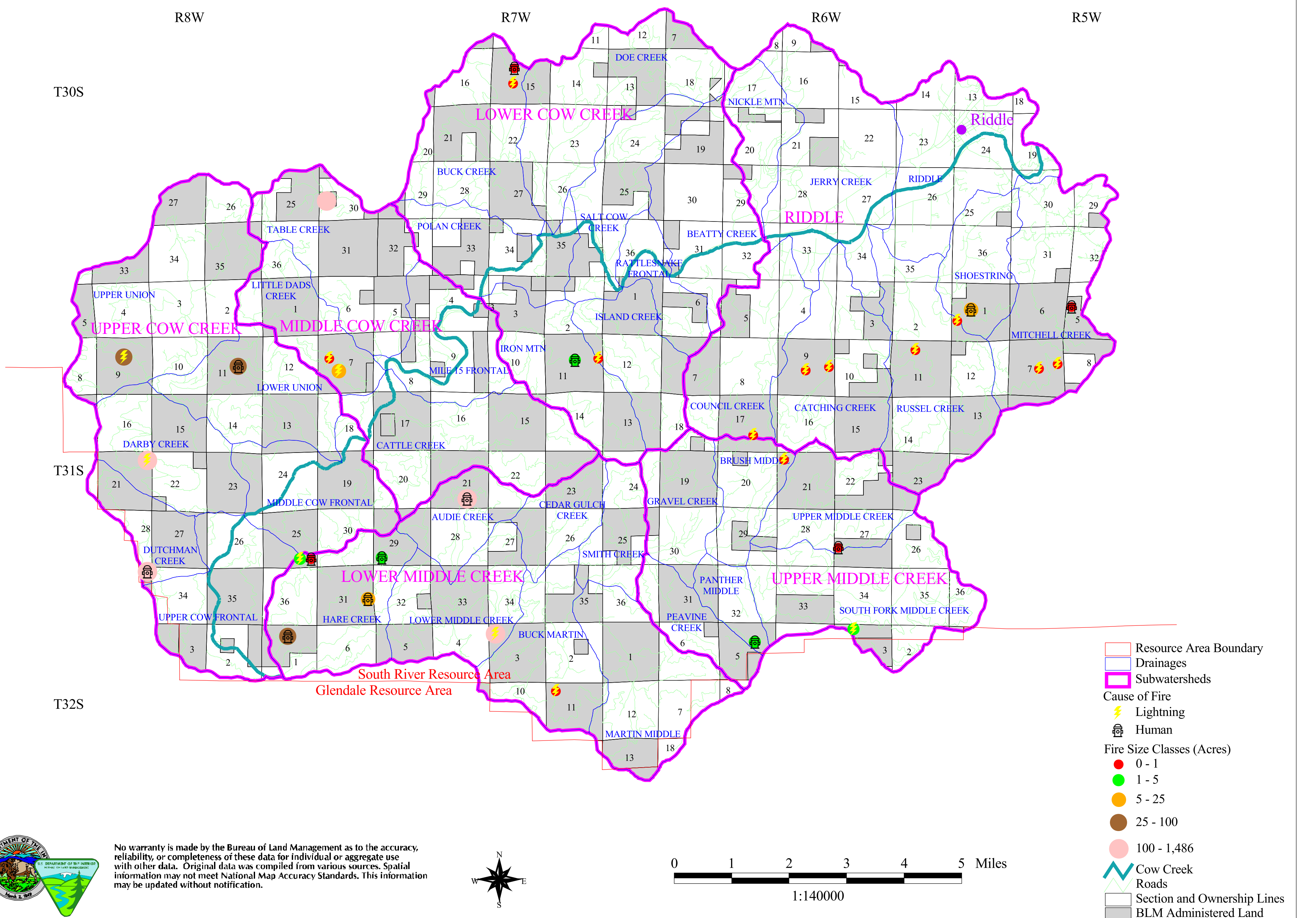
4. Insects and Diseases

Insects and diseases are capable of causing both large and small-scale disturbances across the landscape. Intensive management practices can reduce the risk of large scale habitat loss due to insects and diseases in the WAU. Maintaining forest ecosystem processes functioning can keep a forest healthy with a high degree of resistance and resilience to disturbance (Filip 1994). Native forest pests are often the result, not the cause of poor forest health (Filip 1994). The magnitude of insect and disease-related disturbance is greatly influenced by species composition, age class, stand structure, and history of other disturbances on the same site.

a. Insects

Insect activity within stands in the WAU is present at endemic levels. Insect attacks and outbreaks are usually associated with conditions that stress the tree. There is a common association between root diseases and bark beetles. A high proportion of laminated root rot infected trees are actually

Map 13. Lower Cow Creek Watershed Analysis Unit
Location of Fires Occurring in the WAU From 1980 to 1995



No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data was compiled from various sources. Spatial information may not meet National Map Accuracy Standards. This information may be updated without notification.

killed by bark beetles and not by the fungus. Laminated root rot plays a large part in maintaining endemic bark beetle populations over time.

When epidemic insect populations are reached, healthy trees may be attacked and killed. Direct control measures are impractical and generally not recommended. Damage can be reduced indirectly by thinning. Keeping trees in a healthy, vigorous condition is the most practical means of reducing the impact from bark beetles (Filip and Schmitt 1990).

b. Diseases

Diseases of concern in the Lower Cow Creek WAU are white pine blister rust, Port-Orford-cedar root disease (Phytophthora lateralis), laminated root rot (Phellinus weirii), annosus root disease (Heterobasidion annosum), armillaria root disease (Armillaria ostoyae), and black stain root disease (Leptographium wageneri). The two diseases causing the most concern in the Lower Cow Creek WAU are white pine blister rust and Port-Orford-cedar root disease, both of these diseases are not native to the area.

(1) White Pine Blister Rust

White pine blister rust is an introduced disease that infects five-needle pines, including sugar pine which occurs in the WAU (see Table 15). White pine blister rust is caused by the fungus Cronartium ribicola. The pathogen girdles and kills infected stems and branches causing top and branch death in larger trees and outright mortality in seedling, sapling, and pole-sized trees. Infections in larger trees can predispose these trees to bark beetle attack. Sugar pine in overstocked stands are particularly vulnerable. Tree improvement programs have developed resistant sugar pine trees that can tolerate infection by the fungus.

Table 15. Location of Native Rust-resistant Sugar Pines in the Lower Cow Creek WAU.

Location by Township, Range, and Section	Unique Identifier
30-7-25	SPB0532303
30-8-35	SPB0522256
30-8-35	SPB0522257
31-7-33	SPB0522261

(2) Port-Orford-Cedar Root Disease

Port-Orford-cedar root disease is caused by the introduced fungus Phytophthora lateralis. The pathogen was first reported killing nursery stock around Seattle, Washington in 1923 and appeared in the native range of Port-Orford-cedar (POC) in 1952. Phytophthora lateralis has spread throughout much of the range of Port-Orford-cedar in Oregon and northern California.

Old-growth trees die within two to four years after infection. Seedlings die within a few weeks (Roth et al. 1987). As the disease spreads, discoloration occurs simultaneously throughout the crown. Infected trees are often attacked by bark beetles, which speeds the death of the tree and may modify foliage discoloration by altering the mortality rate. In virtually all cases, infection of POC occurs in areas where avenues for water borne spore dispersal exists. Infection is highly dependent on the presence of water in the immediate vicinity of susceptible tree roots. High risk areas for infection are stream courses, drainages, or low lying areas down slope from already present infection centers or below roads and trails where new inoculum may be introduced (Southwest Oregon Forest Insect and Disease Technical Center 1995). Major spread of the disease is through movement of infected soil in road construction, road maintenance, daily road use, and logging operations. Soil clinging to the feet of cattle and elk has resulted in new infections in a few instances (Southwest Oregon Forest Insect and Disease Technical Center 1995).

Port-Orford-cedar regenerates profusely from surviving trees. The continuing supply of susceptible seedlings on high-risk sites is likely to sustain a chronic disease, threatening trees on more favorable sites.

Port-Orford-cedar does not occur evenly over the landscape. There may be several miles between populations. Extensive roadside surveys in the South River Resource Area during the summers of 1996 and 2000 identified where healthy and infected POC occurred adjacent to roads (see Table 16). Aerial photography interpretation, conducted in 1998, identified areas of infection. The areas of infection identified on BLM-administered land were confirmed by on-site surveys.

Table 16. Locations of Port-Orford-Cedar on BLM Administered Land.

Location by Township, Range, and Section	Healthy	Diseased
30-6-19	X	
30-6-31	X	
30-7-13		X
30-7-34	X	
30-7-35		X
30-8-35	X	
31-6-33	X	X
31-8-11	X	X
31-8-35	X	

Vegetative material has been collected from individual trees in the Lower Cow Creek WAU to test for POC resistance to Phytophthora lateralis in the laboratory. Port-Orford-cedar showing resistance to the Port-Orford-cedar root disease have been located in T 30S, R6W, Section 19; T31S, R6W, Section 19; and T31S, R8W, Section 11 in the WAU. Cuttings from these trees are being screened for resistance to the Port-Orford-cedar root disease at Oregon State University (OSU).

(3) Other Root Diseases

Root diseases present at endemic levels and not considered to be a concern in the WAU include laminated root rot (Phellinus weirii), annosus root disease (Heterobasidion annosum), armillaria root disease (Armillaria ostoyae), and black stain root disease (Leptographium wageneri). Root diseases can cause scattered mortality of individual trees or create openings devoid of susceptible mature trees. Root pathogens are extremely difficult to eradicate from the site once they become established. Depending on the disease the damage can be minimized by increasing host vigor, favoring disease-tolerant conifer species, or reducing inoculum (Filip and Schmitt 1990).

5. Riparian Reserves

There are approximately 17,649 acres of Riparian Reserves on BLM-administered land in the WAU (see Table 17 and Map 14). Riparian Reserves within the Lower Cow Creek WAU and outside of the LSR account for approximately 5,873 acres (15 percent) of the Federally-administered land. There are approximately 74 acres of Riparian Reserves in the Medford BLM District and 5,799 acres in the Roseburg BLM District. The purpose of Riparian Reserves is to maintain and restore riparian structures and functions of intermittent streams, confer benefits to riparian-dependent and associated species other than fish, enhance conservation for organisms that are dependent on the transition zone between upslope and riparian areas, improve travel and dispersal corridors for many terrestrial animals and plants, and provide greater connectivity of the watershed (USDA and USDI 1994b). Silvicultural treatments applied within Riparian Reserves would be to control stocking or reestablish, establish, or maintain desired vegetation characteristics to attain Aquatic Conservation Strategy objectives.

Riparian Reserve widths are defined based on the most limiting criteria of the extent of unstable or potentially unstable areas, the top of the inner gorge, the extent of riparian vegetation, the outer edges of the 100 year floodplain, or the site potential tree height. The site potential tree height defines the widest Riparian Reserves in the WAU.

Table 17. 2001 Riparian Reserve Age Class Distribution on BLM Administered Land.

Area	Number of Acres by Age Class and Percent of Total																		
	Nonforest		0 to 10		10 to 20		20 to 30		30 to 50		50 to 80		80 to 120		120 to 200		200 +		Total
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	
Catching Creek	0	0	6	1	19	3	18	3	31	5	106	16	17	3	6	1	456	69	659
Council Creek	0	0	25	7	46	12	98	26	38	10	3	1	0	0	6	2	165	43	381
Jerry Creek	0	0	12	10	0	0	60	48	0	0	0	0	2	2	2	2	48	39	124
Mitchell Creek	16	2	0	0	35	5	55	8	93	13	76	11	9	1	23	3	399	57	706
Nickle Mountain	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	29	29	71	41
Riddle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Russell Creek	0	0	6	1	21	3	143	21	126	19	0	0	7	1	155	23	222	33	680
Shoestring	0	0	0	0	84	32	0	0	0	0	0	0	18	7	4	2	154	59	260
Riddle Subwatershed	16	1	49	2	205	7	374	13	288	10	185	6	53	2	208	7	1,473	52	2,851
Beatty Creek	11	4	0	0	0	0	0	0	0	0	0	0	0	0	283	95	3	1	297
Buck Creek	14	2	56	9	20	3	92	15	0	0	0	0	10	2	102	17	312	51	606
Doe Creek	7	1	40	8	5	1	159	31	124	24	0	0	4	1	28	5	149	29	516
Iron Mountain	27	5	78	14	16	3	39	7	0	0	1	0	0	0	0	0	393	71	554
Island Creek	57	13	0	0	42	9	120	26	0	0	52	11	0	0	0	0	183	40	454
Polan Creek	115	25	1	0	0	0	0	0	0	0	1	0	25	5	127	27	193	42	462
Rattlesnake Frontal	34	19	0	0	17	10	32	18	0	0	3	2	0	0	10	6	81	46	177
Salt Cow Creek	15	6	28	11	0	0	29	11	8	3	9	4	7	3	84	33	73	29	253
Lower Cow Creek Subwatershed	280	8	203	6	100	3	471	14	132	4	66	2	46	1	634	19	1,387	42	3,319

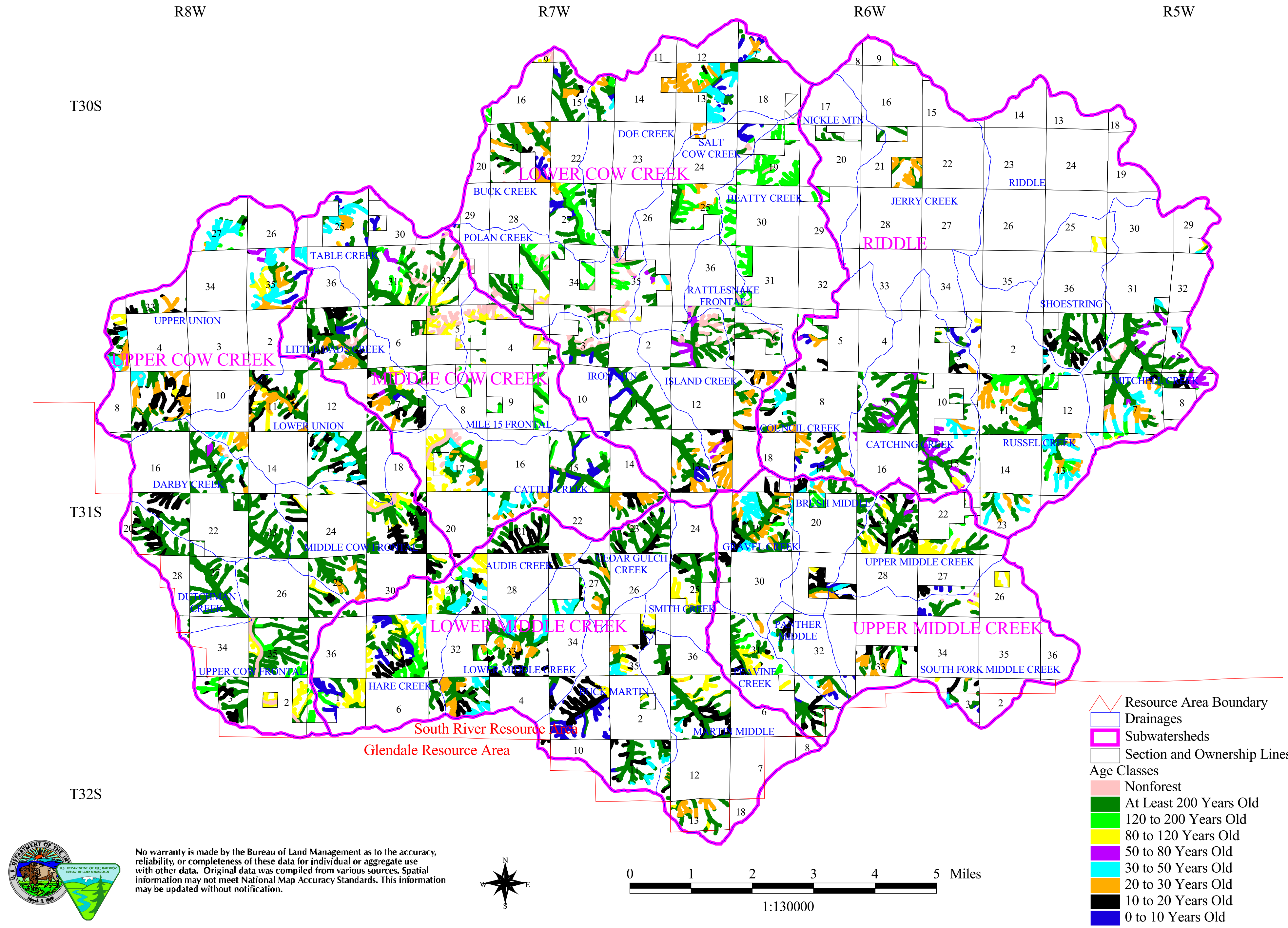
Table 17. 2001 Riparian Reserve Age Class Distribution on BLM Administered Land.

Area	Number of Acres by Age Class and Percent of Total																		
	Nonforest		0 to 10		10 to 20		20 to 30		30 to 50		50 to 80		80 to 120		120 to 200		200 +		Total
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	
Cattle Creek	51	7	60	8	40	5	112	15	74	10	0	0	74	10	49	6	307	40	767
Little Dads Creek	21	3	25	4	145	23	91	14	0	0	7	1	16	3	0	0	326	52	631
Mile 15 Frontal	61	30	0	0	0	0	0	0	0	0	0	0	41	20	66	32	38	18	206
Table Creek	115	15	25	3	0	0	28	4	83	11	16	2	96	12	55	7	351	46	769
Middle Cow Creek Subwatershed	248	10	110	5	185	8	231	10	157	7	23	1	227	10	170	7	1,022	43	2,373
Darby Creek	3	1	0	0	81	14	11	2	10	2	9	2	0	0	0	0	477	81	591
Dutchman Creek	0	0	0	0	53	13	0	0	0	0	0	0	1	0	0	0	353	87	407
Lower Union	2	0	0	0	121	19	95	15	66	10	0	0	46	7	0	0	317	49	647
Middle Cow Frontal	30	4	0	0	179	27	31	5	0	0	0	0	63	9	16	2	348	52	667
Upper Cow Frontal	55	8	0	0	59	9	0	0	0	0	0	0	92	13	104	15	375	55	685
Upper Union	1	0	22	2	167	19	210	24	232	26	16	2	64	7	10	1	171	19	893
Upper Cow Creek Subwatershed	91	2	22	1	660	17	347	9	308	8	25	1	266	7	130	3	2,041	52	3,890

Table 17. 2001 Riparian Reserve Age Class Distribution on BLM Administered Land.

Area	Number of Acres by Age Class and Percent of Total																		
	Nonforest		0 to 10		10 to 20		20 to 30		30 to 50		50 to 80		80 to 120		120 to 200		200 +		Total
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	
Audie Creek	0	0	0	0	147	42	13	4	54	15	0	0	41	12	10	3	86	25	351
Buck Martin	0	0	101	18	212	37	12	2	54	9	0	0	36	6	0	0	155	27	570
Cedar Gulch Creek	2	1	0	0	59	19	27	9	0	0	0	0	0	0	0	0	219	71	307
Hare Creek	0	0	122	16	71	9	1	0	64	8	0	0	165	22	102	13	233	31	758
Lower Middle Creek	0	0	8	1	128	20	105	16	100	16	0	0	3	0	29	5	265	42	638
Martin Middle	0	0	0	0	98	20	55	11	15	3	0	0	45	9	0	0	269	56	482
Smith Creek	0	0	0	0	28	13	0	0	0	0	0	0	51	24	1	0	133	62	213
Lower Middle Creek Subwatershed	2	0	231	7	743	22	213	6	287	9	0	0	341	10	142	4	1,360	41	3,319
Brush Middle	0	0	2	1	66	29	24	10	23	10	0	0	6	3	24	10	86	37	231
Gravel Creek	0	0	0	0	93	21	85	19	89	20	0	0	0	0	10	2	165	37	442
Panther Middle	0	0	9	8	20	18	17	15	9	8	0	0	0	0	0	0	58	51	113
Peavine Creek	0	0	4	1	63	21	0	0	0	0	0	0	54	18	29	9	156	51	306
South Fork Middle Creek	4	1	17	6	61	21	49	17	7	2	2	1	31	11	23	8	100	34	294
Upper Middle Creek	0	0	15	3	107	21	1	0	11	2	17	3	102	20	8	2	250	49	511
Upper Middle Creek Subwatershed	4	0	47	2	410	22	176	9	139	7	19	1	193	10	94	5	815	43	1,897
Lower Cow Creek WAU	641	4	662	4	2,303	13	1,812	10	1,311	7	318	2	1,126	6	1,378	8	8,098	46	17,649

Map 14. Lower Cow Creek Watershed Analysis Unit
Riparian Reserve Age Class Distribution in 2001



Riparian Reserve widths were developed using the Regional Ecosystem Office approved methodology in determining site tree heights. This methodology uses average site index computed from inventory plots throughout the fifth field watershed (Lower Cow Creek Watershed), which corresponds with this WAU. For this watershed analysis, Riparian Reserve widths use a potential tree height of 160 feet. All first and second order streams, which are considered to be non-fish bearing streams for this watershed analysis, were analyzed using a Riparian Reserve width of 160 feet on each side of the stream. Third order and larger streams, which are considered to be fish bearing streams for this watershed analysis, were analyzed using a Riparian Reserve width of 320 feet (two time the site potential tree height) on each side of the stream. Actual projects would use site specific information, such as if a stream was fish bearing, to determine if a stream needed a Riparian Reserve width of 160 or 320 feet.

Riparian Reserve widths may be adjusted following watershed analysis, a site specific analysis, and describing the rationale for the adjustment through the appropriate NEPA decision making process (USDA and USDI 1994b and USDI 1995). Critical hillslope, riparian, channel processes and features, and the contribution of Riparian Reserves to benefit aquatic and terrestrial species would be the basis for the analysis. As a minimum, a fisheries biologist, soil scientist, hydrologist, botanist, and wildlife biologist would be expected to conduct the analysis for adjusting Riparian Reserve widths. The Riparian Reserve Module could be used to evaluate adjusting Riparian Reserve widths.

6. Private Lands

Private lands account for approximately 61 percent (62,488 acres) of the Lower Cow Creek WAU (see Table 18 and Map 15). Private ownership in the Cow Creek Valley consists mainly of agricultural and urban (residential) lands. The upland areas are mainly private forested lands intermingled with BLM-administered lands.

Although private lands are a major component of this Watershed Analysis Unit (61 percent), the focus of this analysis is on BLM-administered land. Timber harvesting on private forest lands could be expected to be influenced by tree maturity, market conditions, and other economic factors. The Oregon Forest Practices Act addresses timber harvesting on private lands.

Table 18. 2001 Private Land Age Class Distribution in the Lower Cow Creek WAU.

Area	Number of Acres by Age Class and Percent of Total																				
	Nonforest		0 to 10		10 to 20		20 to 30		30 to 50		50 to 80		80 to 120		120 to 200		200 +		Hardwoods		Total
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	
Catching Creek	151	9	63	4	33	2	0	0	1,082	62	284	16	27	2	0	0	0	0	111	6	1,751
Council Creek	228	13	5	0	141	8	311	18	97	6	611	35	67	4	273	16	0	0	21	1	1,754
Jerry Creek	2,585	59	0	0	67	2	72	2	431	10	167	4	101	2	210	5	0	0	754	17	4,387
Mitchell Creek	765	38	41	2	2.0128	0	70	3	694	34	365	18	0	0	0	0	0	0	100	5	2,037
Nickle Mountain	608	50	40	3	0	0	0	0	40	3	307	25	36	3	135	11	0	0	42	3	1,208
Riddle	2,708	72	0	0	0	0	0	0	113	3	41	1	0	0	2	0	0	0	877	23	3,741
Russell Creek	268	13	206	10	1	0	0	0	838	41	628	30	8	0	0	0	0	0	111	5	2,060
Shoestring	449	38	0	0	0	0	0	0	47	4	143	12	0	0	0	0	0	0	536	46	1,175
Riddle Subwatershed	7,762	43	355	2	299	2	453	2	3,342	18	2,546	14	266	1	593	3	0	0	2,552	14	18,168
Beatty Creek	480	20	165	7	101	4	0	0	56	2	322	14	153	6	992	42	1	0	97	4	2,367
Buck Creek	65	4	490	26	676	36	382	21	5	0	110	6	0	0	33	2	92	5	0	0	1,853
Doe Creek	308	10	268	9	571	19	984	32	454	15	176	6	0	0	85	3	224	7	1	0	3,071
Iron Mountain	45	4	293	23	303	24	563	45	4	0	20	2	20	2	5	0	7	1	0	0	1,260
Island Creek	0	0	29	3	53	5	587	58	25	2	216	21	80	8	23	2	0	0	0	0	1,013
Polan Creek	188	15	158	13	120	10	140	11	113	9	34	3	62	5	203	16	178	14	35	3	1,231
Rattlesnake Frontal	94	12	78	10	144	19	70	9	22	3	21	3	60	8	281	36	7	1	0	0	777
Salt Cow Creek	140	9	86	5	173	11	516	33	55	4	52	3	52	3	312	20	174	11	10	1	1,570
Lower Cow Creek Subwatershed	1,320	10	1,567	12	2,141	16	3,242	25	734	6	951	7	427	3	1,934	15	683	5	143	1	13,142

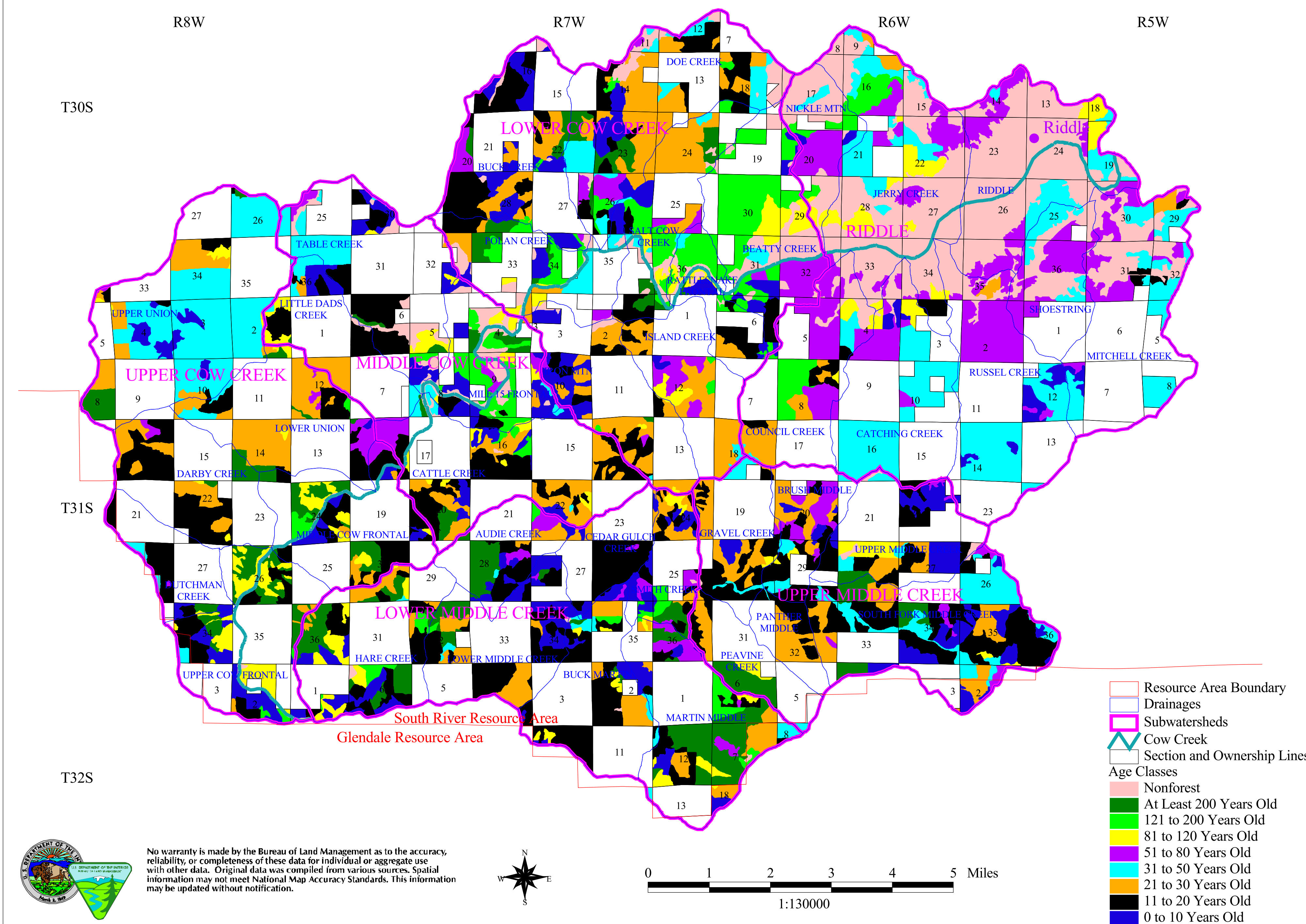
Table 18. 2001 Private Land Age Class Distribution in the Lower Cow Creek WAU.

Area	Number of Acres by Age Class and Percent of Total																				
	Nonforest		0 to 10		10 to 20		20 to 30		30 to 50		50 to 80		80 to 120		120 to 200		200 +		Hardwoods		Total
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	
Cattle Creek	37	2	228	11	768	38	636	31	51	3	109	5	78	4	3.8446	0	87	4	31	2	2,028.8
Little Dads Creek	16	2	113	14	266	32	184	22	139	17	15	2	87	11	0	0	4	0	0	0	824
Mile 15 Frontal	405	25	330	21	97	6	24	2	38	2	61	4	79	5	427	27	103	6	26	2	1,590
Table Creek	258	16	238	15	525	33	5	0	370	23	41	3	98	6	32	2	40	2	0	0	1,607
Middle Cow Creek Subwatershed	716	12	909	15	1,656	27	849	14	598	10	226	4	342	6	514	8	234	4	57	1	6,101
Darby Creek	0	0	0	0	736	59	349	28	0	0	30	2	5	0	0	0	116	9	6	0	1,242
Dutchman Creek	0	0	43	10	291	68	0	0	51	12	4	1	0	0	0	0	34	8	3	1	426
Lower Union	0	0	9	1	325	22	797	55	70	5	133	9	34	2	13	1	69	5	0	0	1,450
Middle Cow Frontal	59	4	134	10	513	37	82	6	0	0	40	3	38	3	0	0	300	22	216	16	1,382
Upper Cow Frontal	92	6	297	19	356	22	34	2	28	2	0	0	52	3	27	2	360	23	347	22	1,593
Upper Union	0	0	198	6	95	3	479	15	2,194	68	5	0	58	2	0	0	177	6	0	0	3,206
Upper Cow Creek Subwatershed	151	2	681	7	2,316	25	1,741	19	2,343	25	212	2	187	2	40	0	1,056	11	572	6	9,299

Table 18. 2001 Private Land Age Class Distribution in the Lower Cow Creek WAU.

Area	Number of Acres by Age Class and Percent of Total																			
	Nonforest		0 to 10		10 to 20		20 to 30		30 to 50		50 to 80		80 to 120		120 to 200		200 +		Hardwoods		Total
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	
Audie Creek	0	0	101	13	207	27	83	11	5	1	67	9	0	0	21	3	252	33	36	5	772
Buck Martin	5	0	166	13	697	53	247	19	69	5	10	1	64	5	27	2	19	1	0	0	1,304
Cedar Gulch Creek	0	0	61	11	416	78	50	9	2	0	7	1	0	0	0	0	0	0	0	0	536
Hare Creek	15	1	265	16	420	26	171	11	5	0	0	0	112	7	100	6	403	25	121	8	1,612
Lower Middle Creek	3	0	291	21	593	43	299	22	16	1	4	0	0	0	9	1	161	12	0	0	1,376
Martin Middle	5	0	183	9	248	12	320	16	78	4	85	4	121	6	160	8	738	36	95	5	2,033
Smith Creek	5	1	172	21	183	22	160	19	0	0	82	10	50	6	85	10	90	11	0	0	827
Lower Middle Creek Subwatershed	33	0	1,239	15	2,764	33	1,330	16	175	2	255	3	347	4	402	5	1,663	20	252	3	8,460
Brush Middle	0	0	54	6	324	34	249	26	89	9	226	24	15	2	0	0	0	0	0	0	957
Gravel Creek	4	0	73	8	399	43	338	36	96	10	11	1	15	2	0	0	0	0	0	0	936
Panther Middle	0	0	0	0	185	44	229	55	3	1	0	0	0	0	0	0	0	0	0	0	417
Peavine Creek	0	0	1	0	95	18	122	23	19	4	0	0	49	9	0	0	240	46	0	0	526
South Fork Middle Creek	5	0	479	15	1,138	35	504	16	664	21	112	3	18	1	0	0	290	9	29	1	3,239
Upper Middle Creek	49	4	353	28	391	31	152	12	86	7	7	1	144	12	0	0	47	4	14	1	1,243
Upper Middle Creek Subwatershed	58	1	960	13	2,532	35	1,594	22	957	13	356	5	241	3	0	0	577	8	43	1	7,318
Lower Cow Creek WAU	10,040	16	5,711	9	11,708	19	9,209	15	8,149	13	4,546	7	1,810	3	3,483	6	4,213	7	3,619	6	62,488

Map 15. Lower Cow Creek Watershed Analysis Unit
2001 Private Age Class Distribution



C. Interpretation

The differences between the historic and current vegetation conditions are due to land ownership patterns, fire suppression, timber harvesting, residential development, and natural disturbances. Historically, the early seral stage was created by natural disturbances, primarily fire. Timber harvesting and stand replacing fires created the early seral vegetative structure and pattern that currently exists in the forested upland areas of the WAU.

Tables 19 and 20 compare the 1936 vegetation with the 2001 vegetation in the WAU and on BLM-administered lands. Although, the data may be correlated, a direct comparison can not be made because the 1936 vegetation data is based on diameter and the 2001 vegetation data is based on age class.

Table 19. Comparison of 1936 Cover Type with 2001 Age Classes in the Lower Cow Creek WAU.

Approximate Seral Stage	1936 Cover Type			2001 Age Class		
		Acres	Percent		Acres	Percent
Early	Burned, Cut < 1920, Less Than 6"	6,622	6	0 to 30 Years Old	36,242	35
Mid	Conifer 6-20"	19,147	19	30 to 80 Years Old	16,241	16
Late	Conifer 20-40", Greater Than 22"	68,514	67	At Least 80 Years Old	34,894	34
Hardwoods	Hardwoods	561	1	Hardwoods	3,619	4
Non-forest	Non-forest, Agricultural	7,603	7	Non-forest	11,445	11
Total		102,447	100		102,441	100

Table 20. Comparison of 1936 Cover Type with 2001 Age Classes on BLM Administered Land in the Lower Cow Creek WAU.

Seral Stage	1936 Cover Type			Current Vegetation		
		Acres	Percent		Acres	Percent
Early	Burned, Cut < 1920, Less Than 6"	3,800	10	0 to 30 Years Old	9,614	24
Mid	Conifer 6-20"	5,033	13	30 to 80 Years Old	3,546	9
Late	Conifer 20-40", Greater Than 22"	31,007	78	At Least 80 Years Old	25,382	64
Hardwoods	Hardwoods	4	0	Hardwoods	0	0
Non-forest	Non-forest	97	0	Non-forest	1,405	4
Total		39,941	100		39,947	100

Bureau of Land Management administered lands available for intensive forest management are those lands outside of LSRs, Riparian Reserves, and other areas reserved or withdrawn from timber harvesting. The WAU contains approximately 6,959 acres (18 percent) of BLM-administered lands that are available for intensive forest management (see Table 21). Silvicultural practices including prescribed fire could be used to obtain desired vegetation conditions in special habitat areas.

Management direction from the Northwest Forest Plan and the Roseburg and Medford District RMPs state that 15 percent of all Federal lands, considering all Land Use Allocations, within fifth field watersheds should remain in late-successional forest stands. The Lower Cow Creek Watershed is a fifth field watershed. Approximately 64 percent (25,382 acres out of 39,947 acres) of the Federally-administered land in the Lower Cow Creek Watershed (the fifth field watershed) is in forest stands at least 80 years old (late-successional) (see Tables 8 and 20). The Lower Cow Creek Watershed meets the management direction to retain 15 percent of all Federal lands within fifth field watersheds in late-successional forest stands. Approximately 54 percent (21,399 acres out of 39,947 acres) of the Federally administered land in the Lower Cow Creek Watershed is in late-successional forest stands and in reserved or withdrawn areas (see Table 22). Maintaining about 5,992 acres of late-successional forest stands on Federally-administered land would meet the management direction to retain 15 percent of all Federal lands within fifth field watersheds in late-successional forest stands.

Matrix lands in the Lower Cow Creek WAU are to be managed for timber production to help meet the Probable Sale Quantity (PSQ) established in the Roseburg and Medford BLM District RMPs. If all of the Matrix lands greater than 80 years old were to be harvested about 10 percent (3,983 acres) of the BLM-administered land would be affected. Map 16 and Table 23 show what the age class distribution would be based on a timber harvesting plan through the year 2024. The timber harvesting plan went through a rigorous process to identify suitable locations while evaluating impacts to wildlife, fisheries, and hydrology resources. The process attempted to adjust the scale, timing, and spacing of timber harvesting to minimize the effects on other resources. The planning process is described in more detail in Appendix I. The results of the process are shown on Map I-1. Table 24 compares the 2000 and 2025 age class distribution based on the same timber harvesting plan. The timber harvesting plan would maintain about 64 percent of the BLM-administered land in the WAU in late-successional forest in 2025.

1. Silviculture Actions

Silviculture actions would be based on Land Use Allocations. Intensive forest management activities would occur on General Forest Management Areas. Silvicultural practices applied within Late-Successional Reserves and Riparian Reserves would be to control stocking, re-establish and manage stands, establish and maintain desired non-conifer vegetation, and acquire desired vegetation characteristics needed to attain Aquatic Conservation Strategy objectives (USDI 1995).

Table 21. Acres of BLM Administered Land by Land Use Allocation.

	Reserved or Withdrawn		Connectivity/Diversity Block		GFMA		
Area	Acres	Percent	Acres	Percent	Acres	Percent	Total Acres
Catching Creek	774	49	558	36	235	15	1,567
Council Creek	382	36	291	27	391	37	1,064
Jerry Creek	138	42	0	0	189	58	327
Mitchell Creek	937	51	669	36	232	13	1,838
Nickle Mountain	97	90	0	0	11	10	108
Riddle	0	0	0	0	0	0	0
Russell Creek	756	42	926	51	135	7	1,817
Shoestring	260	49	26	5	246	46	532
Riddle Subwatershed	3,344	46	2,470	34	1439	20	7,253
Beatty Creek	646	87	0	0	94	13	740
Buck Creek	1,372	100	0	0	0	0	1,372
Doe Creek	710	69	0	0	320	31	1,030
Iron Mountain	1,326	100	0	0	0	0	1,326
Island Creek	870	86	0	0	146	14	1,016
Polan Creek	1,082	100	0	0	0	0	1,082
Rattlesnake Frontal	363	86	0	0	58	14	421
Salt Cow Creek	519	73	0	0	194	27	713
Lower Cow Creek Subwatershed	6,888	89	0	0	812	11	7,700
Cattle Creek	1,814	100	0	0	0	0	1,814
Little Dads Creek	1,134	100	0	0	0	0	1,134
Mile 15 Frontal	622	100	0	0	0	0	622
Table Creek	1,864	100	0	0	0	0	1,864
Middle Cow Creek Subwatershed	5,434	100	0	0	0	0	5,434

Table 21. Acres of BLM Administered Land by Land Use Allocation.

	Reserved or Withdrawn		Connectivity/Diversity Block		GFMA		
Area	Acres	Percent	Acres	Percent	Acres	Percent	Total Acres
Darby Creek	1,320	100	0	0	0	0	1,320
Dutchman Creek	854	96	0	0	32	4	886
Lower Union	1,325	100	0	0	0	0	1,325
Middle Cow Frontal	1,393	100	0	0	0	0	1,393
Upper Cow Frontal	1,364	94	0	0	90	6	1,454
Upper Union	2,038	100	0	0	0	0	2,038
Upper Cow Creek Subwatershed	8,294	99	0	0	122	1	8,416
Audie Creek	670	100	0	0	0	0	670
Buck Martin	1,259	99	0	0	17	1	1,276
Cedar Gulch Creek	687	100	0	0	0	0	687
Hare Creek	1,357	100	0	0	0	0	1,357
Lower Middle Creek	1,228	100	0	0	0	0	1,228
Martin Middle	1,177	95	8	1	51	4	1,236
Smith Creek	403	100	0	0	0	0	403
Lower Middle Creek Subwatershed	6,781	99	8	0	68	1	6,857
Brush Middle	232	58	117	29	52	13	401
Gravel Creek	520	66	56	7	206	26	782
Panther Middle	118	35	223	65	0	0	341
Peavine Creek	417	54	353	46	0	0	770
South Fork Middle Creek	330	36	242	26	345	38	917
Upper Middle Creek	622	58	364	34	82	8	1,068
Upper Middle Creek Subwatershed	2,239	52	1355	32	685	16	4,279
Lower Cow Creek WAU	32,980	83	3,833	10	3,126	8	39,939

Table 22. Age Class Distribution in Reserved or Withdrawn Areas on BLM Administered Land Within the Lower Cow Creek WAU.

Area	Number of Acres by Age Class and Percent of Total																		
	Nonforest		0 to 10		10 to 20		20 to 30		30 to 50		50 to 80		80 to 120		120 to 200		200 +		Total
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	
Catching Creek	0	0	6	1	19	2	18	2	31	4	147	19	17	2	12	2	524	68	774
Council Creek	0	0	25	7	46	12	98	26	38	10	3	1	0	0	6	2	166	43	382
Jerry Creek	0	0	14	10	0	0	60	43	0	0	0	0	14	10	2	1	48	35	138
Mitchell Creek	60	6	0	0	35	4	56	6	102	11	138	15	9	1	44	5	493	53	937
Nickle Mountain	1	1	0	0	0	0	0	0	0	0	0	0	0	0	31	32	65	67	97
Riddle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Russell Creek	10	1	6	1	21	3	172	23	144	19	1	0	20	3	155	21	227	30	756
Shoestring	0	0	0	0	84	32	0	0	0	0	0	0	18	7	4	2	154	59	260
Riddle Subwatershed	71	2	51	2	205	6	404	12	315	9	289	9	78	2	254	8	1,677	50	3,344
Beatty Creek	19	3	0	0	0	0	0	0	0	0	0	0	0	0	624	97	3	0	646
Buck Creek	41	3	107	8	97	7	154	11	0	0	0	0	19	1	203	15	751	55	1,372
Doe Creek	27	4	51	7	11	2	164	23	135	19	0	0	14	2	46	6	262	37	710
Iron Mountain	93	7	148	11	28	2	83	6	0	0	4	0	0	0	0	0	970	73	1,326
Island Creek	95	11	0	0	86	10	171	20	0	0	105	12	0	0	0	0	413	47	870
Polan Creek	291	27	2	0	0	0	0	0	0	0	7	1	67	6	348	32	367	34	1,082
Rattlesnake Frontal	68	19	0	0	34	9	32	9	0	0	3	1	0	0	24	7	202	56	363
Salt Cow Creek	33	6	30	6	0	0	32	6	19	4	27	5	40	8	173	33	165	32	519
Lower Cow Creek Subwatershed	667	10	338	5	256	4	636	9	154	2	146	2	140	2	1,418	21	3,133	45	6,888

Table 22. Age Class Distribution in Reserved or Withdrawn Areas on BLM Administered Land Within the Lower Cow Creek WAU.

Area	Number of Acres by Age Class and Percent of Total																		
	Nonforest		0 to 10		10 to 20		20 to 30		30 to 50		50 to 80		80 to 120		120 to 200		200 +		Total
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	
Cattle Creek	77	4	131	7	83	5	172	9	137	8	0	0	200	11	176	10	838	46	1,814
Little Dads Creek	40	4	42	4	234	21	149	13	0	0	27	2	63	6	0	0	579	51	1,134
Mile 15 Frontal	121	19	0	0	0	0	0	0	0	0	0	0	95	15	235	38	171	27	622
Table Creek	270	14	107	6	8	0	55	3	147	8	46	2	268	14	171	9	792	42	1,864
Middle Cow Creek Subwatershed	508	9	280	5	325	6	376	7	284	5	73	1	626	12	582	11	2,380	44	5,434
Darby Creek	13	1	0	0	189	14	29	2	24	2	13	1	1	0	0	0	1,051	80	1,320
Dutchman Creek	0	0	2	0	73	9	0	0	0	0	0	0	1	0	0	0	778	91	854
Lower Union	5	0	0	0	300	23	133	10	137	10	0	0	109	8	0	0	641	48	1,325
Middle Cow Frontal	32	2	0	0	276	20	66	5	2	0	0	0	185	13	23	2	809	58	1,393
Upper Cow Frontal	55	4	1	0	80	6	0	0	0	0	0	0	177	13	212	16	839	62	1,364
Upper Union	7	0	60	3	381	19	427	21	401	20	37	2	110	5	85	4	530	26	2,038
Upper Cow Creek Subwatershed	112	1	63	1	1,299	16	655	8	564	7	50	1	583	7	320	4	4,648	56	8,294

Table 22. Age Class Distribution in Reserved or Withdrawn Areas on BLM Administered Land Within the Lower Cow Creek WAU.

Area	Number of Acres by Age Class and Percent of Total																		
	Nonforest		0 to 10		10 to 20		20 to 30		30 to 50		50 to 80		80 to 120		120 to 200		200 +		Total
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	
Audie Creek	0	0	0	0	241	36	28	4	82	12	0	0	74	11	32	5	213	32	670
Buck Martin	2	0	272	22	366	29	17	1	111	9	0	0	126	10	0	0	365	29	1,259
Cedar Gulch Creek	3	0	6	1	120	17	43	6	0	0	0	0	0	0	1	0	514	75	687
Hare Creek	2	0	207	15	117	9	3	0	78	6	0	0	302	22	176	13	472	35	1,357
Lower Middle Creek	0	0	38	3	232	19	131	11	162	13	0	0	24	2	93	8	548	45	1,228
Martin Middle	0	0	0	0	176	15	92	8	34	3	0	0	178	15	0	0	697	59	1,177
Smith Creek	0	0	0	0	45	11	9	2	0	0	0	0	111	28	20	5	218	54	403
Lower Middle Creek Subwatershed	7	0	523	8	1,297	19	323	5	467	7	0	0	815	12	322	5	3,027	45	6,781
Brush Middle	0	0	2	1	66	28	24	10	23	10	0	0	6	3	24	10	87	38	232
Gravel Creek	0	0	0	0	105	20	85	16	89	17	0	0	0	0	10	2	231	44	520
Panther Middle	0	0	9	8	21	18	17	14	10	8	0	0	0	0	1	1	60	51	118
Peavine Creek	0	0	4	1	63	15	0	0	0	0	0	0	85	20	82	20	183	44	417
South Fork Middle Creek	18	5	17	5	62	19	50	15	7	2	2	1	50	15	23	7	101	31	330
Upper Middle Creek	3	0	15	2	109	18	1	0	19	3	22	4	109	18	42	7	302	49	622
Upper Middle Creek Subwatershed	21	1	47	2	426	19	177	8	148	7	24	1	250	11	182	8	964	43	2,239
Lower Cow Creek WAU	1,386	4	1,302	4	3,808	12	2,571	8	1,932	6	582	2	2,492	8	3,078	9	15,829	48	32,980

Map 16. Lower Cow Creek Watershed Analysis Unit
Potential BLM Age Class Distribution in 2025

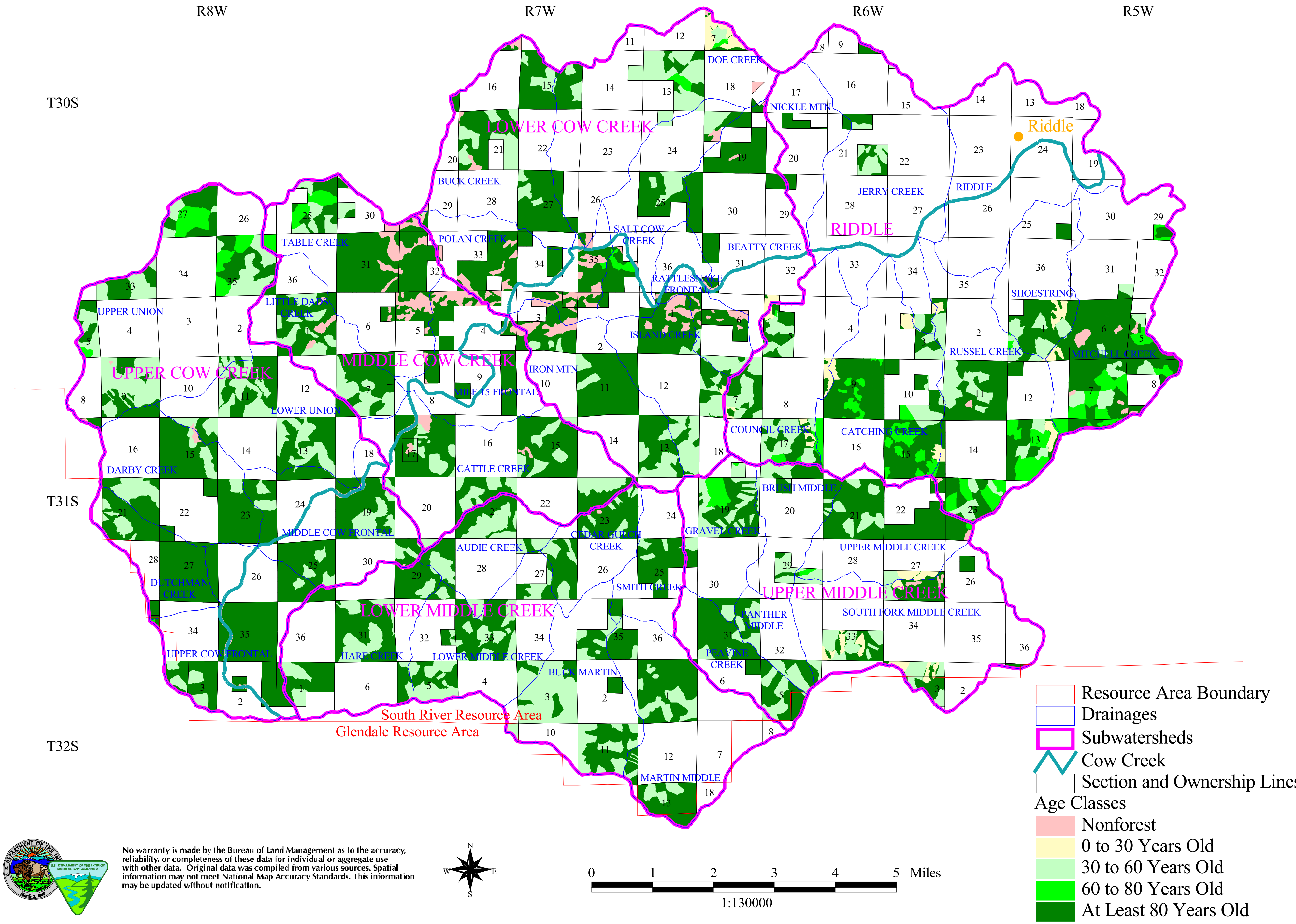


Table 23. Potential 2025 BLM Age Class Distribution.

	Number of Acres by Age Class and Percent of Total										
Area	Nonforest	%	0 to 30	%	30 to 60	%	60 to 80	%	At least 80 Years Old	%	Total
Catching Creek	0	0	69	4	174	11	295	19	1,028	66	1,566
Council Creek	0	0	88	8	519	49	39	4	419	39	1,065
Jerry Creek	0	0	10	3	159	49	0	0	158	48	327
Mitchell Creek	65	4	23	1	212	12	316	17	1,223	67	1,839
Nickle Mountain	1	1	0	0	0	0	0	0	106	99	107
Riddle	0	0	0	0	0	0	0	0	0	0	0
Russell Creek	10	1	62	3	488	27	349	19	908	50	1,817
Shoestring	0	0	45	8	143	27	1	0	344	65	533
Riddle Subwatershed	76	1	297	4	1,695	23	1,000	14	4,186	58	7,254
Beatty Creek	19	3	28	4	4	1	0	0	689	93	740
Buck Creek	41	3	0	0	358	26	0	0	973	71	1,372
Doe Creek	30	3	112	11	483	47	47	5	357	35	1,029
Iron Mountain	93	7	0	0	258	19	0	0	974	74	1,325
Island Creek	95	9	9	1	322	32	0	0	589	58	1,015
Polan Creek	291	27	0	0	2	0	7	1	781	72	1,081
Rattlesnake Frontal	68	16	0	0	114	27	0	0	240	57	422
Salt Cow Creek	33	5	0	0	191	27	40	6	449	63	713
Lower Cow Creek Subwatershed	670	9	149	2	1,732	23	94	1	5,052	66	7,697

Table 23. Potential 2025 BLM Age Class Distribution.

	Number of Acres by Age Class and Percent of Total										
Area	Nonforest	%	0 to 30	%	30 to 60	%	60 to 80	%	At least 80 Years Old	%	Total
Cattle Creek	77	4	0	0	523	29	0	0	1,214	67	1,814
Little Dads Creek	40	4	0	0	425	37	0	0	669	59	1,134
Mile 15 Frontal	121	19	0	0	0	0	0	0	500	81	621
Table Creek	270	14	0	0	170	9	146	8	1,277	69	1,863
Middle Cow Creek Subwatershed	508	9	0	0	1,118	21	146	3	3,660	67	5,432
Darby Creek	13	1	0	0	241	18	0	0	1,065	81	1,319
Dutchman Creek	0	0	0	0	75	8	0	0	811	92	886
Lower Union	5	0	0	0	570	43	0	0	750	57	1,325
Middle Cow Frontal	32	2	0	0	344	25	0	0	1,016	73	1,392
Upper Cow Frontal	55	4	0	0	123	8	4	0	1,273	87	1,455
Upper Union	7	0	0	0	993	49	276	14	762	37	2,038
Upper Cow Creek Subwatershed	112	1	0	0	2,346	28	280	3	5,677	67	8,415
Audie Creek	0	0	0	0	350	52	0	0	318	48	668
Buck Martin	2	0	0	0	782	61	0	0	491	39	1,275
Cedar Gulch Creek	3	0	0	0	169	25	0	0	515	75	687
Hare Creek	2	0	0	0	405	30	0	0	950	70	1,357
Lower Middle Creek	0	0	0	0	564	46	0	0	665	54	1,229
Martin Middle	0	0	0	0	310	25	0	0	925	75	1,235
Smith Creek	0	0	0	0	53	13	0	0	350	87	403
Lower Middle Creek Subwatershed	7	0	0	0	2,633	38	0	0	4,214	61	6,854

Table 23. Potential 2025 BLM Age Class Distribution.

	Number of Acres by Age Class and Percent of Total										
Area	Nonforest	%	0 to 30	%	30 to 60	%	60 to 80	%	At least 80 Years Old	%	Total
Brush Middle	0	0	0	0	185	46	1	0	214	54	400
Gravel Creek	0	0	0	0	312	40	101	13	368	47	781
Panther Middle	0	0	0	0	183	54	0	0	157	46	340
Peavine Creek	0	0	0	0	162	21	0	0	607	79	769
South Fork Middle Creek	18	2	120	13	342	37	0	0	438	48	918
Upper Middle Creek	11	1	51	5	201	19	22	2	782	73	1,067
Upper Middle Creek Subwatershed	29	1	171	4	1,385	32	124	3	2,566	60	4,275
Lower Cow Creek WAU	1,402	4	617	2	10,909	27	1,644	4	25,355	64	39,927

Table 24. Comparison of Age Class Distributions on BLM Administered Land in the Lower Cow Creek WAU Between 2001 and 2025 (based on a timber harvesting plan through 2024).

Age Classes	2001		2024	
	Acres	Percent	Acres	Percent
0 to 30 Years Old	9,614	24	618	2
30 to 80 Years Old	3,546	9	12,554	31
At Least 80 Years Old	25,382	64	25,353	64
Nonforest	1,405	4	1,398	4

Forest stands in the Lower Cow Creek WAU were separated into three seral stages (see Table 25). The early seral stage consists of stands from zero to 30 years old. Silvicultural treatments within the early seral stage would include planting, controlling competing vegetation, precommercial thinning, fertilizing, and pruning. The mid seral stage consists of stands from 31 to 80 years old. Commercial thinning or density management would be the main silvicultural treatment for this seral stage. The late seral stage consists of stands at least 81 years old. Regeneration harvest would be the main silvicultural treatment for this seral stage in Matrix lands.

Table 25. Seral Stages by Land Use Allocation in the Lower Cow Creek WAU.

Seral Stage	Acres			
	GFMA	Connectivity/Diversity Blocks	Riparian Reserves	Late-Successional Reserve
Early (0 to 30 Years Old)	1,180	754	4,777	6,049
Mid (30 to 80 Years Old)	275	756	1,629	1,618
Late (At Least 80 Years Old)	1,666	2,314	10,602	16,880
Non-forested	3	13	641	1,194

a. Matrix Land Use Allocation

Providing a sustainable supply of timber and other forest products and early-successional habitat are some of the objectives of the Matrix Land Use Allocation. Connectivity/Diversity Blocks also provide important ecological functions, such as dispersal of organisms, carry over of some species from one stand to the next, and maintenance of ecologically valuable structural components, such as down logs, snags, and large trees. Silvicultural prescriptions would be planned to produce, over time, forests with the desired species compositions, structural characteristics, and a distribution of seral classes.

(1) Site Preparation, Reforestation, and Maintenance

Regeneration of recently harvested areas is usually achieved by planting seedlings following site preparation. Genetically selected stock would be planted, when available. A mixture of species appropriate to the site would be planted, monitored, and maintained. Vegetation treatments may be necessary to allow seedlings to become established. Mulching to reduce competition from grass may be necessary at lower elevations where grass can affect seedling survival. Brush competition may affect seedling survival in the higher elevations of the WAU. Competition from undesired vegetation may be reduced by cutting, burning, spraying, digging, or pulling.

(2) Precommercial Thinning

Precommercial thinning maintains stand vigor and controls species composition and stand density. Stands between five and 15 years old with high tree densities (greater than 400 trees per acre) are where precommercial thinning would be proposed.

(3) Fertilization

Precommercially thinned stands could be fertilized to increase diameter and height growth, improve tree vigor, and maintain live crown ratio. Fertilization may also maintain or accelerate the development of desired habitat components, such as large trees. Fertilization actions would be designed to apply 200 pounds of available nitrogen per acre (USDI 1995).

(4) Pruning

Pruning young stands increases wood quality through the production of clear wood in a shorter amount of time than would be required without the action. Stands on higher quality sites could be pruned following precommercial thinning. The mortality risks of sugar pine, due to white pine blister rust, can be reduced by pruning.

(5) Commercial Thinning/Density Management

One objective of the Matrix Land Use Allocation is to provide a sustainable supply of timber and other forest commodities. Commercial thinning in GFMA or density management in Connectivity/Diversity Blocks would be conducted where practical and where increased gains in timber production are likely. Thinning intervals would range from ten to 30 years, depending on site class. Stands growing on poor sites would have longer intervals between thinnings.

Commercial thinning usually occurs in 40 to 60 year old stands. Stands considered suitable for commercial thinning generally have a closed canopy, dead lower limbs, dead standing and down trees, and slowed tree growth. These conditions indicate mortality is occurring in the suppressed and intermediate sized trees. Suppression mortality occurs in stands with a relative density index greater than .65 (using the Organon growth and yield model), which is the lower limit of competition mortality. Thinning would maintain the stand at a relative density index between .40 and .65 (using the Organon growth and yield model). Stand exams to collect information, such as species composition, size, density, and standing and downed dead material, would help prioritize potential commercial thinnings.

In Connectivity/Diversity Blocks, density management would provide habitat for a variety of organisms associated with both late-successional and younger forests. Density management would accelerate development into a multilayered stand with large trees, canopy gaps for spatial diversity and understory development, snags, and large down wood. Unthinned patches could be retained to provide wildlife habitat. Treatments would attempt to optimize habitat for late-successional forest related species in the short term. Density management could occur in stands less than 120 years old. Stands between 80 and 120 years old that exhibit late-successional or old-growth characteristics could be retained without density management, unless they are identified as needing treatment as part of a risk reduction effort.

(6) Regeneration Harvests

Most regeneration harvest would occur in the late seral stands. These stands would help provide a sustainable supply of timber and other forest commodities. Regeneration harvests would be programmed for stands at least 60 years old. Long term rotation age would be planned for culmination of mean annual increment (CMAI), which generally occurs when a stand is between 80 and 110 years old in this WAU.

The modified reserve seed-tree method of harvest used in GFMA removes the majority of a stand in a single entry except for six to eight conifer trees per acre. Coarse woody debris and snags would be retained to meet management objectives.

Connectivity/Diversity Blocks would be managed using a 150 year area control rotation. Between 12 and 18 green conifer trees per acre and 120 linear feet of viable down logs per acre would be left within regeneration harvest units. At least 25 percent of each Connectivity/Diversity Block would be maintain in late-successional forests.

Some portion of 17 Connectivity/Diversity Blocks occur in the Lower Cow Creek WAU. All of the Connectivity/Diversity Blocks contain more than 30 percent in late-successional forests (see Table 26). These 17 Connectivity/Diversity Blocks meet the Standard and Guideline to maintain at least 25 percent of each Connectivity/Diversity Block in late-successional forests. Thirteen Connectivity/Diversity Blocks have at least 25 percent that are in reserved areas and late-successional forests.

b. Late-Successional Reserves (LSR)

The South Coast - Northern Klamath Late-Successional Reserve Assessment (LSRA) presents management strategies for ten coastal LSRs in the Coos Bay, Medford, and Roseburg BLM Districts. A large portion of LSR 259, which is included in the LSRA, lies in the Lower Cow Creek WAU.

Late-Successional Reserve 259 was considered to be a high priority for management actions. One reason for the high priority was because it is a large LSR with more than 30,000 acres and could accommodate self-sustaining populations of most late-successional species. Large, mobile predators, migratory species, and rare, local endemic species may not occur in the large reserves (USDI and USDA 1998). The LSR in the Lower Cow Creek WAU is also considered a high priority for management actions because of the key link it provides in the LSR network and the large number of acres of early seral stands, which could benefit from silvicultural treatments (USDI and USDA 1998). The checkerboard ownership pattern in the LSR does not provide much opportunity to develop blocks of contiguous interior late-successional/old-growth habitat larger than 640 acres.

Table 26. Acres of Late Successional Stands in Connectivity/Diversity Blocks in the Lower Cow Creek WAU.

Connectivity/Diversity Block	Total Acres in Block	Amount of Reserved or Withdrawn Areas 80 Years Old or Older		Total Area 80 Years Old or Older	
		Acres	Percent	Acres	Percent
Block 5	768	421	55	682	89
Block 6	662	178	27	430	65
Block 48	523	147	28	257	49
Block 49	609	297	49	440	72
Block 50	609	141	23	295	48
Block 51	338	130	38	305	90
Block 52	656	93	14	346	53
Block 53	655	228	35	437	67
Block 54	642	167	26	383	60
Block 55	306	174	57	299	98
Block 56	613	200	33	436	71
Block 57	628	304	48	556	89
Block 58	649	110	17	253	39
Block 59	633	298	47	456	72
Block 60	594	189	32	543	91
Block 61	385	34	9	195	51
Block 62	663	254	38	484	73

Silvicultural manipulation of the younger stands can accelerate the development of desired stand characteristics. Depending on stand conditions potential treatments could include reforestation, release, density management, pruning, fertilization, tree culturing, and stand conversion (USDI and USDA 1998). Silviculture treatments as described in the LSRA are exempt from further REO review.

The overall criteria for silviculture treatments in the LSR is that they are beneficial to the creation of late-successional forest conditions. Silvicultural systems proposed in LSRs have two principal objectives. They are: 1) development of old-growth characteristics including snags, logs on the forest floor, large trees, and canopy gaps that enable establishment of multiple tree layers and diverse species composition and 2) prevention of large-scale disturbances by fire, wind, insects, and diseases that would destroy or limit the ability of the reserves to sustain viable forest species populations (USDI 1995).

Treatment priorities by age class designated in the LSRA were based on the expected level of biological responses and the emphasis for treatment as specified in the SEIS ROD (USDI and USDA 1998). Table 27 shows the acres potentially available in each age class and treatment priority. Biological treatment windows, budget constraints, or stand conditions would influence the number of acres that are treated in the next decade.

Table 27. Treatment Priorities by Age Class.

Age Class	Treatment Priority	Acres Currently Available in Age Class
Less Than 30 Years Old	High	6,048
30 to 49 Years Old	Medium	1,349
50 to 79 Years Old	Low	269

(1) Site Preparation, Reforestation, and Maintenance

Disturbed areas within the LSR may need planting, maintenance, or release treatments to obtain late-successional conditions quicker or protect site quality. Regeneration is generally achieved by planting seedlings following site preparation. Genetically selected seedlings would be used when available. Some areas may need to be re-planted to meet stocking standards. Site preparation by hand scalping, piling and burning, or prescribed burning may be necessary to reforest an area. Maintenance, protection, and release of individual trees through treatments such as mulching, brush cutting, or animal damage control, may be necessary to ensure survival of the desired number and proportion of trees and species (USDI and USDA 1998).

(2) Precommercial Thinning

Density management or precommercial thinning (PCT) can accelerate the growth of trees by reducing the effects of competition. This will shorten the time needed to grow large diameter trees, snags, and large woody debris, which are key components of late-successional forests. In the long-term, the proposed treatments would create and maintain late-successional forest conditions (USDI and USDA 1998).

Precommercial thinning usually occurs when the trees are between ten and 15 years old, the average tree height is from ten to 15 feet, and before the lower branches begin to die. Stands past the optimum precommercial thinning time, which are at risk of growth stagnation, could still be treated to maintain or improve growth rates, manipulate species composition, or spatial arrangement of trees (USDI and USDA 1998).

(3) Fertilization

Fertilization of retained trees could be employed after PCT. The goal of fertilization is to accelerate individual tree and stand growth through improvements to stand nutrition. Fertilization produces larger trees and late-successional conditions faster (USDI and USDA 1998).

(4) Pruning

Pruning in Late-Successional Reserves can reduce the risk of blister rust infection in sugar pine. In young plantations, the mortality risk from blister rust can be reduced by pruning sugar pine trees to a height of ten feet. Pruning eliminates many of the most susceptible infection sites, which are the lower branches and needles.

Pruning in Late-Successional Reserves can also help reduce fuel ladders. Wildfire presents the greatest risk to late-successional habitat within the LSRA area. The majority of risk reducing activities would be aimed at managing fuels and sources of ignition. Pruning to reduce fuel ladders into the canopy would reduce the risk of habitat loss because of fire (USDI and USDA 1998).

(5) Density Management

In the long-term, density management would benefit the creation and maintenance of late-successional forest conditions. Density management would maintain or improve tree diameter growth rates, control crown depth and crown closure, create openings, and recruit snags and coarse woody debris.

Structural diversity would be enhanced by density management. The resultant stand would resemble a late-successional forest due to the variation in density and distribution of overstory and understory vegetation. Improved tree growth rates at lower densities would decrease the amount of time required to develop large diameter trees. Openings created by density management would allow understory development. Unthinned and lightly thinned areas would allow some suppression mortality to continue providing snag and coarse woody debris recruitment. Wide spacing of leave trees and openings would encourage understory vegetation development and contribute to horizontal and vertical structural diversity.

Potential density management usually would occur in stands that have 40 and 50 year old, even-aged, commercial harvest sized trees, a single canopy layer, dominant tree crown ratios of at least 50 percent, high height growth rates, and before the understory trees develop a flat top. Multiple density management treatments in Late-Successional Reserves could be required to maintain the desired stand development trajectory (USDI and USDA 1998).

c. Riparian Reserves

Silvicultural activities in Riparian Reserves would be to control stocking, re-establish and manage stands, and acquire desired vegetation characteristics needed to attain Aquatic Conservation Strategy objectives (USDI 1995). Silvicultural treatments in the Riparian Reserves would restore large conifers (USDI 1995).

In about 60 years, approximately 80 percent of the Riparian Reserves on BLM-administered land would be at least 80 years old (see Table 28 and Map 17). In approximately 80 years, all of the forested Riparian Reserves on BLM-administered land would be at least 80 years old. Approximately four percent of the Riparian Reserves are considered to be nonforested.

Table 28. Percent of Riparian Reserves at Least 80 Years Old on BLM Administered Land in the Lower Cow Creek Watershed (Fifth Field).

Year	2001	2011	2021	2031	2041	2051	2056	2061	2071	2081
Percent	60	60	61	62	64	69	75	80	93	96

(1) Site Preparation, Reforestation, and Maintenance

Regeneration of disturbed areas would be achieved by planting seedlings following site preparation. Some areas may need to be re-planted to meet stocking standards. Site preparation by hand scalping, piling and burning, or prescribed burning may be necessary to reforest an area. Maintenance, protection, and release of individual trees through treatments such as mulching, brush cutting, or animal damage control, may be necessary to ensure survival of the desired number and proportion of trees and species. Reforestation would help meet the ACS objectives.

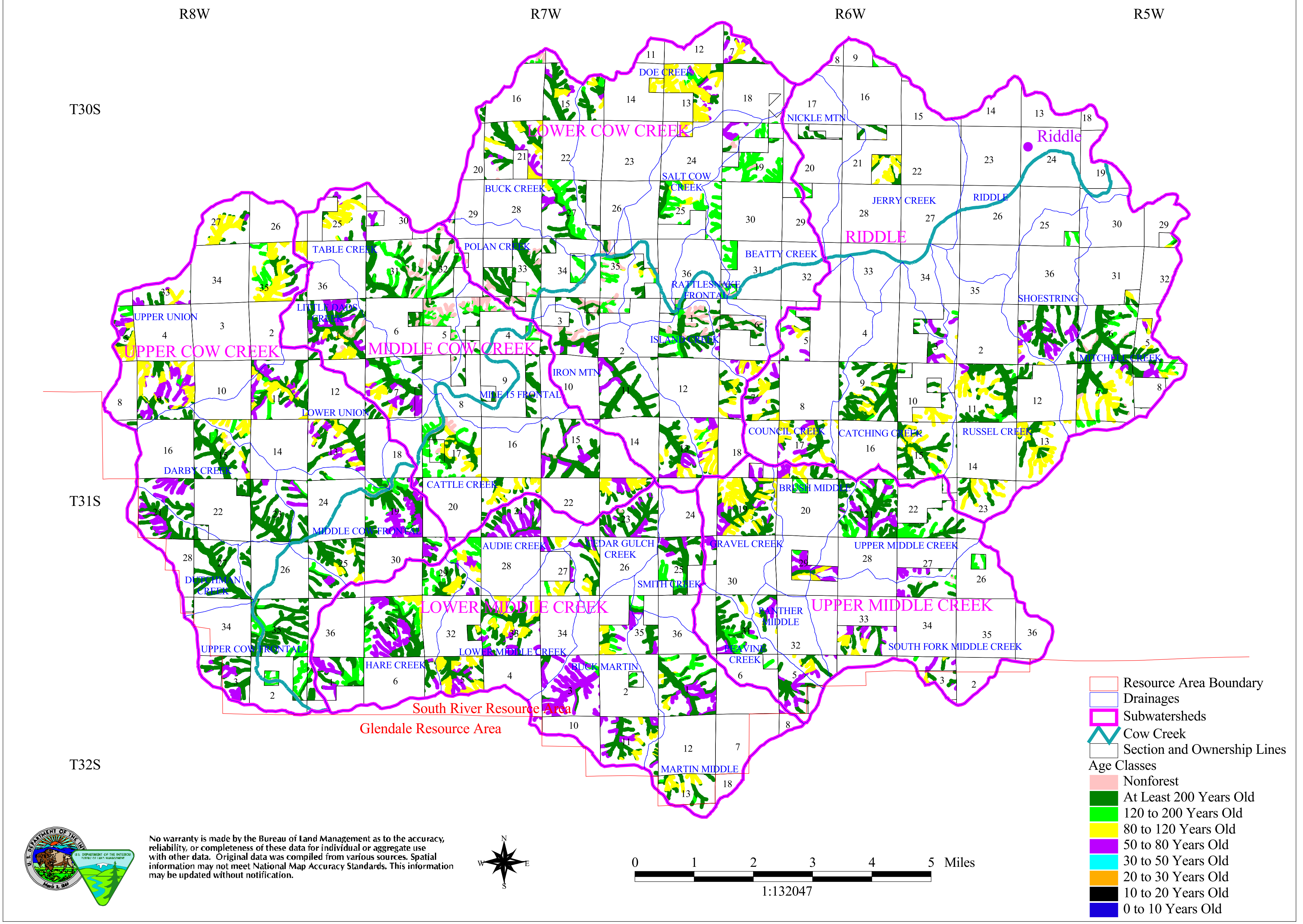
(2) Precommercial Thinning

Precommercial thinning in Riparian Reserves would be consistent with the ACS objectives by accelerating the development of large trees to provide habitat for riparian dependent species and large woody debris. Precommercial thinning maintains stand vigor and controls species composition and stand density. Precommercial thinning usually occurs in stands between five and 15 years old with high tree densities (greater than 400 trees per acre).

(3) Pruning

Pruning in Riparian Reserves can reduce the risk of blister rust infection in sugar pine. In young plantations, the mortality risk from blister rust can be reduced by pruning sugar pine trees to a height

Map 17. Lower Cow Creek Watershed Analysis Unit
Riparian Reserve Age Class Distribution in 2061



of ten feet. Pruning eliminates the most susceptible infection sites, which are the lower branches and needles.

Pruning in Riparian Reserves can also help reduce fuel ladders. Wildfire presents the greatest risk to late-successional habitat in the WAU. The majority of risk reducing activities would be aimed at managing fuels and sources of ignition. Pruning to reduce fuel ladders into the canopy would reduce the risk of habitat loss because of fire.

(4) Density Management

One ACS objective is to maintain and restore species composition and structural diversity of plant communities in riparian zones. Another objective is to maintain and restore habitat to support well distributed populations of native riparian dependent species (USDI 1995). Density management can help develop structural diversity characteristics of late-successional habitat including larger diameter trees, large down wood, canopy gaps for understory development, multi-storied stands, and hardwoods for species diversity. Thinned portions of the Riparian Reserves would develop large trees to provide long-term structure and coarse woody debris. Unthinned areas would provide the short-term coarse woody debris through suppression mortality.

Single story conifer stands generally would not develop into multi-storied stands without some kind of disturbance. Shade-tolerant conifers like grand fir, western red cedar, and western hemlock could exist in the understory, but growth would be limited. Regeneration of Douglas-fir and most hardwoods usually occur in stand openings. Mortality caused by suppression and crowding among trees would not provide large snags or logs on the ground because mortality would occur primarily in the smaller trees. Suppression related mortality of hardwoods would decrease the species diversity. Excluding Riparian Reserves from density management would limit tree growth and maintain smaller diameter trees from which snags and down logs would be created.

d. Disease Treatments

Guidelines to prevent the spread of Port-Orford-cedar root disease are listed in the Port-Orford-Cedar Management Guidelines (USDI 1994b). Port-Orford-Cedar Management Guidelines that are being implemented include limiting special use permits to the time of year when the pathogen is least likely to be spread and assessing activities likely to spread the pathogen, such as road maintenance, fire suppression, and silvicultural activities. Roadside sanitation, decommissioning, gating, and rocking roads, restricting the use of water sources and rock quarries suspected of being contaminated with the pathogen, checking water sources and rock quarries for the pathogen, and testing trees for resistance could reduce the spread of the disease to healthy POC. Sanitation, by removing POC adjacent to roads, has the potential to reduce the amount of inoculum. Preliminary tests indicate inoculum levels remain high the first three years following sanitation. Inoculum levels decrease after the third year. Sites could become reinfected if POC seeds back into the site. Decommissioning roads would help reduce the potential of human activities spreading the disease to healthy POC. Gates restricting the amount of traffic may also help reduce disease spread. The type of road surface can also affect sanitation success. Paved roads have the most success in limiting the spread of the disease, followed by gravel roads, then dirt roads. Rocking natural surfaced roads would limit the spread of the disease by reducing the amount of soil sticking to vehicles.

The Lower Cow Creek WAU contains two remote sub-populations of Port-Orford-cedar. The populations in T30S, R6W, Section 9 and T31S, R6W, Section 33 occur the farthest east of any known natural populations of Port-Orford-cedar in Oregon. The Port-Orford-cedar in T30S, R6W, Section 9 are considered to be healthy.

Port-Orford-cedar occurs in the Beatty Creek Research Natural Area (RNA) in T30S, R6W, Section 31. The Beatty Creek population grows as a dominant overstory on unique, relatively dry, serpentine soils. This is different than the usual Port-Orford-cedar growing conditions, which is as a minor overstory species in riparian zone habitats. The Beatty Creek population may be genetically unique from the general Port-Orford-cedar population and may contain highly desirable genotypes. An example may be a potential genetic resistance to Phytophthora lateralis. Another healthy population of Port-Orford-cedar in T30S, R6W, Section 19 is upstream from the RNA. This section is more susceptible to the introduction of Phytophthora lateralis due to the roads in the headwaters of Beatty Creek. Spreading the disease into Section 19 would put the Port-Orford-cedar in the RNA at risk. Closing roads may prevent spreading the disease into Section 19.

2. Fire and Fuels Management

The combined effects of fire suppression, timber harvesting followed by prescribed burning, and occasional wildfires have helped shaped vegetative conditions in the Lower Cow Creek WAU. Discussing these forests in terms of the natural fire regime helps explain why species composition and forest density has changed with human management dating back thousands of years when native Indians set fires as a means of improving areas for foraging. In many forests of the West, years of successful fire suppression have created unnatural fuel accumulations causing fires to be more destructive, burning with greater intensity and in fire regimes where stand replacement fires would rarely occur in a "natural" forest. Forest health has declined in many areas because fire has been excluded. Although, fire suppression has probably had little or no effect on fuel accumulation in the forests west of the Cascade Mountains, where the natural fire regime has a long return interval (with the exception of southwest Oregon where the fire return interval is shorter) (Norris 1990).

Fire suppression during the past 75 years has been successful at minimizing the number of acres burned by wildfires. During this same period, prescribed fire has been used extensively. The pattern of prescribed fire use has evolved in the last 50 years. Originally, prescribed fire was used almost exclusively for reducing fire hazards. More recently the emphasis has shifted to using prescribed fire for site preparation prior to reforestation (Norris 1990).

Treatments of natural fuels may be planned near areas with high recreation use, along heavily traveled road corridors, or in forest stands to reduce the risks of a wildfire, improve habitat of special status species, or improve forest health. Prescribed underburning, pile burning, and manual or mechanical treatments could be used in areas where wildfire exclusion has resulted in natural fuel accumulations considered to be unnatural and wildfire is considered to be a high risk to forest resources. Extensive fuels management treatments are difficult to justify for the sole reason of wildfire risk reduction. Other site specific resource objectives would normally be the basis for prescribing a fuels treatment on natural forest fuels. Prescribed broadcast burning poses risks that in many cases would outweigh potential risk reduction benefits. Prescribed broadcast burning, pile burning, manual or mechanical fuels treatments, or fuels removal would be applied primarily on activity fuels created from timber management operations.

Fire management in the Lower Cow Creek WAU would continue to require an aggressive suppression strategy on all unplanned wildland fires. The Roseburg District Fire Management Plan, prepared June 1998, identified appropriate fire management activities for Matrix, Riparian Reserve, and Late-Successional Reserve Land Use Allocations. The Fire Management Plan also identified three categories of fire management or protection that covers all Land Use Allocations. The fire prevention contract with the Oregon Department of Forestry requires all unplanned wildland fires to be suppressed. Additionally, the initial attack standards are to control 94 percent of all fires before they reach ten acres in size.

VI. Geology, Soils, and Erosion Processes

A. Geology

Most of the Lower Cow Creek WAU is comprised of volcanic and sedimentary rocks within the Klamath Mountains Geomorphic Province. The Klamath Mountains Geomorphic Province has a complex mineralogy and is conducive to mining activities. A portion of this WAU is located within the Coast Range Geomorphic Province.

The Lower Cow Creek WAU contains the oldest formations (Mesozoic and Jurassic age) in Douglas County. The southern part of the WAU is mainly composed of one sedimentary rock formation (KJds), while the geology in the north half is more diverse. The Lower Cow Creek WAU appears to have been formed through large faults, uplifting processes, and earth movement that dictated tributary water flow. Contact zones between geologic formations can exhibit excess surface and groundwater delivery and cause earth flows. The Lower Cow Creek WAU is characterized by deeply weathered sandstone creating steep canyons with slopes averaging approximately 60 percent.

Geology of the WAU is shown on Map 18. Unit descriptions are from the Geologic Map of Oregon by George W. Walker and Norman S. MacLeod (1991).

Jop

Otter Point Formation of Dott (1971) and related rocks (Upper Jurassic) - Highly sheared graywacke, mudstone, siltstone, and shale with lenses and pods of sheared greenstone, limestone, chert, blueschist, and serpentine.

Ju

Ultramafic and related rocks of ophiolite sequences (Jurassic) - Predominantly harzburgite and dunite with both cumulate and tectonite fabrics. Locally altered to serpentinite. Includes gabbroic rocks and sheeted diabasic dike complexes.

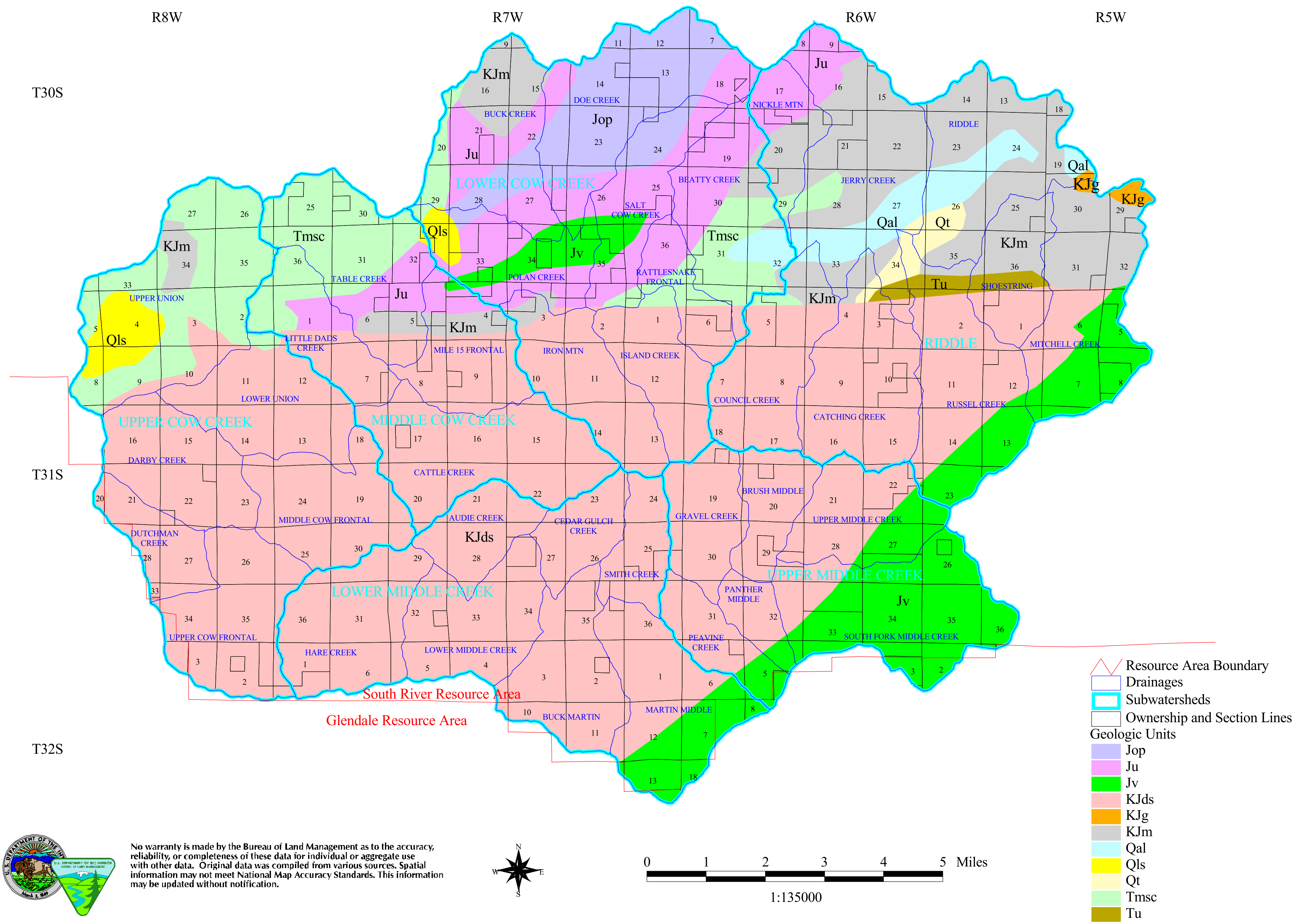
Jv

Volcanic rocks (Jurassic) - Lava flows, flow breccia, and agglomerate dominantly of plagioclase, pyroxene, and hornblende porphyritic and aphyric andesite. Includes flow rocks that range in composition from basalt to rhyolite as well as some interlayered tuff and tuffaceous sedimentary rocks. Commonly metamorphosed to greenschist facies; locally foliated, schistose or gneissic.

KJds

Dothan Formation and related rocks (Lower Cretaceous and Upper Jurassic) - Sedimentary rocks - Sandstone, conglomerate, graywacke, rhythmically banded chert lenses.

Map 18. Lower Cow Creek Watershed Analysis Unit
Geology



KJg

Granitic rocks (Cretaceous and Jurassic) - Mostly tonalite and quartz diorite but including lesser amounts of other granitoid rocks.

KJm

Myrtle Group (Lower Cretaceous and Upper Jurassic) - Conglomerate sandstone, siltstone, and limestone. Locally fossiliferous.

Qal

Alluvial deposits (Holocene) - Sand, gravel, and silt forming flood plains and filling channels of present streams. In places includes talus and slope wash. Locally includes soils containing abundant organic material and thin peat beds.

Qls

Landslide and debris-flow deposits (Holocene and Pleistocene) - Unstratified mixtures of fragments of adjacent bedrock. Locally includes slope wash and colluvium.

Qt

Terrace, pediment, and lag gravels (Holocene and Pleistocene) - Unconsolidated deposits of gravel, cobbles, and boulders intermixed and locally interlayered with clay, silt, and sand. Mostly on terraces and pediments above present flood plains. Locally fossiliferous.

Tmsc

Marine siltstone, sandstone, and conglomerate (lower Eocene) - Cobble and pebble conglomerate, pebbly sandstone, lithic sandstone, siltstone, and mudstone; massive to thin bedded; shelf and slope depositional setting.

Tu

Undifferentiated tuffaceous sedimentary rocks, tuffs, and basalt (Miocene and Oligocene) - Heterogeneous assemblage of continental, largely volcanogenic deposits of basalt and basaltic andesite, including flows and breccia, complexly interstratified with epiclastic and volcaniclastic deposits of basaltic to rhyodacitic composition.

B. Soils

Historic and Current Conditions

The main sources of information for the soils section are the National Cooperative Soil Survey (NCSS) of Douglas County, conducted by the Natural Resources Conservation Service (NRCS), and the Timber Production Capability Classification (TPCC) conducted by the Bureau of Land Management. Interpretations for most of the chemical and physical soil characteristics are included in the NCSS. Tables and maps built from NCSS data include information on private and BLM-administered lands. Tables and maps built from TPCC data include information only on BLM-administered lands.

Soils in the Lower Cow Creek WAU have developed dominantly from metamorphosed sedimentary, igneous, and volcanic parent materials mostly in the Klamath Mountains Geomorphic Province. The Klamath Mountains Geomorphic Province is an area of complex geology and rugged topography. The northwest portion of the WAU (headwaters of Union, Manzanita, Live Oak, and Table creeks) developed from marine siltstone, sandstone, and conglomerates in the Coast Range Geomorphic Province. The Coast Range Geomorphic Province consists of sub-marine lavas and marine sediments. It is less deformed than the Klamath Mountains Geomorphic Province and has slightly less relief.

Soils are influenced by five soil forming factors consisting of climate (hot, cold, wet, dry), geologic parent material (the rocks and minerals which soil is made from), topography (aspect, slope, elevation, and landforms), biological (vegetation and animals), and time (interaction of the four previous properties to develop soil types). Human influence could be considered the sixth soil forming factor. Management actions can affect soil depth, structure, organic matter content, texture, pH, infiltration, permeability, and drainage properties. These soil properties can be improved or degraded depending on the type and degree of management.

Human influences started affecting the Lower Cow Creek WAU before the 1700s. Native Americans used fire to burn grass in the valleys and lower hill sides. They also set many small fires in portions of the upland forests (Boyd 1899). Cooler burning fires affect the soil less than fires that burn under hot, dry, and windy conditions. Hot fires may burn organic matter, destroy the soil food web complexity contained in the upper soil layers, and remove the protective vegetative cover.

European-Americans began settling in the WAU around 1850. They were in search of gold and land for farming. Placer mining on the slopes above Cow Creek extracted gold from gravel terrace deposits in the 1890s. Ditches were constructed to supply water to hydraulic hoses that would wash the soil and gold bearing gravels into sluice boxes. Scars are still visible from this type of mining due to a lack of top soil, organic matter, and nutrient base.

Grain and fruit crops were important until the 1930s, then sheep and cattle grazing became more prominent. The Cow Creek Valley was considered to be very fertile and easy to farm (Riddle 1964).

Removing vegetation from hillsides, along creeks and streams, and heavy grazing increases soil compaction, surface erosion, and runoff.

Extensive timber harvesting in the WAU began during the 1950s. Roads were constructed to transport logs to the lumber mills. Ground based timber harvesting (pulling logs along the ground behind horses, oxen, or tractors) is generally the most economical way to transport trees to the road. Soil compaction and displacement can occur with this type of harvesting. Ground based harvesting generally occurs on slopes less than 45 percent. A little more than half of the Lower Cow Creek WAU has slopes less than 45 percent. Improvements in logging system technology has generally reduced the soil impacts.

a. General Soil Groups as Defined by Parent Material

The NCSS of Douglas County was used to group soils by parent material type (see Map 19 and Appendix J). The soil characteristics, qualities, and properties are described. The main soil parent material types in the WAU are the metamorphic and the sandstone, siltstone, and metamorphic groups. These two groups cover about 75 percent of the WAU. They exhibit high relief and are rocky. Granitic soils make up a minor part of the WAU. Serpentine soils cover about six percent of the WAU. Soils tend to weather deeper in areas that have stable landscapes and higher precipitation. North aspects tend to have deeper soils due to more moist conditions (reduced drainage class) which favor deeper weathering. Shallow soils are generally found on narrow ridge tops and shoulders or along steep canyon sides. Shallow soils occur along Darby Creek and in the area between Table Creek and Smith Creek. Shallow soils and rock outcrop occur along Cow Creek from Table Creek to Beatty Creek. Clayey textured soils occur mainly in the northern third of the WAU. Loamy textured soils occur mainly in the southern portion of the WAU. Sandy textured soils are found to a limited extent along the lower seven miles of Cow Creek in the flood plain. Crop and pasture lands occur mainly in the flat mixed alluvial areas bordering the lower portions of Cow Creek.

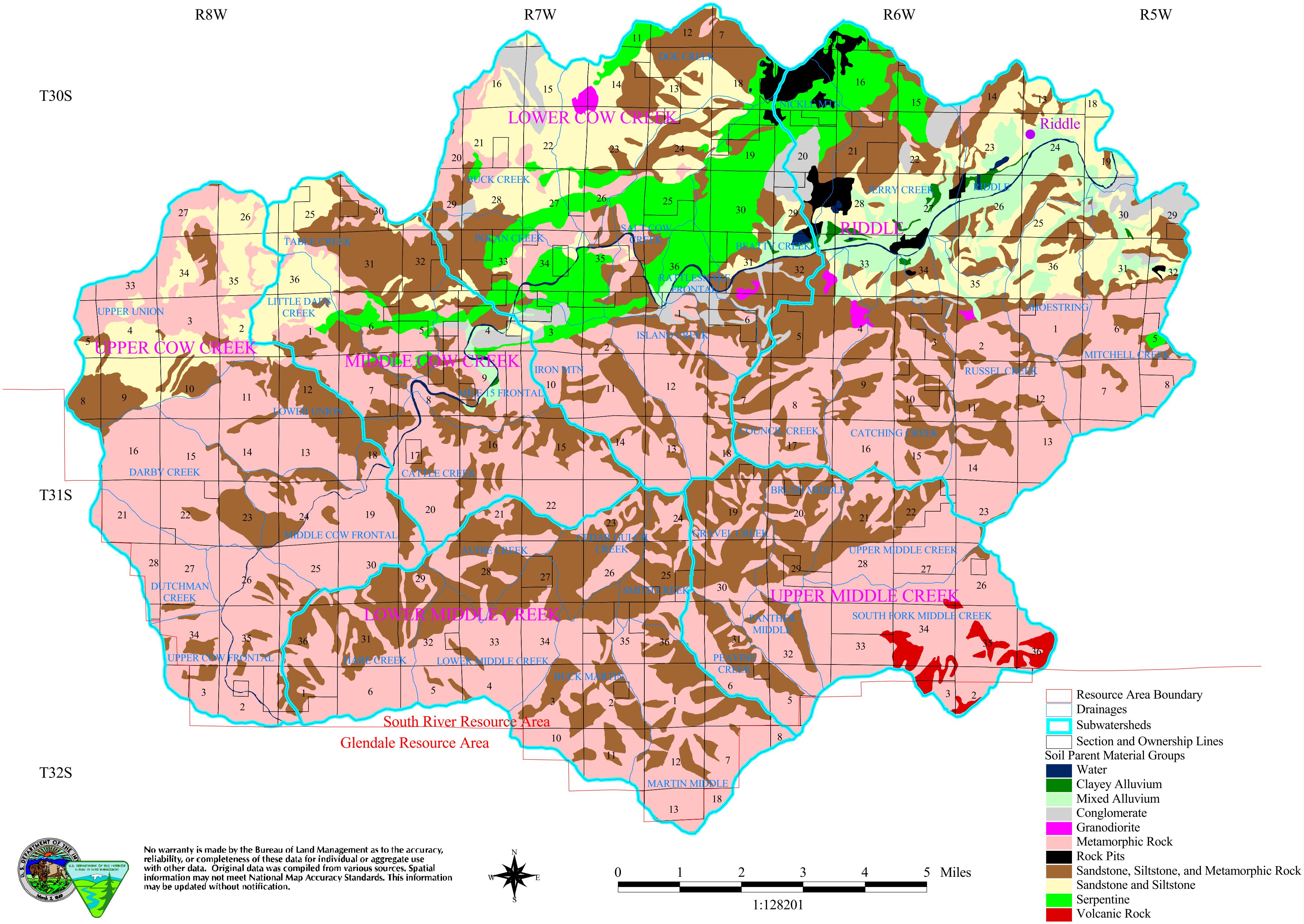
(1) Clayey Alluvium

The clayey alluvium parent material covers less than one percent of the WAU. They are found on intermediate floodplains, low terraces and old meander channels along the lower seven miles of Cow Creek. Soil depths average greater than 60 inches to bedrock. Clayey alluvium soils are poorly drained with an average subsoil clay content of 46 percent. These soils are hydric (wet) and rarely flood in years with average precipitation. Soil permeability is low, resulting in a high potential for surface runoff.

(2) Mixed Alluvium

Mixed alluvium parent materials cover about three percent of the WAU. They occur mostly on low and high floodplains and low terraces along the lower reaches of Cow Creek. Soils depths average greater than 60 inches to bedrock. These soils are well drained with an average subsoil clay content

Map 19. Lower Cow Creek Watershed Analysis Unit
Soil Parent Material Groups



of 26 percent. Soil permeability is moderate and the surface runoff potential is moderate. Stream bank erosion is possible along cut bank meanders. Very fine sandy loam subsurface textures are highly erosive. These soils were deposited by higher stream flows than the clayey alluvium. The soils occur in an area with little elevation differences. Flooding occurs during average climate conditions along the present floodplain and low terraces of Cow Creek. Less frequent flooding occurs on the higher terraces. The majority of prime farmland (areas capable of producing sustained high yield crops) is found in these soils.

(3) Conglomerate

Conglomerate parent materials cover about two percent of the WAU. These soils are located on lower hills above the lower 15 miles of Cow Creek. Soil depths average 27 inches to hard bedrock. Conglomerate soils are well drained with an average subsoil clay content of 18 percent. High rock fragment content can occur on the surface and in the subsoil. Soil permeability is moderately rapid and the surface runoff potential is low.

(4) Granodiorite

Granodiorite parent materials cover less than one percent of the WAU. They occur in upland and mountainous areas in isolated spots in the northern third of the WAU. Soil depths average 58 inches to soft bedrock. These soils are well drained with an average subsoil clay content of 34 percent. Soil permeability is moderate and the surface runoff potential is moderately high. Bare soil erodibility is high.

(5) Metamorphic Parent Material

Metamorphic parent materials cover about 46 percent of the WAU. They occur on upland hill slopes, located in a large block in the southern portion of the WAU. Soil depths average 37 inches to hard bedrock. These soils are well drained with an average subsoil clay content of 27 percent. Soil permeability is moderately rapid and the surface runoff potential is moderately high.

(6) Sandstone and Siltstone

Sandstone and siltstone parent materials cover about eleven percent of the WAU. They occur on upland hill slopes, alluvial fans, and toe slopes in the northern third of the WAU. Soil depths average 43 inches to hard and soft bedrock. These soils are well drained with an average subsoil clay content of 40 percent. Soil permeability is moderate and the surface runoff potential is moderate to moderately high. Bare soil erodibility is high.

(7) Sandstone, Siltstone, and Metamorphic Rock

Sandstone, siltstone, and metamorphic rock parent materials cover about 29 percent of the WAU. They occur on hill slopes mainly in the southern portion of the WAU. These soils are associated with the metamorphic parent material group. Soil depths average 46 inches to hard and soft bedrock. These soils are well drained with an average subsoil clay content of 33 percent. Soil permeability is moderate and the surface runoff potential is moderate.

(8) Serpentine

Serpentine parent materials cover about six percent of the WAU. These soils are found on hill slopes in the north central portion of the WAU. Soil depths average 28 inches to hard bedrock. These soils are well drained and have an average subsoil clay content of 45 percent. Soil permeability is slow and surface runoff potential is moderately high. A nickel mine is located at the northern end of the serpentine soils. Nickel is formed by the decomposition and enrichment of serpentine.

(9) Volcanic Rock

Volcanic rock parent materials cover less than one percent of the WAU. They occur on ridges and mountain slopes in the southeastern portion of the WAU and mainly above 2,000 feet in elevation. Soil depths average 48 inches to hard bedrock. These soils are well drained with an average subsoil clay content of 20 percent. Soil permeability is moderately rapid and the surface runoff potential is moderate.

b. National Cooperative Soil Survey (NCSS) Information

The main soils related properties considered to be of concern for planning and analysis are hydric, floodplain, somewhat poorly drained, conglomerate, serpentine, granitic, and prime farmland soils (see Table 29 and Map 20).

(1) Prime Farmland Soils

Prime farmland has the combination of soil properties, low slope gradient, growing season, and moisture supply to produce sustained high crop yields. The Farmland Protection Policy Act, published in the Federal Register, Vol. 43, No. 21, January 31, 1978, directs federal agencies to identify and take into account the adverse effects of federal programs on the preservation of prime farmland.

(2) Floodplain Soils

Floodplain management objectives on BLM-administered lands include reducing the risk of flood loss or damage to property, minimizing the impact of flood loss on human safety, health, and welfare, and restoring, maintaining, and preserving the natural and beneficial functions of floodplains. These objectives originate from Executive Order 11988, Floodplain Management, Section 1, May 24, 1977.

(3) Somewhat Poorly Drained (SWP) Soils

Somewhat poorly drained soils usually have a seasonal high water table within 18 inches of the soil surface. These soil types are frequently associated with riparian areas and areas with slope stability problems. Timber is more susceptible to windthrow on these soils.

(4) Somewhat Poorly Drained - Floodplain Soils

There are approximately 222 acres of somewhat poorly drained - floodplain soils on private land in the WAU. Bureau of Land Management administered land in the WAU does not have any soils classified as somewhat poorly drained - floodplain.

(5) Hydric Soils

Hydric soils generally have a watertable within ten inches of the soil surface for at least five percent of the growing season. The current definition of a hydric soil from the NRCS is "a soil that is sufficiently wet in the upper part to develop anaerobic conditions during the growing season." These areas have the greatest potential to be classified as wetlands. Hydric or wet soil areas too small for mapping (NCSS standards <5 acres) exist as minor components within areas mapped as somewhat poorly drained.

(6) Hydric - Floodplain Soils

There are approximately 141 acres of hydric - floodplain soils on private land and five acres on BLM-administered land in the WAU.

(7) Serpentine Soils

Serpentine soils may contain high amounts of magnesium, chromium, cobalt, nickel, or iron. These soils may also have low amounts of nitrogen, phosphorus, potassium, and molybdenum. Productivity of Douglas-fir is poor. However, grasses grow rapidly. Conversion from native forest vegetation to other commercial forest types is difficult. Serpentine areas are usually associated with geologic contact zones, indicating an increase in the amount of groundwater present and decreased slope stability.

(8) Somewhat Poorly Drained - Serpentine Soils

There are approximately 401 acres of somewhat poorly drained - serpentine soils on private land and 39 acres on BLM-administered land in the WAU.

(9) Granitic Soils

Granitic soils are highly susceptible to surface erosion and shallow slope failure. They have low organic carbon reserves and are not very resilient. Resiliency is the ability of a soil to recover from a disturbance, whether it is natural or human caused. Management options on these soils are reduced.

Approximately 26 acres of the granitic soils on BLM-administered land occur on slopes greater than 35 percent. These soils are classified as Category 1 soils, as defined in Monitoring Western Oregon Records of Decision (USDI 1988).

(10) Conglomerate Soils

Conglomerate soils tend to weather rapidly and unevenly when exposed. Slope stability is unpredictable because of parent material and cementing agent variability. Dry ravel erosion may occur on steep slopes producing high coarse fragment content on the surface and in the soil. Droughtiness, seedling mortality, road maintenance needs, and sediment potential increase as dry ravel increases.

Table 29. Soil Management Concerns Within the Lower Cow Creek WAU.

Drainage **Subwatershed**	Acres of Prime Farmland Soils		Acres of Floodplain Soils		Acres of Somewhat Poorly Drained Soils		Acres of Somewhat Poorly Drained - Floodplain Soils		Acres of Hydric Soils		Acres of Hydric - Floodplain Soils		Acres of Serpentine Soils		Acres of Somewhat Poorly Drained - Serpentine Soils		Acres of Granitic Soils		Acres of Conglomerate Soils	
	BLM	Private	BLM	Private	BLM	Private	BLM	Private	BLM	Private	BLM	Private	BLM	Private	BLM	Private	BLM	Private	BLM	Private
Catching Creek	20	109	0	47	0	0	0	0	0	0	0	5	0	0	0	0	0	5	0	13
Council Creek	0	85	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	90	16	0
Jerry Creek	0	697	0	393	0	48	0	104	0	114	0	35	11	594	0	234	0	0	0	226
Mitchell Creek	0	209	0	31	2	76	0	0	0	67	0	0	40	0	0	0	0	1	1	374
Nickle Mountain	0	1	0	0	0	0	0	1	0	6	0	0	60	438	0	0	0	0	29	229
Riddle	0	841	0	588	0	385	0	80	0	151	0	64	0	0	0	0	0	0	0	61
Russell Creek	0	136	0	23	0	0	0	0	0	0	0	0	0	0	0	0	0	19	16	6
Shoestring	0	116	0	18	3	69	0	0	0	0	0	0	0	0	0	0	0	0	0	9
Riddle Subwatershed	20	2,193	0	1,104	5	578	0	184	0	338	0	104	111	1,032	0	234	0	114	62	918
Beatty Creek	0	115	0	29	0	0	0	38	0	19	0	0	517	763	0	36	0	33	60	254
Buck Creek	0	0	0	0	141	58	0	0	0	0	0	0	163	23	23	12	0	0	145	253
Doe Creek	0	0	0	0	0	5	0	0	0	0	0	0	18	503	0	0	32	50	1	0
Iron Mountain	0	10	0	0	0	0	0	0	0	0	0	0	114	42	4	18	0	0	72	55
Island Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	57	1
Polan Creek	0	5	0	4	0	0	0	0	0	0	0	0	594	353	8	52	0	0	17	31
Rattlesnake Frontal	2	23	2	0	0	0	0	0	0	0	5	5	9	388	0	0	0	0	112	86
Salt Cow Creek	0	0	2	4	10	38	0	0	0	0	0	11	289	484	2	26	0	0	13	10
Lower Cow Creek Subwatershed	2	153	4	37	151	101	0	38	0	19	5	16	1,703	2,556	37	144	32	83	476	689

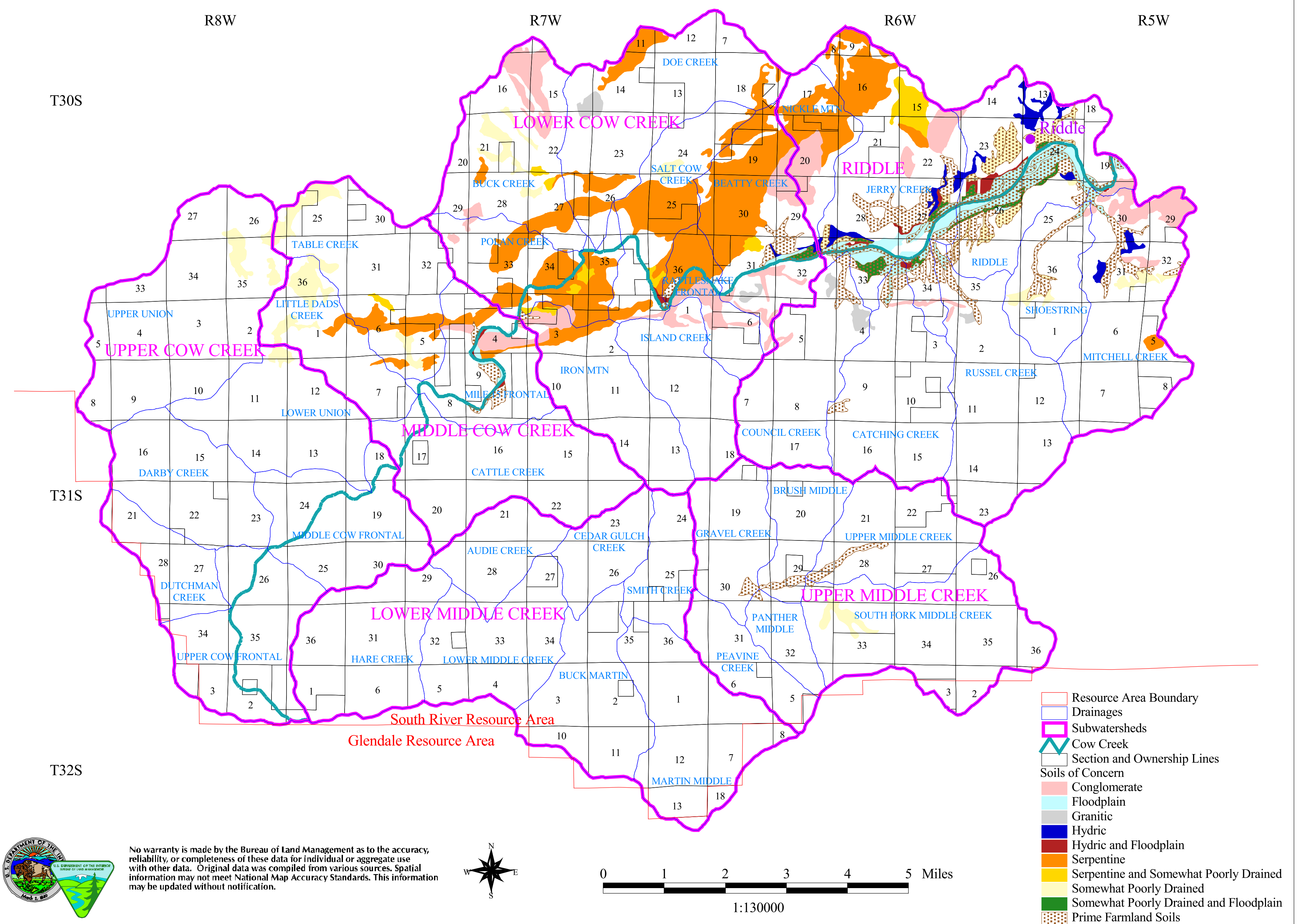
Table 29. Soil Management Concerns Within the Lower Cow Creek WAU.

Drainage **Subwatershed**	Acres of Prime Farmland Soils		Acres of Floodplain Soils		Acres of Somewhat Poorly Drained Soils		Acres of Somewhat Poorly Drained - Floodplain Soils		Acres of Hydric Soils		Acres of Hydric - Floodplain Soils		Acres of Serpentine Soils		Acres of Somewhat Poorly Drained - Serpentine Soils		Acres of Granitic Soils		Acres of Conglomerate Soils	
	BLM	Private	BLM	Private	BLM	Private	BLM	Private	BLM	Private	BLM	Private	BLM	Private	BLM	Private	BLM	Private	BLM	Private
Cattle Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little Dads Creek	0	0	0	0	58	198	0	0	0	0	0	0	44	22	0	0	0	0	0	0
Mile 15 Frontal	0	109	2	38	0	0	0	0	0	0	0	21	35	92	0	0	0	0	19	137
Table Creek	0	0	0	0	75	210	0	0	0	0	0	0	100	189	2	23	0	0	1	0
Middle Cow Creek Subwatershed	0	109	2	38	133	408	0	0	0	0	0	21	179	303	2	23	0	0	20	137
Darby Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dutchman Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lower Union	0	0	0	0	17	38	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Middle Cow Frontal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Cow Frontal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Union	0	0	0	0	143	34	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Cow Creek Subwatershed	0	0	0	0	160	72	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 29. Soil Management Concerns Within the Lower Cow Creek WAU.

Drainage **Subwatershed**	Acres of Prime Farmland Soils		Acres of Floodplain Soils		Acres of Somewhat Poorly Drained Soils		Acres of Somewhat Poorly Drained - Floodplain Soils		Acres of Hydric Soils		Acres of Hydric - Floodplain Soils		Acres of Serpentine Soils		Acres of Somewhat Poorly Drained - Serpentine Soils		Acres of Granitic Soils		Acres of Conglomerate Soils	
	BLM	Private	BLM	Private	BLM	Private	BLM	Private	BLM	Private	BLM	Private	BLM	Private	BLM	Private	BLM	Private	BLM	Private
Audie Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Buck Martin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cedar Gulch Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hare Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lower Middle Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Martin Middle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smith Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lower Middle Creek Subwatershed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brush Middle	27	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gravel Creek	0	36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Panther Middle	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peavine Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
South Fork Middle Creek	8	0	0	0	6	113	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Middle Creek	26	65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Middle Creek Subwatershed	61	136	0	0	6	113	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lower Cow Creek WAU	82	2,590	6	1,178	455	1,271	0	222	0	357	5	141	1,993	3,890	39	401	32	198	558	1,744

Map 20. Lower Cow Creek Watershed Analysis Unit
Soil Management Concerns



c. Timber Production Capability Classification (TPCC) Information, Fragile Sites

Soil related data for planning and analysis, using the Timber Production Capability Classification (TPCC), are the Fragile-Suitable and Fragile-Nonsuitable Classifications (see Table 30 and Map 21). Timber Production Capability Classification Fragile sites refer to those areas where the timber growing potential may be reduced due to inherent soil properties and landform characteristics. The TPCC groups sites into Fragile-Suitable and Fragile-Nonsuitable for timber production classifications. Fragile-Suitable sites have the potential for unacceptable soil productivity losses as a result of forest management activities unless mitigating measures are applied to protect the soil/site productivity (see Best Management Practices, Appendix D, Roseburg District Resource Management Plan, USDI 1995). Fragile-Nonsuitable sites are considered to be unsuitable for timber production and are classified as Nonsuitable Woodland. Table 30 lists the number of acres in each classification on BLM-administered land within the WAU.

(1) Soil Moisture (FS)

Soils on these sites are typically moisture deficient due to soil physical characteristics. These sites are not considered moisture deficient due to competing vegetation or annual precipitation.

(a) Suitable (FSR)

Soils on these sites typically have loamy textures with high amounts of coarse fragments. They generally have between one and one and a half inches of available water holding capacity in the top twelve inches of soil.

(b) Nonsuitable (FSNW)

Soils on these sites typically have textures that are skeletal or fragmental (greater than 35 percent rock fragment content). They have less than one inch of available water holding capacity in the top 12 inches of soil.

(2) Slope Gradient (FG)

These sites have steep to extremely steep slopes with a high potential for debris type landslides. Gradients commonly range from 60 to more than 100 percent. Classifications are based on geology, geomorphology, physiographic position, climate (especially precipitation), and soil types.

(a) Suitable (FGR)

These sites are less fragile than the nonsuitable areas. Unacceptable soil and organic matter losses may occur from mass soil movement as a result of forest management activities unless mitigating measures (Best Management Practices) are used to protect the soil/growing site. This soil classification occurs in all of the subwatersheds.

(b) Nonsuitable (FGNW)

Unacceptable soil and organic matter losses could occur from mass soil movement as a result of forest management activities. These losses cannot be mitigated even using Best Management Practices.

(3) Mass Movement Potential (FP)

These sites consist of deep seated, slump, or earth flow types of mass movements with undulating topography and slope gradients generally less than 60 percent.

(a) Suitable (FPR)

These sites may contain soil tension cracks and/or sag ponds. Trees on these sites may be curved at the butt or along the stem. Forest management is feasible on these sites since the movement rate is slow.

(b) Nonsuitable (FPNW)

These sites have active, deep-seated slump-earthflow types of mass movements. They include areas where the soils have been removed and do not produce commercial forest stands. The rate of movement may result in jackstrawed trees. Forest management is not feasible on these sites due to the movement rate. These sites with this classification type are usually small in size.

(4) Nutrient (FN)

Soils on these sites are inherently low in nutrients or have a nutrient imbalance that inhibits tree growth.

(a) Suitable (FNR)

Forest management activities would not reduce site productivity below the threshold considered to be commercial forest land (20 cubic feet per acre per year).

(b) Nonsuitable (FNNW)

Forest management activities could reduce site productivity below the threshold considered to be commercial forest land of 20 cubic feet per acre per year.

(5) Groundwater (FW)

These soils contain water at or near the soil surface for sufficient periods of time that vegetation survival and growth are affected.

(a) Suitable (FWR)

Conifer production is usually limited because the groundwater is close to the surface. Soils typically have high chroma mottles close to the surface. These sites may support water tolerant species. Depth to the water table, subsurface flow, or duration of the groundwater is usually altered when a site is disturbed but the productivity loss is considered to be acceptable. Forest management activities would not reduce site productivity below the threshold considered to be commercial forest land of 20 cubic feet of wood production per acre per year or cause noncommercial forest land to be converted to nonforest land.

(b) Nonsuitable (FWNW)

Water tolerant tree and understory species grow on these sites. Commercial conifer survival and productivity are severely limited because groundwater is close to the surface. Soils typically have dark colored surface horizons and low chroma mottles at or near the surface. Depth to the water table, subsurface flow, or duration of the groundwater is altered when a site is disturbed resulting in unacceptable productivity losses and/or the loss of water tolerant tree species. Forest management activities could reduce site productivity below the threshold considered to be commercial forest land of 20 cubic feet of wood production per acre per year or cause noncommercial forest land to be converted to nonforest land. Sites with this classification do not occur in the Lower Cow Creek WAU.

(6) Non Forest Rockland (NR)

These sites are not capable of producing commercial trees at greater than 20 cubic feet of wood per acre per year due to the presence of rock outcrops and shallow soils.

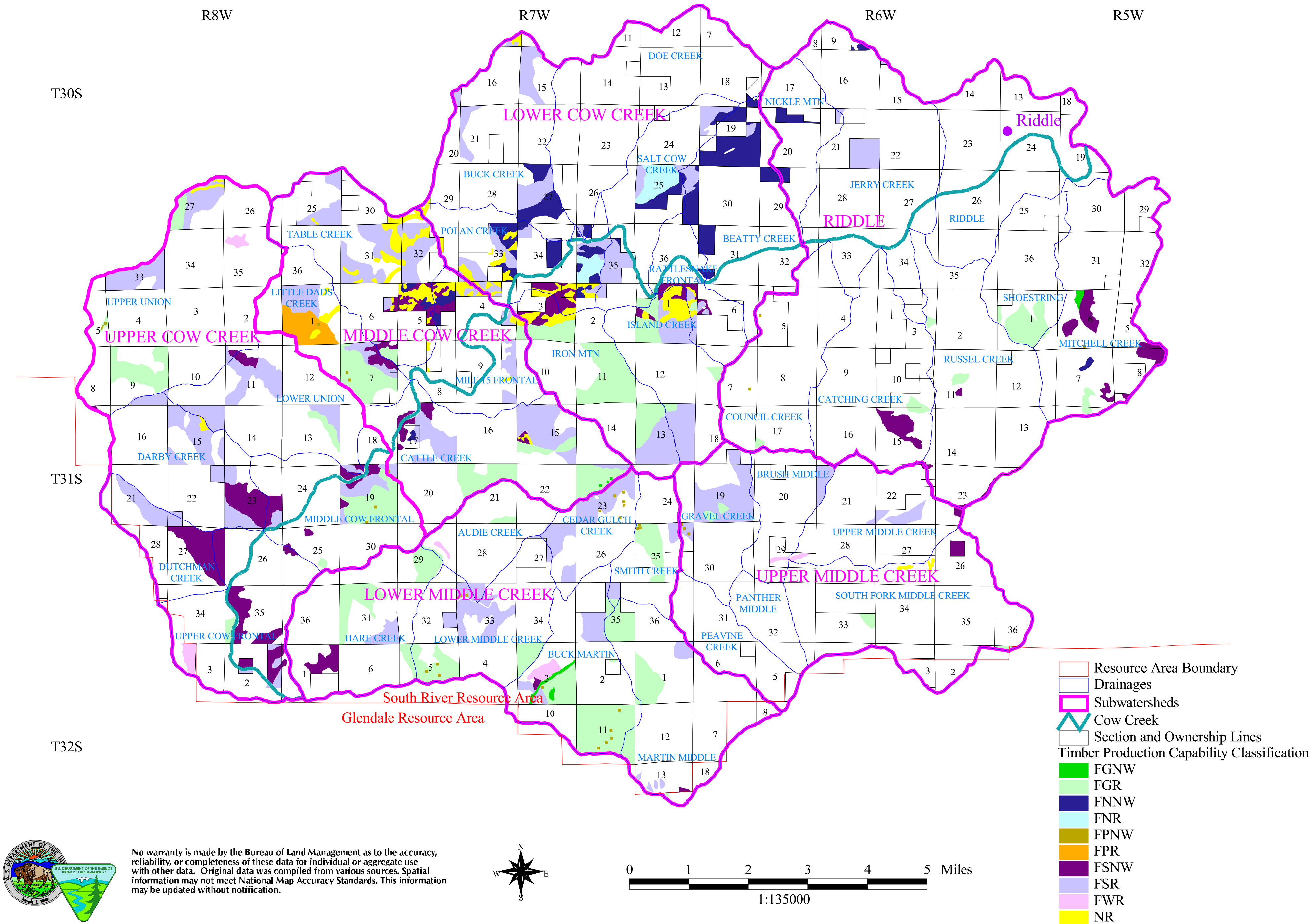
Table 30. Acres of Fragile Site Classifications on BLM Administered Lands From the Timber Production Capability Classification.

Drainage **Subwatershed**	**Fragile Soil Moisture Restrictive (FSR)**	**Fragile Soil Moisture Nonsuitable Woodland (FSNW)**	**Fragile Gradient Restrictive (FGR)**	**Fragile Gradient Nonsuitable Woodland (FGNW)**	**Fragile Mass Movement Potential Restrictive (FPR)**	**Fragile Mass Movement Potential Nonsuitable Woodland (FPNW)**	**Fragile Nutrient Restrictive (FNR)**	**Fragile Nutrient Nonsuitable Woodland (FNNW)**	**Fragile Groundwater Restrictive (FWR)**	**Non Forest Rockland (NR)**
Catching Creek	88	133	41	0	0	0	0	0	0	0
Council Creek	0	0	44	0	0	2	0	0	0	0
Jerry Creek	183	0	12	0	0	0	0	14	0	0
Mitchell Creek	0	233	272	18	0	1	0	15	0	0
Nickle Mountain	17	0	0	0	0	0	0	160	0	0
Russell Creek	0	48	746	0	0	0	0	0	0	0
Shoestring	0	0	247	0	0	0	0	0	0	0
Riddle Subwatershed	**288**	**414**	**1,363**	**18**	**0**	**3**	**0**	**189**	**0**	**0**
Beatty Creek	101	774	0	0	0	0	0	0	0	0
Buck Creek	441	0	0	0	0	0	0	275	0	58
Doe Creek	304	0	0	0	0	0	0	518	0	0
Iron Mountain	1,906	129	801	0	0	0	0	0	0	158
Island Creek	820	197	1,441	0	0	0	0	0	0	156
Polan Creek	841	159	0	0	0	0	0	0	0	355
Rattlesnake Frontal	219	136	77	0	0	0	0	206	0	596
Salt Cow Creek	524	11	0	0	0	0	287	263	0	12
Lower Cow Creek Subwatershed	**5,155**	**1,406**	**2,319**	**0**	**0**	**0**	**287**	**1,261**	**0**	**1,335**
Cattle Creek	1,742	83	670	3	0	2	0	9	0	9
Little Dads Creek	273	75	386	0	241	3	0	0	0	40
Mile 15 Frontal	792	134	65	0	0	0	0	60	0	300
Table Creek	776	281	35	0	0	0	0	75	0	406
Middle Cow Creek Subwatershed	**3,583**	**572**	**1,155**	**3**	**241**	**5**	**0**	**145**	**0**	**755**

Table 30. Acres of Fragile Site Classifications on BLM Administered Lands From the Timber Production Capability Classification.

Drainage **Subwatershed**	**Fragile Soil Moisture Restrictive (FSR)**	**Fragile Soil Moisture Nonsuitable Woodland (FSNW)**	**Fragile Gradient Restrictive (FGR)**	**Fragile Gradient Nonsuitable Woodland (FGNW)**	**Fragile Mass Movement Potential Restrictive (FPR)**	**Fragile Mass Movement Potential Nonsuitable Woodland (FPNW)**	**Fragile Nutrient Restrictive (FNR)**	**Fragile Nutrient Nonsuitable Woodland (FNNW)**	**Fragile Groundwater Restrictive (FWR)**	**Non Forest Rockland (NR)**
Darby Creek	1,675	1,245	0	0	0	0	0	0	0	14
Dutchman Creek	195	324	1	0	0	0	0	0	0	0
Lower Union	1,126	104	56	0	723	0	0	0	0	43
Middle Cow Frontal	280	374	494	0	0	3	0	0	0	0
Upper Cow Frontal	238	601	31	0	0	0	0	0	61	0
Upper Union	712	51	336	0	0	2	0	0	33	17
Upper Cow Creek Subwatershed	**4,226**	**2,699**	**919**	**0**	**723**	**5**	**0**	**0**	**94**	**74**
Audie Creek	239	0	0	0	0	0	0	0	12	0
Buck Martin	212	10	2,187	0	0	6	0	0	69	0
Cedar Gulch Creek	466	0	760	0	0	6	0	0	0	0
Hare Creek	94	90	0	0	0	0	0	0	0	0
Lower Middle Creek	749	3	0	0	0	6	0	0	0	0
Martin Middle	484	7	882	0	0	0	0	0	0	0
Smith Creek	116	0	325	0	0	3	0	0	0	0
Lower Middle Creek Subwatershed	**2,361**	**110**	**4,154**	**0**	**0**	**21**	**0**	**0**	**81**	**0**
Brush Middle	723	0	0	0	0	0	0	0	27	0
Gravel Creek	891	0	31	0	0	3	0	0	0	0
Peavine Creek	58	0	0	0	0	0	0	0	0	0
South Fork Middle Creek	0	40	42	0	0	0	0	0	27	18
Upper Middle Creek	432	42	0	0	0	0	0	0	27	0
Upper Middle Creek Subwatershed	**2,105**	**82**	**73**	**0**	**0**	**3**	**0**	**0**	**80**	**18**
Lower Cow Creek WAU	**15,612**	**5,202**	**9,910**	**21**	**965**	**34**	**287**	**1,595**	**174**	**2,164**

Map 21. Lower Cow Creek Watershed Analysis Unit
Fragile Soil Classification From the Timber Production Capability Classification (TPCC)



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d. Soil Productivity

(1) Category 1 Soils

Category 1 Soils are defined as shallow soils (soils with depths less than 20 inches to bedrock and comprising at least 20 percent of a soil map unit), soils with less than four inches of A horizon, soils formed from granitic or granitic like parent material on slopes greater than 35 percent, or non-granitic soils on slopes greater than 70 percent. Category 1 Soils are considered highly sensitive to prescribed fire (including burning of hand and machine piles) because they are unusually erodible, nutrient deficient, or low in organic matter (USDI1995). Approximately 12,942 acres of BLM-administered land may be characterized as consisting of Category 1 Soils (see Table 31 and Map 22). The soil A horizon thickness property is not presented in Table 31 but is identified in the field. Shallow soils (less than 20 inches deep to bedrock) were divided into groups that comprise 30 to 75 percent of the soil map unit (shallow soils of less concern) or 75 to 100 percent (shallow soils of most concern) of the soil map unit. Shallow soil groups were also combined with soils formed from non-granitic parent materials with slopes greater than 70 percent to create three groups of non-granitic soils. The information in Table 31 was developed using ten meter Digital Elevation Models (DEM), which were used to identify slope groups and the Douglas County Soil Survey, which was used to identify the geologic parent materials and areas with shallow soils.

Table 31. Acres of Category 1 Soils on BLM Administered Land in the Lower Cow Creek WAU.

Drainage	Acres					
Subwatershed	Shallow Soils of Most Concern	Shallow Soils of Less Concern	Granitic Soils	Non-Granitic Soils	Non-Granitic Soils With Shallow Soils of Most Concern	Non-Granitic Soils With Shallow Soils of Less Concern
Catching Creek	0	249	0	193	0	64
Council Creek	0	51	0	68	0	12
Jerry Creek	0	25	0	6	0	7
Mitchell Creek	0	343	0	291	0	95
Nickle Mountain	0	57	0	7	0	2
Russell Creek	0	227	0	250	0	45
Shoestring	0	5	0	70	0	0
Riddle Subwatershed	**0**	**957**	**0**	**884**	**0**	**225**
Beatty Creek	2	498	0	17	0	19
Buck Creek	23	286	0	42	1	39
Doe Creek	13	43	26	48	1	16
Iron Mountain	6	148	0	85	21	15
Island Creek	82	53	0	99	7	10
Polan Creek	75	626	0	20	52	90
Rattlesnake Frontal	22	15	0	46	1	4
Salt Cow Creek	9	389	0	15	5	22
Lower Cow Creek Subwatershed	**232**	**2,058**	**26**	**372**	**89**	**215**
Cattle Creek	16	420	0	108	2	94
Little Dads Creek	52	213	0	33	4	29
Mile 15 Frontal	101	223	0	7	66	19
Table Creek	351	208	0	55	114	39
Middle Cow Creek Subwatershed	**521**	**1,064**	**0**	**203**	**187**	**180**

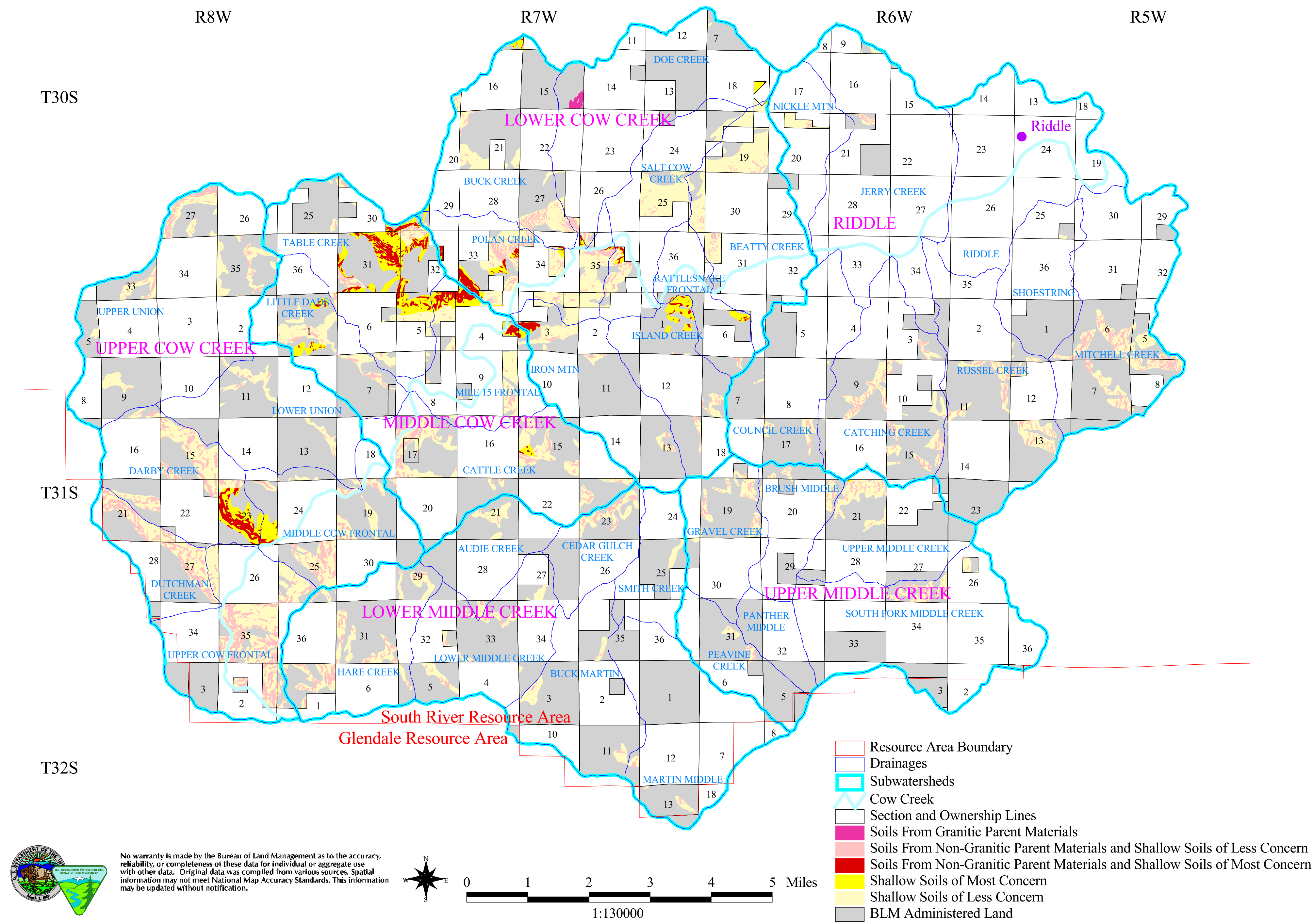
Table 31. Acres of Category 1 Soils on BLM Administered Land in the Lower Cow Creek WAU.

Drainage **Subwatershed**	Acres Shallow Soils of Most Concern	Shallow Soils of Less Concern	Granitic Soils	Non-Granitic Soils	Non-Granitic Soils With Shallow Soils of Most Concern	Non-Granitic Soils With Shallow Soils of Less Concern
Darby Creek	130	372	0	123	79	110
Dutchman Creek	0	285	0	50	0	131
Lower Union	0	127	0	52	0	11
Middle Cow Frontal	64	311	0	147	7	92
Upper Cow Frontal	0	651	0	69	0	233
Upper Union	0	379	0	13	0	75
Upper Cow Creek Subwatershed	**194**	**2,124**	**0**	**454**	**86**	**652**
Audie Creek	0	88	0	10	0	6
Buck Martin	0	92	0	78	0	6
Cedar Gulch Creek	0	100	0	20	0	26
Hare Creek	0	312	0	82	0	85
Lower Middle Creek	0	134	0	91	0	15
Martin Middle	0	32	0	78	0	7
Smith Creek	0	26	0	8	0	1
Lower Middle Creek Subwatershed	**0**	**784**	**0**	**368**	**0**	**145**
Brush Middle	0	59	0	14	0	0
Gravel Creek	0	123	0	58	0	20
Panther Middle	0	0	0	45	0	0
Peavine Creek	0	27	0	60	0	6
South Fork Middle Creek	0	105	0	128	0	25
Upper Middle Creek	1	157	0	63	0	21
Upper Middle Creek Subwatershed	**1**	**471**	**0**	**368**	**0**	**81**
Lower Cow Creek	**949**	**7,458**	**26**	**2,649**	**362**	**1,498**

(2) Soil Compaction

Soil compaction is a soil productivity concern, which could occur from ground based timber harvesting operations. Management direction is to plan timber harvests, using ground based yarding systems, to have insignificant (less than one percent) growth loss (USDI 1995). Soil compaction and the removal or disturbance of humus layers and coarse woody debris may impact the soil food web. Minimizing soil and litter disturbance that may occur as a result of yarding and operation of heavy equipment would help maintain a healthy food web. The soil food web is the living component interacting with the nonliving (organic and mineral) component of the soil to produce a complex system of nutrient cycling, soil structure formation, decomposition, and pest cycles. The

Map 22. Lower Cow Creek Watershed Analysis Unit Category 1 Soils



soil food web promotes healthy soil functions including biological activity, diversity, and productivity, regulates the flow of water and dissolved nutrients, stores and cycles nutrients and other elements, and filters, buffers, degrades, immobilizes, and detoxifies organic and inorganic materials that are potential pollutants (USDA 1999). Table 32 and Map 23 show the amount of BLM-administered land with slopes less than 35 percent that could potentially be ground based harvested.

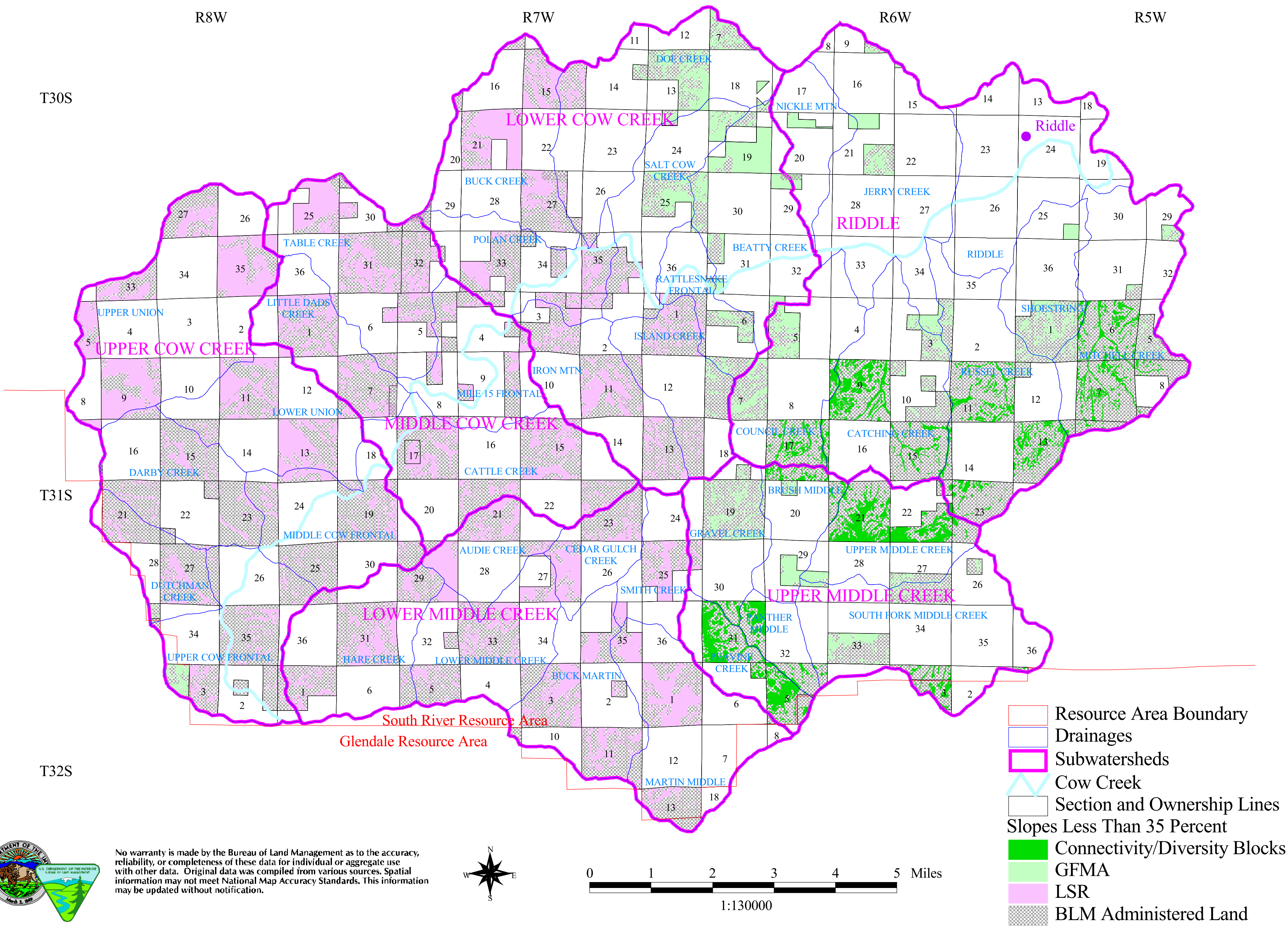
Table 32. Acres of BLM Administered Land by Land Use Allocation With Slopes Less Than 35 Percent.

Drainage **Subwatershed**	Acres			
	GFMA	Connectivity/Diversity Blocks	LSR	Total
Catching Creek	74	234	0	308
Council Creek	227	90	0	317
Jerry Creek	196	0	0	196
Mitchell Creek	65	175	0	240
Nickle Mountain	103	0	0	103
Russell Creek	42	213	0	255
Shoestring	149	8	0	157
Riddle Subwatershed	856	720	0	1,576
Beatty Creek	489	0	0	489
Buck Creek	0	702	0	702
Doe Creek	276	0	93	369
Iron Mountain	0	0	381	381
Island Creek	27	0	140	167
Polan Creek	0	0	343	343
Rattlesnake Frontal	83	0	32	114
Salt Cow Creek	234	0	46	281
Lower Cow Creek Subwatershed	1,109	702	1,035	2,846
Cattle Creek	0	0	528	528
Little Dads Creek	0	0	389	389
Mile 15 Frontal	0	0	175	175
Table Creek	0	0	789	789
Middle Cow Creek Subwatershed	0	0	1,881	1,881
Darby Creek	0	0	178	178
Dutchman Creek	10	0	136	146
Lower Union	0	0	589	589
Middle Cow Frontal	0	0	243	243
Upper Cow Frontal	68	0	207	275
Upper Union	0	0	1,236	1,236
Upper Cow Creek Subwatershed	78	0	2,589	2,667

Table 32. Acres of BLM Administered Land by Land Use Allocation With Slopes Less Than 35 Percent.

Drainage **Subwatershed**	Acres			
	GFMA	Connectivity/Diversity Blocks	LSR	Total
Audie Creek	0	0	333	333
Buck Martin	5	0	430	435
Cedar Gulch Creek	0	0	275	275
Hare Creek	0	0	347	347
Lower Middle Creek	0	0	373	373
Martin Middle	6	1	488	495
Smith Creek	0	0	199	199
Lower Middle Creek Subwatershed	11	1	2,445	2,457
Brush Middle	106	43	0	149
Gravel Creek	118	14	15	147
Panther Middle	0	92	0	92
Peavine Creek	0	285	0	286
South Fork Middle Creek	143	55	0	197
Upper Middle Creek	63	321	0	384
Upper Middle Creek Subwatershed	430	810	15	1,255
Lower Cow Creek WAU	2,484	2,233	7,965	12,682

Map 23. Lower Cow Creek Watershed Analysis Unit
Acres of BLM Administered Land by Land Use Allocation With Slopes Less Than 35 Percent



No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data was compiled from various sources. Spatial information may not meet National Map Accuracy Standards. This information may be updated without notification.

VII. Hydrology

The Lower Cow Creek WAU drains 160 square miles, or 35 percent of the total 456 square mile Cow Creek drainage. Cow Creek is the largest tributary of the South Umpqua River within the larger Umpqua River drainage. Cow Creek contributes to the South Umpqua River's water quality. Cow Creek supplied over half of the flow in the South Umpqua River near Brockway, Oregon in August and September 1992 (Tanner and Anderson 1996). Water quality problems associated with low flows in the lower South Umpqua River could be more severe without flow augmentation from Galesville Reservoir on Cow Creek (Tanner and Anderson 1996).

The Lower Cow Creek Watershed is located in the Klamath Mountains geologic province. The moderately steep slopes and soil and bedrock conditions promote moderate permeability and runoff rates in response to rainfall and snowmelt. Soils are well-drained loams and clay loams, which allow for moderate rates of percolation through the soil to depressions and stream channels. The hydrologic regime under these conditions is characterized by a runoff-dominated system with relatively "flashy" stream flows (high magnitude and short duration) and large seasonal differences. The moderate permeability of the soil indicates that in an undisturbed condition, the tendency for slope failure would be low to moderate.

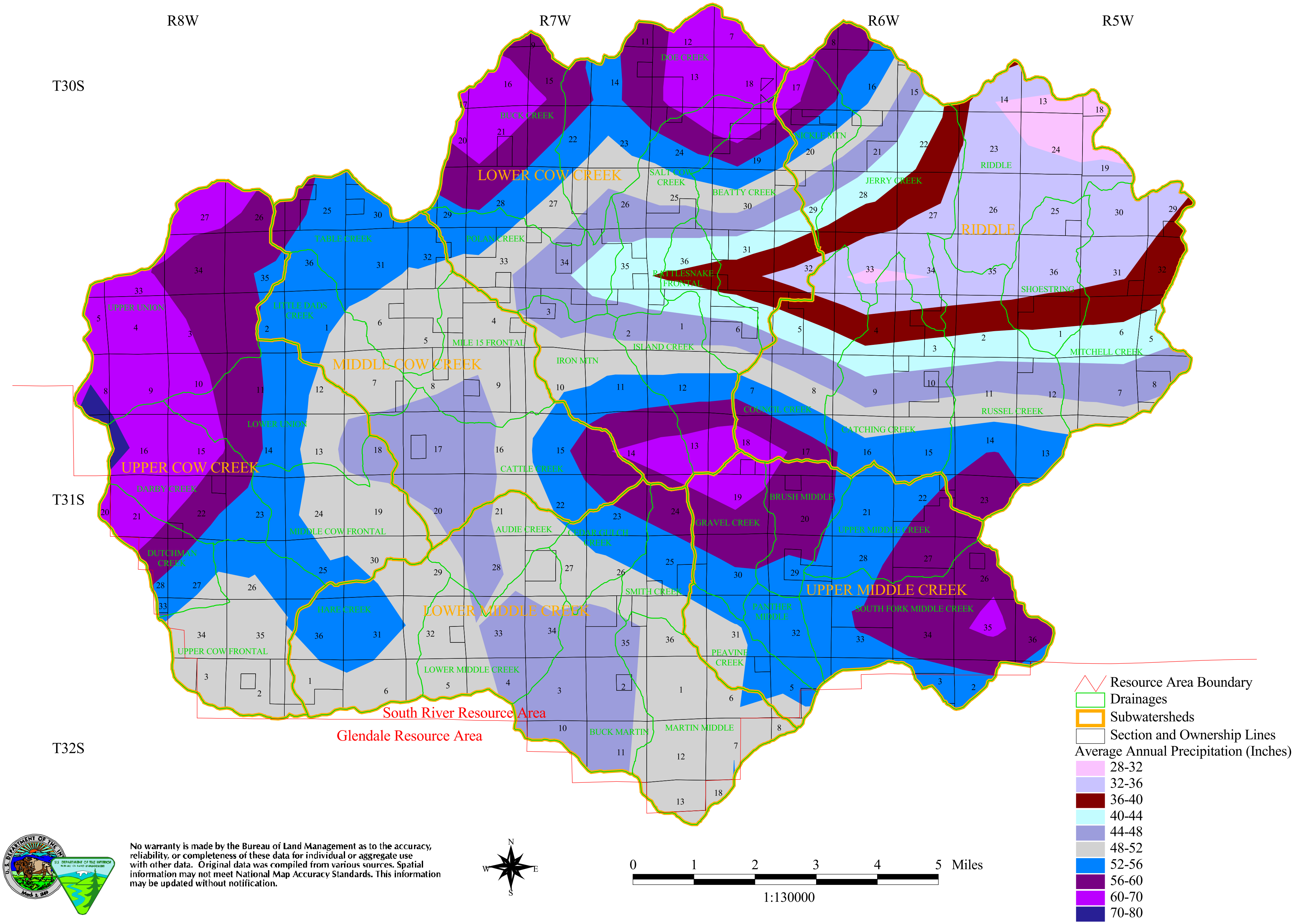
A. Climate

Measured average annual precipitation ranges from 32 inches near the town of Riddle, Oregon (located near the mouth of Cow Creek, at about 700 feet in elevation) to about 80 inches at higher elevations (see Map 24). Seventy-three percent of the annual precipitation comes in the form of winter rains from November through March. Precipitation occurs both as snow and rain in the higher elevations. The natural annual hydrograph peaks in January in response to rain and rain-on-snow generated runoff events (see Graph 1). Less than three inches of precipitation on average per month falls during the dryer months (April through October).

B. Effect of Roads and Timber Harvesting

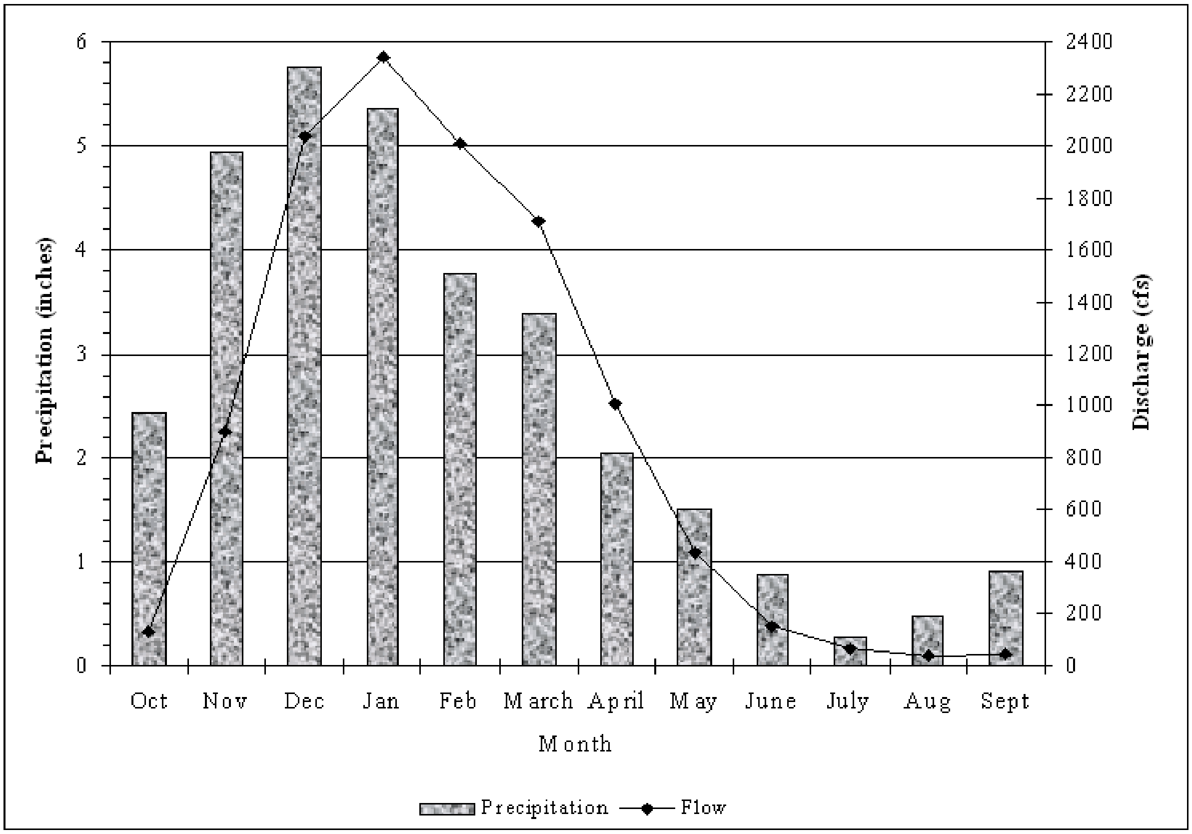
Roads influence sediment and water flow in the Lower Cow Creek WAU. There are approximately 783 miles of roads in the WAU with approximately 260 miles of roads on BLM-administered land (see Tables 33 and 34). Interception and diversion of groundwater and surface flow patterns by roads may create an imbalance in hydrologic function and response. Natural surfaced roads, cut and fill slopes, and ditch lines may potentially be exposed to surface erosion processes. Subsurface flow may be partially intercepted by roads. Ditch lines may act as extensions of stream networks. Ditch lines may deliver fine sediment, as well as intercepted ground and surface water, directly into stream channels (Wemple 1994). Stream network extension is typically expressed as a percentage of the length of ditchline feeding directly into streams compared to the total length of the stream network. The miles of roads in Riparian Reserves and within 100 feet of a stream are shown in Table 35. Magnitude and duration of ditchline flow are needed to quantify the effect stream network extension might have on the hydrology in a watershed.

Map 24. Lower Cow Creek Watershed Analysis Unit
Average Annual Precipitation



No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data was compiled from various sources. Spatial information may not meet National Map Accuracy Standards. This information may be updated without notification.

Graph 1. Comparison of Mean Monthly Flow 6.7 Miles From the Mouth of Cow Creek From 1986 to 1997 and Precipitation at Riddle, Oregon From 1948 to 2000.



Stream crossing failures and potential stream channel diversion pose the greatest risk for severe sedimentation and mass wasting (Furniss et al. 1991). A diverted stream channel can destabilize soils or road fills causing sudden, massive slope failure. These slope failures may produce channel scouring debris flows. Stream channels lacking large wood are more likely to have a debris flow and chronic fluvial erosion.

Table 33. Miles of Roads and Streams, Number of Stream Crossings, and Densities in the Lower Cow Creek WAU.

Drainage Name **Subwatershed Name**	Area (Acres)	Area (Square Miles)	Miles of Roads	Road Density (Miles per Square Mile)	Miles of Streams	Stream Density (Miles per Square Mile)	Number of Stream Crossings	Stream Crossings per Stream Mile
Catching Creek	3,320	5.19	21.54	4.15	35.44	6.83	57	1.61
Council Creek	2,820	4.41	24.11	5.47	30.43	6.90	64	2.10
Jerry Creek	4,716	7.37	23.23	3.15	40.15	5.45	47	1.17
Mitchell Creek	3,931	6.14	27.48	4.48	38.78	6.32	97	2.50
Nickle Mountain	1,315	2.05	13.52	6.60	8.45	4.12	28	3.31
Riddle	3,740	5.84	31.70	5.43	31.50	5.39	71	2.25
Russell Creek	3,877	6.06	30.91	5.10	38.85	6.41	94	2.42
Shoestring	1,708	2.67	12.84	4.81	22.75	8.52	58	2.55
Riddle Subwatershed	25,426	39.73	185.33	4.66	246.35	6.20	516	2.09
Beatty Creek	3,108	4.86	8.50	1.75	28.94	5.95	11	0.38
Buck Creek	3,226	5.04	24.33	4.83	37.43	7.43	89	2.38
Doe Creek	4,102	6.41	37.11	5.79	54.61	8.52	166	3.04
Iron Mountain	2,586	4.04	17.45	4.32	23.88	5.91	29	1.21
Island Creek	2,029	3.17	17.10	5.39	21.57	6.80	50	2.32
Polan Creek	2,312	3.61	8.81	2.44	24.17	6.70	33	1.37
Rattlesnake Frontal	1,198	1.87	7.05	3.77	14.45	7.73	23	1.59
Salt Cow Creek	2,283	3.57	17.63	4.94	25.83	7.24	60	2.32
Lower Cow Creek Subwatershed	20,844	32.57	137.98	4.24	230.88	7.09	461	2.00

Table 33. Miles of Roads and Streams, Number of Stream Crossings, and Densities in the Lower Cow Creek WAU.

Drainage Name **Subwatershed Name**	Area (Acres)	Area (Square Miles)	Miles of Roads	Road Density (Miles per Square Mile)	Miles of Streams	Stream Density (Miles per Square Mile)	Number of Stream Crossings	Stream Crossings per Stream Mile
Cattle Creek	3,894	6.08	34.71	5.71	45.39	7.47	135	2.97
Little Dads Creek	1,959	3.06	15.92	5.20	25.64	8.38	61	2.38
Mile 15 Frontal	2,210	3.45	13.43	3.89	20.37	5.90	34	1.67
Table Creek	3,472	5.43	17.03	3.14	38.03	7.00	47	1.24
Middle Cow Creek Subwatershed	11,535	18.02	81.09	4.50	129.43	7.18	277	2.14
Darby Creek	2,564	4.01	16.45	4.10	30.97	7.72	71	2.29
Dutchman Creek	1,312	2.05	7.11	3.47	14.38	7.01	23	1.60
Lower Union	2,776	4.34	30.07	6.93	34.17	7.87	144	4.21
Middle Cow Frontal	2,775	4.34	19.12	4.41	35.82	8.25	97	2.71
Upper Cow Frontal	3,048	4.76	19.39	4.07	38.82	8.16	97	2.50
Upper Union	5,245	8.20	37.53	4.58	62.29	7.60	164	2.63
Upper Cow Creek Subwatershed	17,721	27.69	129.67	4.68	216.45	7.82	596	2.75

Table 33. Miles of Roads and Streams, Number of Stream Crossings, and Densities in the Lower Cow Creek WAU.

Drainage Name **Subwatershed Name**	Area (Acres)	Area (Square Miles)	Miles of Roads	Road Density (Miles per Square Mile)	Miles of Streams	Stream Density (Miles per Square Mile)	Number of Stream Crossings	Stream Crossings per Stream Mile
Audie Creek	1,440	2.25	13.88	6.17	20.85	9.27	80	3.84
Buck Martin	2,581	4.03	25.03	6.21	29.27	7.26	78	2.66
Cedar Gulch Creek	1,223	1.91	11.65	6.10	16.88	8.84	52	3.08
Hare Creek	2,971	4.64	28.22	6.08	43.77	9.43	161	3.68
Lower Middle Creek	2,605	4.07	28.18	6.92	32.86	8.07	115	3.50
Martin Middle	3,269	5.11	22.63	4.43	30.94	6.05	78	2.52
Smith Creek	1,231	1.92	11.47	5.97	14.53	7.57	46	3.17
Lower Middle Creek Subwatershed	15,321	23.94	141.06	5.89	189.1	7.90	610	3.23
Brush Middle	1,360	2.13	13.81	6.48	22.51	10.57	72	3.20
Gravel Creek	1,717	2.68	16.20	6.04	26.69	9.96	72	2.70
Panther Middle	757	1.18	5.87	4.97	8.18	6.93	12	1.47
Peavine Creek	1,298	2.03	9.95	4.90	13.82	6.81	45	3.26
South Fork Middle Creek	4,157	6.50	38.93	5.99	48.64	7.48	144	2.96
Upper Middle Creek	2,311	3.61	23.16	6.42	33.10	9.17	98	2.96
Upper Middle Creek Subwatershed	11,600	18.13	107.92	5.95	152.94	8.44	443	2.90
Lower Cow Creek WAU	102,477	160.12	783.05	4.89	1,165.15	7.28	2903	2.49

Table 34. Miles of Roads and Streams, Number of Stream Crossings, and Densities on BLM Administered Lands in the Lower Cow Creek WAU.

Drainage Name **Subwatershed Name**	Area (Acres)	Area (Square Miles)	Miles of Roads	Road Density (Miles per Square Mile)	Miles of Streams	Stream Density (Miles per Square Mile)	Number of Stream Crossings	Stream Crossings per Stream Mile
Catching Creek	1,567	2.45	7.43	3.03	15.74	6.42	13	0.83
Council Creek	1,065	1.66	10.54	6.35	9.43	5.68	22	2.33
Jerry Creek	328	0.51	1.96	3.84	2.89	5.67	2	0.69
Mitchell Creek	1,839	2.87	8.11	2.83	16.84	5.87	29	1.72
Nickle Mountain	107	0.17	0.97	5.71	1.00	5.88	4	4.00
Riddle	0	0.00	0	0.00	0	0.00	0	0.00
Russell Creek	1,818	2.84	13.75	4.84	16.65	5.86	35	2.10
Shoestring	533	0.83	3.46	4.17	6.46	7.78	15	2.32
Riddle Subwatershed	7,257	11.34	46.22	4.08	69.01	6.09	120	1.74
Beatty Creek	740	1.16	0.61	0.53	7.16	6.17	1	0.14
Buck Creek	1,373	2.15	8.56	3.98	13.94	6.48	31	2.22
Doe Creek	1,030	1.61	10.54	6.55	13.02	8.09	41	3.15
Iron Mountain	1,325	2.07	4.61	2.23	12.31	5.95	9	0.73
Island Creek	1,016	1.59	7.15	4.50	11.34	7.13	17	1.50
Polan Creek	1,082	1.69	2.12	1.25	10.46	6.19	3	0.29
Rattlesnake Frontal	422	0.66	3.17	4.80	4.02	6.09	6	1.49
Salt Cow Creek	713	1.11	4.34	3.91	5.97	5.38	10	1.68
Lower Cow Creek Subwatershed	7,699	12.03	41.1	3.42	78.22	6.50	118	1.51

Table 34. Miles of Roads and Streams, Number of Stream Crossings, and Densities on BLM Administered Lands in the Lower Cow Creek WAU.

Drainage Name **Subwatershed Name**	Area (Acres)	Area (Square Miles)	Miles of Roads	Road Density (Miles per Square Mile)	Miles of Streams	Stream Density (Miles per Square Mile)	Number of Stream Crossings	Stream Crossings per Stream Mile
Cattle Creek	1,814	2.83	13.06	4.61	17.81	6.29	45	2.53
Little Dads Creek	1,134	1.77	7.69	4.34	15.55	8.79	33	2.12
Mile 15 Frontal	621	0.97	1.74	1.79	4.62	4.76	3	0.65
Table Creek	1,864	2.91	3.52	1.21	18.79	6.46	4	0.21
Middle Cow Creek Subwatershed	5,434	8.49	26.01	3.06	56.77	6.69	85	1.50
Darby Creek	1,321	2.06	5.90	2.86	14.61	7.09	20	1.37
Dutchman Creek	886	1.38	2.71	1.96	9.99	7.24	12	1.20
Lower Union	1,325	2.07	14.23	6.87	14.95	7.22	66	4.41
Middle Cow Frontal	1,392	2.18	8.19	3.76	16.81	7.71	47	2.80
Upper Cow Frontal	1,455	2.27	6.75	2.97	17.46	7.69	29	1.66
Upper Union	2,040	3.19	15.14	4.75	22.38	7.02	54	2.41
Upper Cow Creek Subwatershed	8,420	13.16	52.92	4.02	96.20	7.31	228	2.37

Table 34. Miles of Roads and Streams, Number of Stream Crossings, and Densities on BLM Administered Lands in the Lower Cow Creek WAU.

Drainage Name **Subwatershed Name**	Area (Acres)	Area (Square Miles)	Miles of Roads	Road Density (Miles per Square Mile)	Miles of Streams	Stream Density (Miles per Square Mile)	Number of Stream Crossings	Stream Crossings per Stream Mile
Audie Creek	669	1.05	7.28	6.93	9.19	8.75	34	3.70
Buck Martin	1,277	2.00	10.99	5.50	14.07	7.04	38	2.70
Cedar Gulch Creek	686	1.07	5.97	5.58	7.93	7.41	26	3.28
Hare Creek	1,357	2.12	12.72	6.00	18.78	8.86	74	3.94
Lower Middle Creek	1,229	1.92	13.23	6.89	16.27	8.47	63	3.87
Martin Middle	1,236	1.93	7.58	3.93	11.15	5.78	21	1.88
Smith Creek	403	0.63	3.37	5.35	5.35	8.49	14	2.62
Lower Middle Creek Subwatershed	6,857	10.71	61.14	5.71	82.74	7.73	270	3.26
Brush Middle	401	0.63	4.59	7.29	6.03	9.57	24	3.98
Gravel Creek	781	1.22	6.21	5.09	11.27	9.24	24	2.13
Panther Middle	341	0.53	3.14	5.92	2.97	5.60	4	1.35
Peavine Creek	770	1.20	4.29	3.58	7.86	6.55	21	2.67
South Fork Middle Creek	918	1.43	5.41	3.78	7.30	5.10	13	1.78
Upper Middle Creek	1,067	1.67	9.15	5.48	12.89	7.72	28	2.17
Upper Middle Creek Subwatershed	4,277	6.68	32.79	4.91	48.32	7.23	114	2.36
Lower Cow Creek WAU	39,944	62.41	260.18	4.17	431.26	6.91	935	2.17

Table 35. Miles of Roads and Road Densities Within Riparian Reserves and Within 100 Feet of a Stream on BLM Administered Land in the Lower Cow Creek WAU.

	Riparian Reserves				Within 100 Feet of a Stream			
Drainage Name **Subwatershed Name**	Area (Acres)	Area (Square Miles)	Miles of Roads	Road Density (Miles per Square Mile)	Area (Acres)	Area (Square Miles)	Miles of Roads	Road Density (Miles per Square Mile)
Catching Creek	657	1.03	1.76	1.71	373	0.58	1.00	1.72
Council Creek	381	0.60	2.52	4.20	228	0.36	1.19	3.31
Jerry Creek	124	0.19	0.65	3.42	71	0.11	0.25	2.27
Mitchell Creek	708	1.11	2.54	2.29	397	0.62	1.41	2.27
Nickle Mountain	41	0.06	0.26	4.33	25	0.04	0.16	4.00
Riddle	0	0.00	0	0.00	0	0.00	0	0.00
Russell Creek	680	1.06	4.62	4.36	391	0.61	2.30	3.77
Shoestring	261	0.41	1.34	3.27	155	0.24	0.75	3.13
Riddle Subwatershed	2,852	4.46	13.69	3.07	1,640	2.56	7.06	2.76
Beatty Creek	298	0.47	0.24	0.51	172	0.27	0.10	0.37
Buck Creek	604	0.94	3.30	3.51	329	0.51	2.08	4.08
Doe Creek	516	0.81	5.52	6.81	308	0.48	3.18	6.63
Iron Mountain	553	0.86	1.37	1.59	287	0.45	0.69	1.53
Island Creek	455	0.71	2.02	2.85	264	0.41	0.99	2.41
Polan Creek	461	0.72	0.59	0.82	252	0.39	0.23	0.59
Rattlesnake Frontal	177	0.28	0.58	2.07	102	0.16	0.22	1.38
Salt Cow Creek	255	0.40	1.06	2.65	148	0.23	0.49	2.13
Lower Cow Creek Subwatershed	3,319	5.19	14.68	2.83	1,862	2.91	7.98	2.74
Cattle Creek	768	1.20	6.38	5.32	429	0.67	3.68	5.49
Little Dads Creek	630	0.98	3.31	3.38	360	0.56	1.71	3.05
Mile 15 Frontal	206	0.32	0.32	1.00	117	0.18	0.25	1.39
Table Creek	769	1.20	0.60	0.50	448	0.70	0.31	0.44
Middle Cow Creek Subwatershed	2,373	3.71	10.61	2.86	1,354	2.12	5.95	2.81

Table 35. Miles of Roads and Road Densities Within Riparian Reserves and Within 100 Feet of a Stream on BLM Administered Land in the Lower Cow Creek WAU.

	Riparian Reserves				Within 100 Feet of a Stream			
Drainage Name **Subwatershed Name**	Area (Acres)	Area (Square Miles)	Miles of Roads	Road Density (Miles per Square Mile)	Area (Acres)	Area (Square Miles)	Miles of Roads	Road Density (Miles per Square Mile)
Darby Creek	591	0.92	1.70	1.85	345	0.54	0.97	1.80
Dutchman Creek	407	0.64	1.27	1.98	233	0.36	0.76	2.11
Lower Union	646	1.01	7.87	7.79	355	0.55	4.14	7.53
Middle Cow Frontal	666	1.04	4.43	4.26	400	0.63	2.68	4.25
Upper Cow Frontal	685	1.07	3.18	2.97	421	0.66	2.45	3.71
Upper Union	893	1.40	6.63	4.74	533	0.83	3.49	4.20
Upper Cow Creek Subwatershed	3,888	6.08	25.08	4.13	2,287	3.57	14.49	4.06
Audie Creek	352	0.55	4.01	7.29	218	0.34	2.08	6.12
Buck Martin	570	0.89	3.80	4.27	332	0.52	2.08	4.00
Cedar Gulch Creek	307	0.48	3.02	6.29	185	0.29	1.66	5.72
Hare Creek	757	1.18	7.64	6.47	451	0.70	4.38	6.26
Lower Middle Creek	637	1.00	7.70	7.70	383	0.60	4.37	7.28
Martin Middle	481	0.75	3.76	5.01	266	0.42	1.67	3.98
Smith Creek	213	0.33	2.27	6.88	121	0.19	0.97	5.11
Lower Middle Creek Subwatershed	3,317	5.18	32.2	6.22	1,956	3.06	17.21	5.62

Table 35. Miles of Roads and Road Densities Within Riparian Reserves and Within 100 Feet of a Stream on BLM Administered Land in the Lower Cow Creek WAU.

	Riparian Reserves				Within 100 Feet of a Stream			
Drainage Name **Subwatershed Name**	Area (Acres)	Area (Square Miles)	Miles of Roads	Road Density (Miles per Square Mile)	Area (Acres)	Area (Square Miles)	Miles of Roads	Road Density (Miles per Square Mile)
Brush Middle	230	0.36	2.70	7.50	142	0.22	1.35	6.14
Gravel Creek	442	0.69	3.46	5.01	265	0.41	1.52	3.71
Panther Middle	114	0.18	0.80	4.44	71	0.11	0.35	3.18
Peavine Creek	305	0.48	1.87	3.90	185	0.29	1.17	4.03
South Fork Middle Creek	295	0.46	1.80	3.91	181	0.28	0.84	3.00
Upper Middle Creek	510	0.80	4.79	5.99	304	0.48	2.19	4.56
Upper Middle Creek Subwatershed	1,896	2.96	15.42	5.21	1,148	1.79	7.42	4.15
Lower Cow Creek WAU	17,645	27.57	111.68	4.05	10,247	16.01	60.11	3.75

Research on three small watersheds and three pairs of large basins in the western Cascade Mountains evaluated the long-term effects of timber harvesting and road construction on peak flows (Jones and Grant 1996). Jones and Grant (1996) concluded timber harvesting increased peak discharges as much as 50 percent in the small basins and 100 percent in the large basins because of the increased drainage efficiency of basins due to stream network extension. Statistical analyses indicated peak discharges increased because of the timber harvesting and road construction. Another method of statistical analysis could not detect any effect of timber harvesting on peak flows in one of the large basin pairs and results were inconclusive in the other two large basin pairs (Thomas and Megahan 1998). Thomas and Megahan (1998) did find peak flows increased up to 90 percent for two-year flow events in one small watershed that was 100 percent clearcut and up to 40 percent in the other two small watersheds, one had 31 percent in patch-cuts and roads covered six percent of the other small watershed. Increased peak flows after timber harvesting commonly occurs because soils are wetter and more hydrologically responsive in the fall, due to decreased evaporation and transpiration losses (Christner and Harr 1982). Other possible causes for peak flow increases in harvested drainages include soil compaction, road construction, and changes in snow accumulation and melt rates.

C. Stream Flow

1. Municipal Watersheds

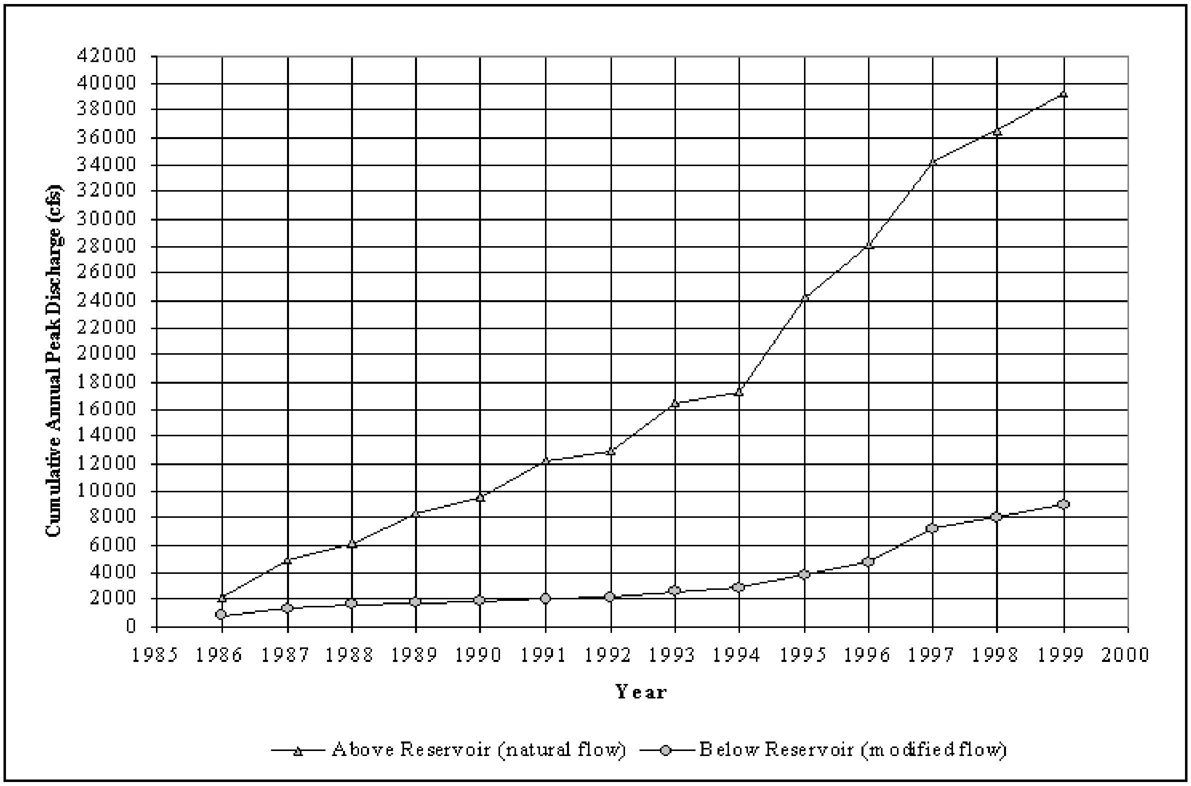
The City of Riddle uses water from Cow Creek and Russell Creek. The city of Glendale uses water from Cow Creek when their other two sources dry up. Glendale is upstream from the Lower Cow Creek WAU. When Glendale uses water from Cow Creek the stream flow in lower Cow Creek would probably decrease.

Groundwater yield in most areas of the WAU is limited, but generally is of good quality. The alluvium of the Cow Creek valley bottom has the best water yield, but the real extent and saturated thickness of these deposits are too small to make them an important source of groundwater supply. The alluvial deposits could yield as much as 50 to 100 gallons per minute, while the older volcanic rocks yield less than five gallons per minute.

2. Peak Flows

Four stream gages are operated on Cow Creek. Two gages are located in the upper reaches of Cow Creek. One gage is located above the Galesville Reservoir (USGS site number 14308990) and another below the reservoir (USGS site number 14309000) near the town of Azalea, Oregon. Galesville Reservoir began operating on October 7, 1985, and has a capacity of 42,220 acre-feet, which is equal to 33 percent of the average annual precipitation falling above the reservoir (based on average annual precipitation at Riddle). The reservoir is used for irrigation, power generation, flood control, and recreation (Hubbard et al. 2000). The Galesville Reservoir has had a major impact on stream flow in Cow Creek below the reservoir. Graph 2 compares accumulated annual peak flows above and below the reservoir from 1986 to 1999. Annual peak flows have been reduced because of the reservoir. However, the peak flow at the mouth of Cow Creek (measured by the Cow Creek near Riddle gage) behaves like an unregulated drainage since 84 percent of the area draining into Cow Creek is not impacted by the reservoir (see Appendix D for flow duration curves).

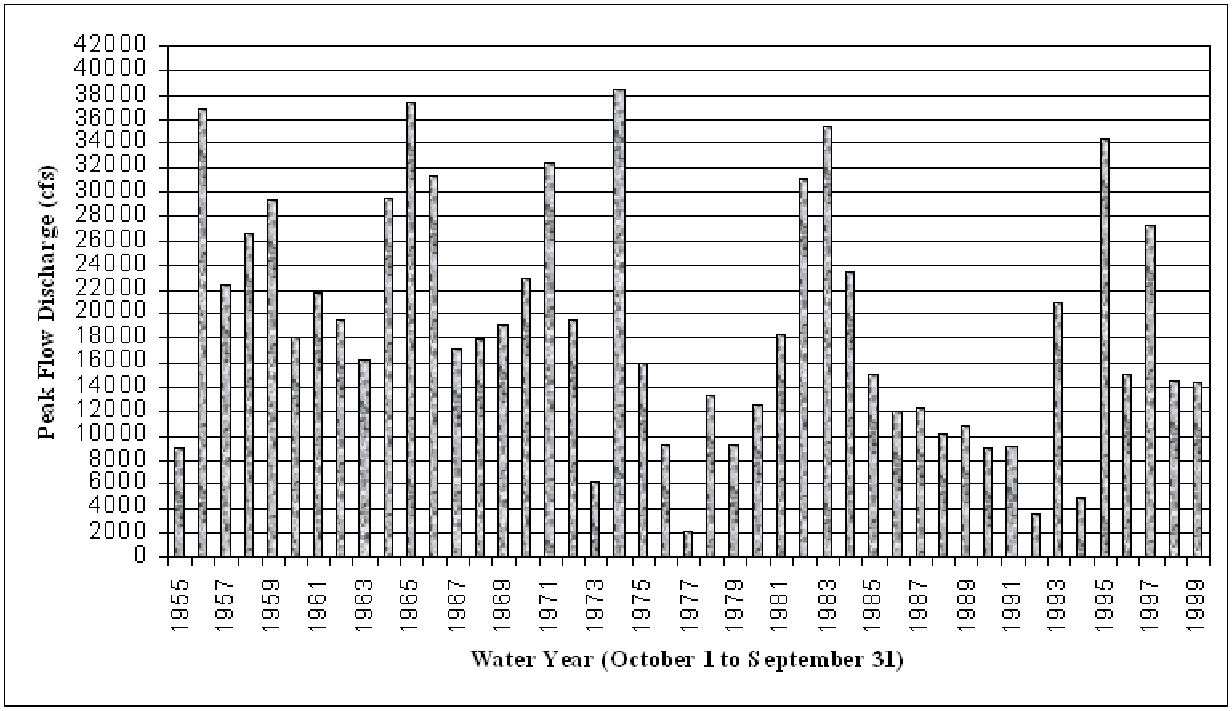
Graph 2. Comparison of the Cumulative Annual Peak Flows Above and Below Galesville Reservoir From 1986 to 1999.



Two other stream gages on Cow Creek are located near the West Fork of Cow Creek (USGS site number 14309500) and at the mouth of Cow Creek (USGS site number 14310000). The West Fork of Cow Creek flows into Cow Creek downstream from Galesville Reservoir. The Cow Creek near Riddle gage is located 6.7 miles upstream from where Cow Creek flows into the South Umpqua River. The Cow Creek near Riddle gage represents the point where cumulative effects of the entire 465 square mile Cow Creek drainage area can be analyzed.

Annual floods for the Cow Creek near Riddle gage are shown in Graph 3 for the period of record from 1955 to 1999. Cow Creek has experienced what could be considered at least a ten-year flood event in the 1951, 1956, 1965, and 1974 water years. The largest flood recorded at the gage was 38,400 cfs on January 15, 1974. A larger event estimated to be 41,100 cfs occurred on October 29, 1950 before the gage was installed (Hubbard et al. 2000). The flood in 1950 was estimated to be a little smaller than a 25-year event (Wellman et al. 1993).

Graph 3. Annual Peak Flows at the Cow Creek near Riddle, Oregon Gage (USGS station number 14310000) From 1955 to 1999.



Large magnitude floods, which rise and fall quickly, typically cause channel adjustment in sensitive stream reaches in the Lower Cow Creek WAU. This type of runoff-dominated stream flow regime results in high stream power, which creates a high potential for erosion and transportation of suspended and bed load sediment. An important question concerning peak flows is whether soil compaction from timber harvesting and road construction has caused precipitation to infiltrate hillslopes less and water to move into stream channels faster. Removing the forest canopy can increase snow accumulation and melting rates, possibly resulting in higher peak flows and lower summer flows. Table 36 shows about 40 percent of the forested lands in the WAU are less than 30 years old.

Table 36. Acres and Percentages of Forested Land Less Than 30 Years Old by Drainage in the Lower Cow Creek WAU.

Area	Total Forested BLM Acres	Percent of Total Forested BLM Acres Less Than 30 Years Old	Total Forested Non-BLM Acres	Percent of Total Forested Non-BLM Acres Less Than 30 Years Old	Total Forested Acres	Percent of Total Forested Acres Less Than 30 Years Old
Catching Creek	1,567	6	1,600	6	3,167	6
Council Creek	1,065	43	1,526	30	2,591	35
Jerry Creek	327	49	1,802	8	2,129	14
Mitchell Creek	1,775	10	1,327	9	3,102	11
Nickle Mountain	106	0	600	7	706	6
Riddle	0	0	1,033	0	1,033	0
Russell Creek	1,808	25	1,792	12	3,600	18
Shoestring	533	26	726	0	1,259	11
Riddle Subwatershed	7,181	21	10,406	11	17,587	15
Beatty Creek	722	1	1,887	14	2,609	10
Buck Creek	1,332	27	1,788	87	3,120	61
Doe Creek	999	42	2,763	66	3,762	60
Iron Mountain	1,233	21	1,215	95	2,448	58
Island Creek	921	35	1,013	66	1,934	51
Polan Creek	790	0	1,043	40	1,833	23
Rattlesnake Frontal	352	32	683	43	1,035	39
Salt Cow Creek	679	28	1,430	54	2,109	46
Lower Cow Creek Subwatershed	7,028	24	11,822	59	18,850	46

Table 36. Acres and Percentages of Forested Land Less Than 30 Years Old by Drainage in the Lower Cow Creek WAU.

Area	Total Forested BLM Acres	Percent of Total Forested BLM Acres Less Than 30 Years Old	Total Forested Non-BLM Acres	Percent of Total Forested Non-BLM Acres Less Than 30 Years Old	Total Forested Acres	Percent of Total Forested Acres Less Than 30 Years Old
Cattle Creek	1,738	22	2,043	80	3,781	53
Little Dads Creek	1,094	39	808	70	1,902	52
Mile 15 Frontal	500	0	1,185	38	1,685	27
Table Creek	1,594	11	1,349	57	2,943	32
Middle Cow Creek Subwatershed	4,926	20	5,385	63	10,311	43
Darby Creek	1,307	17	1,242	87	2,549	51
Dutchman Creek	887	9	426	78	1,313	31
Lower Union	1,320	33	1,450	78	2,770	56
Middle Cow Frontal	1,361	25	1,323	55	2,684	40
Upper Cow Frontal	1,400	8	1,501	46	2,901	28
Upper Union	2,032	43	3,206	24	5,238	31
Upper Cow Creek Subwatershed	8,307	25	9,148	52	17,455	39
Audie Creek	669	40	772	51	1,441	46
Buck Martin	1,275	53	1,299	85	2,574	69
Cedar Gulch Creek	684	25	536	98	1,220	57
Hare Creek	1,355	24	1,597	54	2,952	40
Lower Middle Creek	1,229	33	1,373	86	2,602	61
Martin Middle	1,237	22	2,028	37	3,265	31
Smith Creek	404	13	822	63	1,226	46
Lower Middle Creek Subwatershed	6,853	32	8,427	63	15,280	49

Table 36. Acres and Percentages of Forested Land Less Than 30 Years Old by Drainage in the Lower Cow Creek WAU.

Area	Total Forested BLM Acres	Percent of Total Forested BLM Acres Less Than 30 Years Old	Total Forested Non-BLM Acres	Percent of Total Forested Non-BLM Acres Less Than 30 Years Old	Total Forested Acres	Percent of Total Forested Acres Less Than 30 Years Old
Brush Middle	401	36	957	66	1,358	57
Gravel Creek	780	37	932	87	1,712	64
Panther Middle	341	35	417	99	758	71
Peavine Creek	770	21	526	41	1,296	29
South Fork Middle Creek	900	36	3,234	66	4,134	59
Upper Middle Creek	1,055	22	1,194	75	2,249	50
Upper Middle Creek Subwatershed	4,247	30	7,260	72	11,507	55
Lower Cow Creek WAU	38,542	25	52,448	51	90,990	40

Hydrologic Recovery Analysis

About 41 percent of the Lower Cow Creek WAU is within the transient snow zone (TSZ). The Transient Snow Zone is defined as land between 2,000 and 5,000 feet in elevation where rain-on-snow events commonly occur during the winter. Rain melting snow is an important hydrologic process in many watersheds throughout the Pacific Northwest. A study indicated 88 percent of floods in the Upper Willamette subbasin were associated with rain-on-snow events (Harr 1979). When warm rain falls on a ripe, shallow snow pack in the TSZ, the rate and volume of water delivered to the soil may be increased. The relatively rapid release of water stored in the transient snow zone when it rains often increases soil saturation and produces rapid groundwater flow to depressions and stream channels. Rain-on-snow events can occur with different frequencies. However, the area above and below the TSZ is assumed not to contribute to rain-on-snow runoff events for this analysis, since the probability of a rain-on-snow event occurring outside of the TSZ is low.

The forest canopy influences snow accumulation, distribution, and melt rates by affecting the interception, microclimate, and energy balance of the snow. Snowmelt is driven by heat exchange processes between the snow and the atmosphere, forest canopy, and ground surface. Therefore, changes in forest characteristics from activities, such as timber harvesting and road construction, affect snow accumulation and melting, as well as the overall hydrologic condition of a watershed (Weatherbee 1995). A study comparing snowmelt in shelterwood and mature timber stands in the TSZ found a 59 percent increase in snow water yield during a rain-on-snow event as a result of timber harvesting (Stork et al. 1999). The increase was attributed to increased sensible and latent heat transfers to the snow pack associated with the more open canopy in the shelterwood stand.

The Hydrologic Recovery Procedure (HRP) was used to estimate the change in the hydrologic condition (synonymous with forest canopy closure) in the Lower Cow Creek WAU. The HRP analysis estimates the current hydrologic condition in the WAU. Understanding the hydrologic condition is an important step toward comprehending the processes affecting stream channels and channel morphology.

The HRP estimated 85 percent of the Lower Cow Creek WAU is hydrologically recovered as of 2001 (see Table 37). An HRP of at least 75 percent is considered to maintain the hydrologic condition, and the resulting water quality and fish habitat, by maintaining peak flow response to rain-on-snow events. Since the hydrologic recovery estimate in the Lower Cow Creek WAU is greater than 75 percent, changes in the stream flow regime due to timber harvesting are considered not to be occurring at this time. However, hydrologic recovery estimates indicate notable changes in forest canopy closure (hydrologic condition), which may have produced increases in peak flow magnitude and timing, may be occurring in some Subwatersheds and Drainages. The Upper Middle Creek Subwatershed and the Iron Mountain, Darby Creek, Dutchman Creek, Buck Martin, Panther Middle, South Fork Middle Creek, and Upper Middle Creek Drainages have HRP values less than 75 percent.

More than 50 percent of the Upper Cow Creek, Lower Middle Creek, and Upper Middle Creek Subwatersheds are in the TSZ and are assumed to have greater frequencies of rain-on-snow events. Since rain-on-snow events can produce some of the largest peak flows, Subwatersheds with more than 50 percent in the TSZ probably experience greater runoff and stream flow magnitudes than Subwatersheds with less area in the TSZ. As a result, stream channels in the TSZ potentially experience higher peak flows and have a greater potential for channel scour than others with less area in the TSZ. Therefore, Drainages with HRP values less than 75 percent and having a high percentage in the TSZ would be places to consider restoring and monitoring channel conditions and trends.

Table 37. Amount of the Lower Cow Creek WAU in the Transient Snow Zone (TSZ) and Hydrologic Recovery Procedure (HRP) Percentages.

Drainage Name **Subwatershed Name**	BLM Acres in Transient Snow Zone	Total Acres in Transient Snow Zone	Percent of Entire Drainage in the Transient Snow Zone	HRP (Percent of Drainage Recovered)
Catching Creek	737	1,244	37	98
Council Creek	696	1,063	38	90
Jerry Creek	30	685	15	100
Mitchell Creek	883	1,172	30	98
Nickle Mountain	53	652	50	99
Riddle	0	2	0	100
Russell Creek	1,173	1,885	49	93
Shoestring	69	69	4	98
Riddle Subwatershed	3,641	6,772	27	97
Beatty Creek	321	610	20	98
Buck Creek	370	1,283	40	77
Doe Creek	418	1,375	34	88
Iron Mountain	580	1,372	53	72
Island Creek	434	857	42	88
Polan Creek	91	431	19	94
Rattlesnake Frontal	89	122	10	95
Salt Cow Creek	236	495	22	92
Lower Cow Creek Subwatershed	2,539	6,545	31	87
Cattle Creek	673	1,443	37	83
Little Dads Creek	114	396	20	93
Mile 15 Frontal	5	124	6	96
Table Creek	908	1,622	47	88
Middle Cow Creek Subwatershed	1,700	3,585	31	89

Table 37. Amount of the Lower Cow Creek WAU in the Transient Snow Zone (TSZ) and Hydrologic Recovery Procedure (HRP) Percentages.

Drainage Name **Subwatershed Name**	BLM Acres in Transient Snow Zone	Total Acres in Transient Snow Zone	Percent of Entire Drainage in the Transient Snow Zone	HRP (Percent of Drainage Recovered)
Darby Creek	906	1,883	73	64
Dutchman Creek	557	918	70	72
Lower Union	341	1,066	38	88
Middle Cow Frontal	630	1,086	39	86
Upper Cow Frontal	752	1,210	40	88
Upper Union	1,660	3,207	61	83
Upper Cow Creek Subwatershed	4,846	9,370	53	82
Audie Creek	489	845	59	81
Buck Martin	818	1,343	52	66
Cedar Gulch Creek	483	719	59	75
Hare Creek	567	1,296	44	85
Lower Middle Creek	421	992	38	78
Martin Middle	623	2,155	66	85
Smith Creek	140	570	46	76
Lower Middle Creek Subwatershed	3,541	7,920	52	79
Brush Middle	304	867	64	76
Gravel Creek	683	1,072	62	75
Panther Middle	271	527	70	64
Peavine Creek	581	940	72	85
South Fork Middle Creek	884	3,756	90	54
Upper Middle Creek	864	1,788	77	63
Upper Middle Creek Subwatershed	3,587	8,950	77	66
Lower Cow Creek WAU	19,854	43,142	42	85

Plotting accumulated annual floods on Cow Creek shows an apparent change in the average annual flood from 1955 to 1999 (see Graph 4). Annual floods recorded from 1955 to 1960 was selected as the reference condition, since this was before most timber harvesting activities began. Annual floods from 1961 to 1999 was selected as representative of the current condition. Annual peak stream flow events after the reference period do not show a notable change until about 1976 when the annual peak flow decreased and then returned to previous conditions in 1981. Annual precipitation decreased from 1976 to 1981 relative to the average annual precipitation and might explain the decrease in annual peak flows. However, annual peak stream flow is not well correlated (having a correlation coefficient, or r value, of 0.37) with annual precipitation. Determining differences in timing, duration, and intensity between individual storm runoff events would be needed to completely understand what caused the decrease in annual peak stream flow from 1976 to 1981. Galesville Reservoir, which is located about 54 miles upstream from the Cow Creek near Riddle stream gage, has probably decreased the magnitude of annual peak flows in lower Cow Creek since 1986. However, the impacts to peak flows is largely dependent on the storage capacity of the reservoir at the time of the event. The stream flow record on Cow Creek shows no obvious increase in average annual floods since measurements began in 1955.

An analysis of peak flow response to timber harvesting and road construction in the Western Cascades of Oregon found treatment effects decreased as flow size increased and were not detectable for flows with two-year or greater return periods (Thomas and Megahan 1998). Based on these findings, the average number of peak flows larger than a 1.25-year flow of 13,200 cfs was analyzed for the reference period and the periods after for Cow Creek (see Table 38). The peak flow frequency (peaks per year) decreased 28 to 68 percent from the reference period. The peak flow magnitude also decreased from the reference period, except for a slight increase during the 1961 to 1966 time period. Changes in peak flow do not appear to be a direct result of changes in average annual precipitation. Analysis of individual storm events is necessary to develop a better understanding of what caused the decrease in stream flow events. Peak flow data was not analyzed from 1986 to 2001 since peaks greater than 13,200 cfs were not reported by the USGS because the flow was regulated by Galesville Reservoir. However, peak flow frequency and magnitude probably were less than during the reference period because the flow was regulated by the reservoir.

Graph 4. Accumulated Annual Peak Flow on Cow Creek From 1955 to 1999.

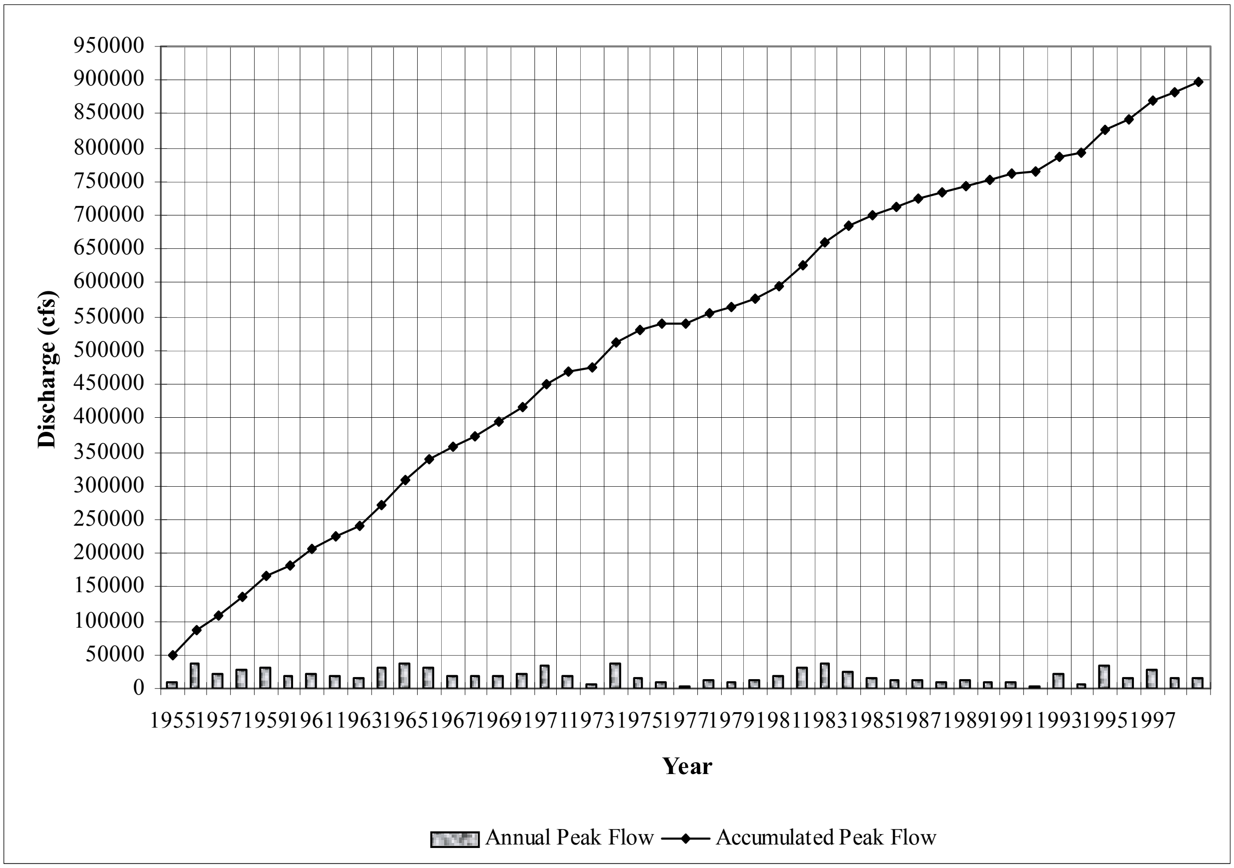


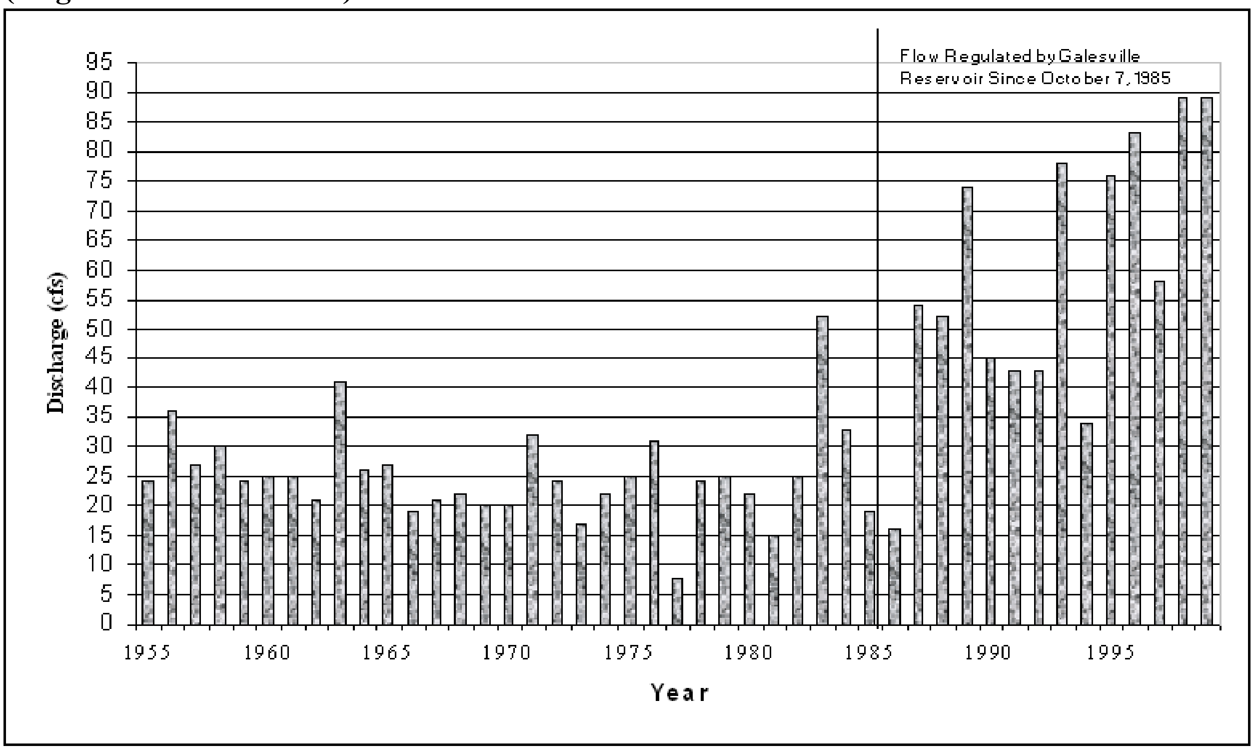
Table 38. Comparison of Recurrence Interval and Mean Peak Flow Discharge of at least 13,200 Cubic Feet per Second for the Reference Period From 1955 to 1960 and Periods From 1961 to1985 in Cow Creek.

Time Period	Frequency (Peaks per Year)	Percent Change in Peaks per Year From the Reference Condition	Mean Peak Flow Discharge (magnitude) (cfs)	Percent Change in Peak Flow Magnitude per Year From the Reference Condition	Average Annual Precipitation for the Time Period at Riddle, Oregon (inches)
1955 to 1960 (Reference Condition)	2.5	NA	22,540	NA	33.5
1961 to 1966	1.5	- 40	22,978	+ 1.9	30.5
1967 to 1972	1.8	- 28	19,636	- 12.9	31.0
1973 to 1978	0.8	- 68	19,580	- 13.1	29.3
1979 to 1985	1.3	- 48	21,933	- 2.7	33.9
1961 to 1985	1.4	- 44	21,121	- 6.3	31.3

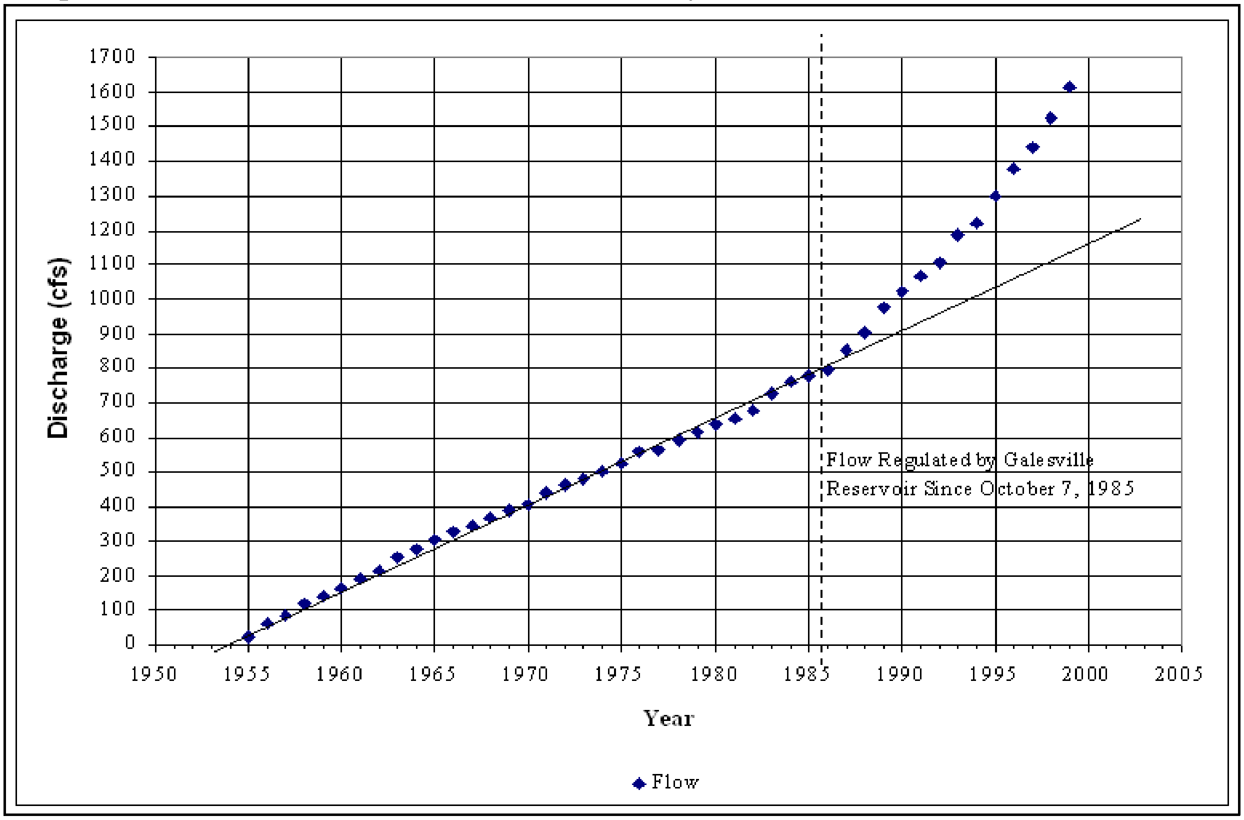
3. Low Flow

The lowest flow from 1955 to 1999 in Cow Creek near Riddle was 7.4 cfs on August 17 through 19, 1977 (Hubbard et al. 2000). The mean daily low flows from 1955 to 1999 are shown in Graph 5. The cumulative mean daily low flows are shown in Graph 6. Data from 1955 to 1985 are before stream flows were regulated by Galesville Reservoir. Low flow conditions in Cow Creek were noticeably influenced by flow regulation after 1985. The average mean daily low flow in Cow Creek near Riddle was 25.2 cfs before construction of the reservoir and 59.6 cfs after construction.

Graph 5. Lowest Average Daily Flow From 1955 to 1999 at the Cow Creek near Riddle Gage (Gage Number 14310000).



Graph 6. Accumulated Lowest Annual Mean Daily Flow in Cow Creek From 1955 to 1999.



D. Water Quality

1. Beneficial Uses

Beneficial uses designated by the Oregon Department of Environmental Quality (ODEQ) in the Umpqua River Basin include domestic and industrial water supply, irrigation, livestock watering, anadromous fish passage, salmonid fish rearing and spawning, resident fish and aquatic life, wildlife, hunting, fishing, boating, water contact recreation, aesthetic quality, and hydroelectric power (ODEQ 1996). Cow Creek and several tributaries in the Lower Cow Creek WAU were included on the 1998 303(d) water quality limited list. The streams and the cause for listing are presented in Table 39. Section 303(d) in the 1977 Clean Water Act requires management plans be developed to protect and restore streams included on the water quality limited list to meet state standards.

2. Water Quality Standards Set by Law

The Federal Clean Water Act of 1972 directs each state to adopt an antidegradation policy as a component of water quality standards. The Oregon Administrative Rules Antidegradation Policy (OAR 340-41-026) is to prevent unnecessary degradation from point and nonpoint sources of pollution, protect, maintain, and enhance existing surface water quality, and protect all existing beneficial uses. The Oregon Administrative Rules (OAR 340-41-282) set the Standards to be used in the Umpqua River Basin. The criteria used to list a stream as water quality limited are based on the parameters in Listing Criteria for Oregon's 1998 303(d) List of Water Quality Limited Water Bodies.

Table 39. Summary of 303(d) Listed Waterbodies in the Lower Cow Creek WAU.

Stream Channel	Location of Listing	Listing Parameter
Cattle Creek	Mouth to headwaters	Water temperature during rearing
Cow Creek	Mouth to the confluence with the West Fork of Cow Creek; Mouth to Riddle	Habitat modification, pH, and water temperature during rearing; Toxics (Chlorine)
Iron Mountain Creek	Mouth to headwaters	Water temperature during rearing
Middle Creek	Mouth to headwaters	Habitat modification and water temperature during rearing
South Fork of Middle Creek	Mouth to headwaters	Water temperature during rearing

Best Management Practices (BMPs) and management directions in the RMP were developed to achieve the Oregon water quality standards. Best Management Practices, identified and required by the Clean Water Act as amended by the Water Quality Act of 1987, are defined as methods, measures, or practices designed to protect water quality and soil productivity. The Bureau of Land Management satisfies the requirement for Federal agencies to comply with all State requirements to control water pollution from nonpoint sources by implementing BMPs (USDI 1995).

3. Water Quality Parameters

a. Stream Temperature

Stream temperature affects resident fish, aquatic life, and salmonid fish spawning and rearing. Currently, streams with salmonids meet the Oregon DEQ water quality for stream temperature criteria when maintained at or below 64 degrees Fahrenheit (17.8 degrees Celsius) for the seven-day moving average daily maximum temperature.

The Roseburg BLM District has collected stream temperature data on eight streams in the WAU (see Map 25 and Table 40). The number of sites has varied from year to year. For example, there were eight sites in 1999 and seven sites in 2000. The sites were selected to provide current stream conditions and water temperatures on BLM-administered land in the WAU. Stream temperature data are separated by water year in Table 41.

Map 25. Lower Cow Creek Watershed Analysis Unit
Water Quality Data Collection Sites

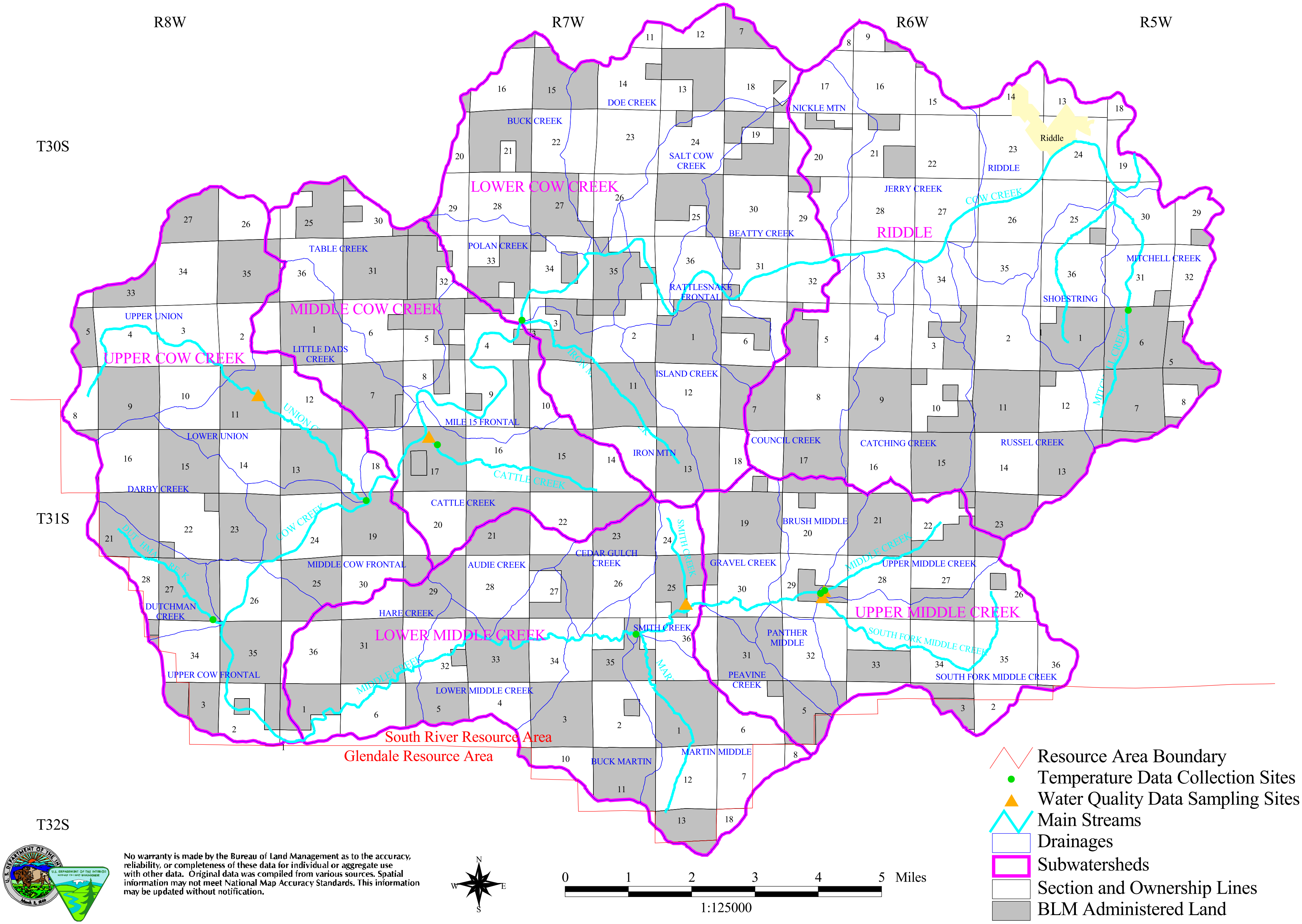


Table 40. Water Temperature Data Collected by the Roseburg BLM District in the Lower Cow Creek WAU.

Stream Name	Year Data was Collected	Range of Seven-Day Maximum Temperatures (°C)	Average of Seven-Day Maximum Temperatures (°C)	Maximum Number of Days Temperature Exceeded 17.8 °C (Year)	Low Flow at Site for 1999/2000 (cfs)	Drainage Area Above Site (Acres)
Cattle Creek	1997 to 2000	18.6 - 20.6	19.5	45 (1997)	0.55/0.34	2,755
Dutchman Creek	1999	16.4	16.4	0	---	683
Iron Mountain	1997 to 1999	17.9 - 19.6	18.6	31 (1998)	0.30/---	2,587
Martin Creek	1998 to 2000	18.9 - 20.4	19.7	38 (1998)	0.48/0.41	3,276
Martin Creek (Upper Site)	2000	16.9	16.9	0	---/0.30	1,109
Middle Creek	1994, 1995, 1997 to 2000	19.4 - 21.5	20.5	54 (1997)	0.44/0.38	2,302
Mitchell Creek	1999, 2000	19.1 - 20.1	19.6	42 (2000)	0.35/0.39	1,986
South Fork of Middle Creek	1994, 1995, 1997 to 2000	19.8 - 23.5	21.0	66 (1994)	2.08/1.82	4,117
Union Creek	1997 to 2000	19.6 - 21.5	20.6	65 (1997)	1.36/1.47	8,012

Streams on the water quality limited list for temperature in the Lower Cow Creek WAU include Cow Creek, Cattle Creek, Iron Mountain Creek, Martin Creek, Middle Creek, and the South Fork of Middle Creek. Data collected by the BLM show Union Creek and Mitchell Creek also exceeded the water quality limited standard for temperature but they have not been included on the list at this time. Water temperatures in the Lower Cow Creek WAU generally exceeded the 64 degrees Fahrenheit (17.8 degrees Celsius) standard in July and August.

Both stream temperature and flow vary seasonally and annually. Water temperatures are cool during the winter months but can exceed the state standard during the summer when streamflows are lowest and solar radiation and air temperatures are the highest. Normally stream temperatures increase in July and August when flows are receding but are not at their lowest flow level. However, maximum temperatures may occur earlier in the summer on streams with little shade (Johnson and Jones 2000). Water temperature data collected by BLM personnel in the Lower Cow Creek WAU were found to be highest during July and August when streamflows were lowest (see Table 41).

Table 41. Summer Stream Temperature Data Summarized by Year Collected by the Roseburg BLM District in the Lower Cow Creek WAU.

						Seven-Day Averages			
Stream Name	**Date**	**Maximum Temperature (°C)**	**Date**	**Minimum Temperature (°C)**	**ªT (°C)**	**Maximum**	**Minimum**	**ªT (°C)**	**Days Greater Than 17.8 °C**
Cattle Creek	8/6/97	20.3	5/21/97	9.9	5.0	19.3	15.3	4.0	45
Cattle Creek	7/28/98	21.7	6/17/98	10.2	5.3	20.6	17.0	3.6	39
Cattle Creek	8/28/99	19.6	9/28/99	6.9	5.5	18.6	15.9	2.8	33
Cattle Creek	8/8/00	20.2	10/24/00	5.9	5.9	19.4	15.8	3.6	29
Dutchman Creek	8/28/99	16.8	9/28/99	8.8	2.2	16.4	15.2	1.2	0
Iron Mountain Creek	8/6/97	19.0	5/26/97	10.1	4.0	18.2	16.3	1.8	14
Iron Mountain Creek	7/28/98	20.6	6/17/98	10.4	4.1	19.6	16.5	3.1	31
Iron Mountain Creek	8/28/99	18.3	10/3/99	9.3	4.4	17.9	16.1	1.8	7
Martin Creek	7/28/98	21.7	6/17/98	9.0	5.1	20.4	16.7	3.7	38
Martin Creek	8/10/99	20.1	10/3/99	6.9	5.9	18.9	15.6	3.3	37
Martin Creek	7/31/00	20.5	4/29/00	5.9	5.9	19.8	15.5	4.3	32
Martin Creek (Upper Site)	8/8/00	17.7	4/29/00	5.7	4.2	16.9	14.0	2.9	0
Middle Creek	7/20/94	22.6	10/13/94	4.9	8.1	21.5	15.5	6.0	40
Middle Creek	7/27/95	22.0	6/12/95	8.1	7.5	20.6	15.4	5.2	41
Middle Creek	8/6/97	20.6	5/21/97	8.3	9.5	19.7	13.8	5.9	54
Middle Creek	7/27/98	22.6	6/17/98	8.6	7.2	21.4	15.2	6.2	49
Middle Creek	8/10/99	20.4	9/28/99	5.0	8.7	19.4	11.9	7.5	46
Middle Creek	7/31/00	21.1	4/29/00	5.7	7.5	20.3	14.6	5.7	48
Mitchell Creek	8/28/99	20.0	9/28/99	9.0	5.0	19.1	16.1	3.0	36
Mitchell Creek	8/8/00	20.8	5/11/00	7.3	5.0	20.1	16.2	4.0	42
South Fork of Middle Creek	7/20/94	24.9	10/13/94	4.3	10.2	23.5	15.2	8.3	66
South Fork of Middle Creek	7/27/95	22.0	6/12/95	7.8	8.5	20.8	13.1	7.7	52
South Fork of Middle Creek	8/6/97	21.9	5/21/97	8.1	8.4	20.9	13.1	7.8	63
South Fork of Middle Creek	7/27/98	21.9	6/17/98	8.1	7.0	20.6	14.5	6.2	41
South Fork of Middle Creek	8/28/99	20.9	9/28/99	5.5	8.1	19.8	12.5	7.3	47
South Fork of Middle Creek	8/8/00	21.6	4/29/00	5.4	7.8	20.7	13.9	6.8	53
Union Creek	8/6/97	21.4	5/25/97	9.9	6.2	20.5	15.8	4.6	65
Union Creek	7/27/98	22.8	6/17/98	10.2	5.9	21.5	16.4	5.1	53
Union Creek	8/10/99	20.4	9/28/99	7.6	6.6	19.6	15.6	4.0	47
Union Creek	7/31/00	21.5	10/24/00	6.4	6.0	20.8	15.8	5.1	54

Definitions:
ªT = Highest value of the daily difference between the maximum and the minimum temperatures for the season.
Seven-Day Maximum = Average value of daily maximum temperatures for the highest seven consecutive days.
Seven-Day Minimum = Average value of daily minimum temperatures for the same seven days.
Seven-Day ªT = Average of the daily difference between the maximum and minimum temperatures for the same seven days.

The width and height of riparian vegetation needed to provide effective shade varies according to the width of the stream, the direction of flow (orientation to the sun), and the steepness of the streambanks. Studies have investigated the effects of riparian vegetation on stream temperatures in Pacific Northwest forests. Temperatures tend to decrease as riparian vegetation recovers (Holaday 1992). However, stream channel characteristics can also affect stream temperatures. In a healthy stream channel, gravel storage areas act as large sponges, holding cool groundwater and releasing it slowly. The removal of large wood from the channel can cause the release of accumulated gravel to be transported downstream. In bedrock dominated channels, intergravel flow is greatly diminished and stream temperatures increase. Streams with narrow channels tend to have cooler stream temperatures. The wetted width of Middle Creek, Union Creek, and Table Creek are wide and riparian vegetation does not provide effective shade. Many stream reaches in the WAU are characterized by simplified stream substrate and dominated by bedrock.

Summer water temperatures would improve as riparian vegetation grows and shade increases. The establishment of Riparian Reserves are expected to decrease stream temperatures on BLM-administered lands in the Lower Cow Creek WAU.

b. General Chemistry

Water samples were collected from five streams in the Lower Cow Creek WAU during the summer in 1996 (see Table 42). The water samples did not exceed the drinking water standards set by the Environmental Protection Agency (EPA). The geology in the Lower Cow Creek WAU consists of sedimentary, metamorphic, igneous, and volcanic rocks, and river bottom alluvium. The water type at sites sampled in the WAU was sodium bicarbonate/chloride or sodium bicarbonate/sulfate. The balance between cation and anion was often less than 30 percent and the concentrations of calcium and magnesium were consistently low, indicating there was some error in the data. The error probably occurred because the non-suppressed ion chromatography laboratory method was used (Michael T. Land, personnel communication). The error could also be the water samples had such low ionic concentrations.

c. pH

The pH standard set by DEQ for aquatic life in the Umpqua River Basin is 6.5 to 8.5. MacDonald et al. (1990) found pH levels less than 6.5 and greater than 9 can have adverse affects on fish and aquatic insects. However, non-lethal effects of pH levels on fish are unknown.

The Little River Watershed Analysis reported algae accumulations in streams can affect pH (USDA and USDI 1995). The process of photosynthesis by aquatic organisms uses dissolved carbon dioxide and consumes hydrogen ions during the daylight hours, raising pH levels (more alkaline). Respiration by aquatic organisms at night releases carbon dioxide, decreasing pH levels. Diurnal algae-driven pH cycles in Little River were found to range from 7.8 in the morning to 9.1 in the late afternoon. Photosynthesis occurs less on shaded stream reaches or on cloudy days and pH levels are lower. Maximum pH values of 9.0 may occur in streams unaffected by pollution (Hem 1985).

Bureau of Land Management hydrologists set out instruments to collect pH data on five streams in the WAU. The pH data was collected every half-hour for three consecutive days in July and August

2000. The pH data met water quality standards. Data collected in 1999 also met the pH water quality standards. However, Cow Creek was placed on water quality limited list for pH based on the data DEQ collected.

Table 42. Water Quality Data for Streams in the Lower Cow Creek WAU.

Stream Name	Cattle Creek	Middle Creek	Smith Creek	South Fork of Middle Creek	Union Creek
Date	8/20/96	8/20/96	8/20/96	8/20/96	8/20/96
Time	900	1300	1430	1600	1030
Discharge (cfs)	0.3	0.4	0.17	2.73	0.46
Specific conductance (uS/cm at 25 °C)	206	300	372	149	66
Dissolved oxygen (mg/l)	10	9.6	9.5	9.4	9.7
pH (standard units)	7.9	7.8	7.5	8.0	7.7
Water Temperature (°C)	12.0	13.0	12.0	14.0	13.0
Calcium (mg/l)	1.8	4.4	3.4	2.6	0.7
Magnesium (mg/l)	0.6	2.0	0.9	0.6	0.3
Sodium (mg/l)	13.7	5.6	35.0	4.7	3.9
Potassium (mg/l)	0.9	0.4	0.8	0.3	0.4
Alkalinity (as $CaCO_3$) (mg/l)	52	45	45	45	28
Sulfate (as SO_4) (mg/l)	4.8	99.8	1.5	24.3	4.1
Chloride (mg/l)	32.2	3.2	89.7	2.2	1.9
Fluoride (mg/l)	0.2	<0.2	<0.2	<0.2	<0.2
Nitrogen (as NO_2)	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrogen (as NO_3)	<0.02	<0.02	0.02	<0.02	<0.02
Nitrogen (as NH_3)	<0.2	<0.05	<0.05	<0.05	<0.05
Phosphate (as PO_4)	0.3	<0.2	<0.2	<0.2	<0.2
Bromide (mg/l)	0.3	0.3	0.8	<0.3	<0.3
Lithium (mg/l)	<0.2	<0.05	<0.05	<0.05	<0.05
Strontium (mg/l)	<1.0	<1.0	<1.0	<1.0	<1.0
Barium (mg/l)	<0.5	<0.5	<0.5	<0.5	<0.5

Acid mine drainage from the Formosa Mine is suspected to have caused pH values to exceed state standards in a tributary of Middle Creek. During active runoff periods, pH values between 4 and 5 were measured close to the mine. In the main stem of Middle Creek, above the South Fork of Middle Creek, and in the South Fork of Middle Creek pH values were 7.8 and 8.0 respectively on August 20, 1996. These pH values are at the upper range of the state water quality standards.

d. Dissolved Oxygen

Dissolved oxygen (DO) is required for resident fish and aquatic organism survival and salmonid spawning and rearing. Temperature and air pressure affect the amount of DO in water. The ODEQ set minimum DO standards at 6.5 mg/l for cool-water aquatic resources, which became effective July 1, 1996. Greater than ten percent of the samples must exceed the standard with at least two samples collected per season in order for the stream to be considered water quality limited for DO. The minimum DO standards for salmonid spawning streams were set at eleven mg/l, except where barometric pressure, altitude, and naturally occurring temperatures preclude attainment of the standard, then DO levels should not be less than 95 percent saturation. The minimum DO standards for cold water aquatic resources were set at eight mg/l, unless the same conditions mentioned for salmonid spawning streams are present, then the DO levels should not be less than 90 percent saturation.

During the summer of 1992, the daily minimum dissolved oxygen in Cow Creek at Riddle was less than 90 percent saturation most of the time. The dissolved oxygen level was further reduced by the Riddle wastewater treatment plant causing periphyton growth downstream from Riddle (Tanner and Anderson 1996). Dissolved oxygen measurements taken on August 20, 1996 in Middle Creek and the South Fork of Middle Creek were within state standards.

Bureau of Land Management hydrologists set out instruments to collect DO data at four sites in the WAU in July and August 2000. Sites were selected based on spot measurements taken in 1999, which indicated more data was needed to determine if the streams are water quality limited for DO. Dissolved Oxygen data was collected every half-hour for three consecutive days at each site. The streams met the state water quality standards for DO.

e. Turbidity and Sedimentation

Turbidity is a function of suspended sediments and algal growth in a stream. Turbidity varies naturally from stream to stream depending upon geology, slope stability, rainfall, and temperature. Turbidity causing activities are allowed no more than a ten percent cumulative increase in stream turbidities, as measured relative to a control point upstream. High turbidity levels can impact salmonid feeding and fish growth (McDonald et al. 1990). Turbidity may also impact drinking water quality and recreational and aesthetic uses of water. Turbidity reduces the depth sunlight penetrates, altering the rate of photosynthesis, and impairing a fish's ability to capture food. Turbidity increases with, but not as fast as, suspended sediment concentrations. Turbidity data have not been collected by the BLM in the WAU. The DEQ did not identify any problems with turbidity.

Mass wasting is the dominant erosional process observed occurring in the Lower Cow Creek WAU. Mass wasting can increase sediment transport and storage in streams, influencing water quality and channel morphology (Benda and Dunne 1997). Mass wasting is the displacement and downslope transport of mostly intact masses of soil, rock, and organic debris by gravity (Thornbury 1965). Generally, they are initiated by infrequent episodic climatic events. Sediment transport to stream channels occurs over similar spatial and temporal patterns of flux and storage that define the sediment regime of a given watershed (Benda and Dunne 1997).

Erosion and sediment production is a natural, cyclic, and inherent process on the landscape. Although sediment yield before human disturbance is unknown, humans have caused a net increase in sediment yield in stream channels.

Although the amount of sediment available to the stream channel has increased, sediment storage capacity has decreased as a result of LWD removal and decreased recruitment, simplifying the aquatic habitat. Increasing sediment, which changes the balance between streamflow and sediment can change the water quality and channel shape.

Roads have the potential to affect the sediment regime. Erosional effects can occur when culverts become plugged or cannot handle peak flows, diverting streams out of the original channel, flowing down the road, and entering another stream channel. Road surface erosion varies greatly with the type and amount of traffic, season of use, and the type and quality of road surfacing material (Reid and Dunne 1984). The types of road-related surface erosion were not quantified for this analysis. The quantity of sediment associated with mass wasting and potential stream crossing failures needs to be evaluated. Roads adjacent to stream channels can deliver sediment to streams, especially when culverts plug and debris torrents occur.

Indirect effects of increased sediment loads may include increased stream temperatures and decreased intergravel dissolved oxygen (MacDonald et al. 1990). In 1991, benthic macroinvertebrate sampling and evaluations were conducted on the West Fork of Cow Creek, Union Creek, and Iron Mountain Creek. The species present, population, and diversity of macroinvertebrates are indicators of water quality. Certain organisms are sensitive to changes in the aquatic environment, such as excessive amounts of sand and silt. Low or moderate levels of fine sediment can greatly depress invertebrate abundance on stream margins and inhibit scrapers. Bioassessments on these streams were expressed as a percent of maximum score. This was done in order to relate site bioassessments to water and habitat quality at each site. A bioassessment score between 80 and 100 percent is considered nonimpaired, between 60 and 79 percent is considered slightly impaired, between 40 and 59 percent is considered moderately impaired, and less than 40 percent is considered severely impaired. The maximum bioassessment score for the West Fork of Cow, Union, and Iron Mountain Creeks was 37, 39, and 53, respectively. Union and the West Fork of Cow Creeks were considered to be severely impaired, while Iron Mountain Creek was considered to be moderately impaired. The high road densities and Riparian Reserve conditions in Union and Iron Mountain Creeks probably contributed to the invertebrate habitat conditions. Iron Mountain Creek had a higher bioassessment score and has 71 percent of the Riparian Reserves that are 80 years old and older.

Suspended sediment and turbidity studies were conducted by Onions (1969), Curtiss (1982), and Rinella (1986) on Cow Creek. Onions and Curtiss determined baseline and storm event suspended sediment and turbidity values at the Cow Creek near Azalea gaging station. The drainage area at the gage is 78 square miles. Only one storm event occurred during the sampling period from December 2, 3, and 4, 1980. The discharge during the storm was 4,020 cfs, which is considered to have a four-year recurrence interval, and yielded 4,050 tons of sediment in three days. This storm produced 95 percent of the total estimated load of 4,270 tons for the 1981 water year. The characteristics controlling the sediment regime have not changed appreciably since the analysis by Onions and Curtiss. A particle analysis done in Cow Creek yielded clay-sized particles.

The study by Rinella (1986) displayed the data differently than the previous studies and used a larger drainage area, 456 square miles, based on data from the Cow Creek near Riddle gaging station. Table 43 lists sediment loads and the percentage of time sediment yields were less than or equal to some value. Generally, there is a positive correlation between suspended sediment and discharge. Suspended sediment loads reach a maximum when streams experience bankfull or greater discharges and reach a minimum during low flow.

Table 43. Sediment Loads and Yields for the Cow Creek Near Riddle Gaging Station.

Percent of time Greater than or Equal to	5	10	25	50	75	90
Pounds of Sediment per Day per Square Mile	0.67	0.80	1.4	5.8	47	381
Tons of Sediment per Year	56	67	116	483	3,911	31,707

Annual load and yield, and median load data for the 1977 water year were 140 tons per year, 0.3 tons per year per square mile, and 1.3 tons per day, respectively. Since a large storm event did not occur in 1977, suspended sediment loads were less than the four-year storm event in the 1981 water year. Rinella calculated suspended sediment yields and loads using sediment transport curves based on monthly samples, whereas Curtiss used flow-duration curves based on 18 years of streamflow records. The Rinella study used a smaller data set and would produce lower estimates than in the Curtiss study. Unfortunately, both studies used large drainage areas and did not discuss smaller drainages, such as Cattle Creek or Iron Mountain Creek. Small increases in sediment loads in Cow Creek probably have occurred since the 1982 study because of road construction. Monitoring sediment concentrations would require measuring large discharge events and taking continuous discharge measurements to document increased sediment loads in streams. First, second, and third order streams drain more than 80 percent of the commercial forest land in western Oregon (Harr et al. 1975). Some of these streams may be important fish rearing and spawning areas. They also transport gravel, wood, and sediment to downstream areas.

f. Trace Metals

The ODEQ established water quality standards for the Umpqua River Basin in the Oregon Administrative rules, Chapter 340-41-282. Trace metals should not be introduced into waters of the state in amounts, concentrations or combinations above natural background levels, which may be harmful, may chemically change to harmful forms in the environment, or may accumulate in sediments or bioaccumulate in aquatic life or wildlife to levels that adversely affect public health, safety, or welfare, aquatic life, wildlife, or other designated beneficial uses. Trace metal water quality criteria should not exceed the criteria established for the various metals by the Environmental Protection Agency (Environmental Protection Agency 1986).

Trace metal data were collected in Middle Creek, Mitchell Creek, the South Fork of Middle Creek, and Russell Creek by the USGS in 1998. Most trace-element concentrations were less than the minimum reporting level of 1 microgram per liter (Hinkle 1999). However, concentrations of zinc (1,450 micrograms per liter), copper (97 micrograms per liter), and cadmium (eight micrograms per liter) in Middle Creek at Silver Butte exceeded the EPA criterion continuous concentration guidelines for the protection of aquatic life (Environmental Protection Agency 1998). The concentration of zinc (134 micrograms per liter) in Middle Creek near Riddle also exceeded the EPA criterion continuous concentration guidelines. The EPA criterion continuous concentration is an estimate of the highest concentration a material in surface water an aquatic community can be exposed to indefinitely without an unacceptable effect (Environmental Protection Agency 1998).

g. Habitat Modification

Streams in the Lower Cow Creek Watershed on the water quality limited list due to habitat modification are Middle Creek and Cow Creek. The Oregon Department of Environmental Quality used the lack of LWD to support the listing. Aquatic macroinvertebrates sensitive to changes in habitat can be used to assess habitat conditions. Aquatic invertebrates are the primary food source for fish and perform an important role in the stream ecosystem. Macroinvertebrate community status is one accepted ODEQ 303 (d) listing criteria for determining impairment of aquatic life.

(1) Middle Creek

Water quality and macroinvertebrate surveys were conducted in Middle Creek by BLM personnel in 1999 because of mining related concerns (see Table 44). Although Middle Creek is on the water quality limited list for habitat modification and temperature, aquatic life uses are primarily limited due to the release of toxic metals from abandoned mining operations (USDI 2000). The ODEQ and BLM are developing a plan to improve water quality in Middle Creek (ODEQ 2000). The effects of habitat modification on aquatic life uses in Middle Creek would remain difficult to quantify until the mining related water quality concerns improve.

(2) Cow Creek

Water quality and macroinvertebrate surveys were conducted in Cow Creek by BLM personnel in 1999 because of mining related concerns (see Table 44). Elevated levels of lead were measured in Cow Creek 100 yards downstream from the confluence with Middle Creek. Metal concentrations were not elevated in Cow Creek ½ mile downstream from the confluence with Middle Creek. However, impacts to macroinvertebrate communities in Cow Creek from toxics were not evident.

Macroinvertebrate data indicated aquatic life had been adversely impacted by habitat modification. Based on the ODEQ macroinvertebrate Biotic Index, sites in Cow Creek above and below the West Fork of Cow Creek were both classified as severely impaired. The site in the West Fork of Cow Creek was classified as severely to moderately impaired (see Table 44). About 58 to 78 percent of the total macroinvertebrates found at the surveyed locations consisted of the tolerant aquatic snail

Juga juga. The dominance of Juga juga was attributed to the presence of filamentous green algae in Cow Creek and the West Fork of Cow Creek in the summer of 1999. Filamentous algal growth is often associated with human caused habitat modification. Human caused habitat modification conditions may include:

•Decreased stream shade, which may increase absorbed sunlight and summer water temperatures;

•Increased stream width/depth ratio, which may increase absorbed sunlight and summer water temperatures;

•Decreased amount of LWD, resulting in fewer deep pools and a greater percentage of riffle to run habitat.

The objective of the 1999 macroinvertebrate surveys conducted by the Roseburg BLM District was to determine the impacts from toxics. However, a stream without extensive habitat modification to use as a comparison was not sampled at the same time.

Table 44. Summary of the 1999 Roseburg BLM District Macroinvertebrate Data Collected In and Near the Lower Cow Creek WAU.

Stream	303(d) Listed Segment/Parameters	Location of Macroinvertebrate Sites	Macroinvertebrate Community Status Evaluation
Middle Creek	Mouth to headwaters/ Habitat Modification and Temperature	5 sites located from the headwaters to the confluence with Cow Creek.	**Severely impaired**. Water quality and macroinvertebrate data indicate toxic metals are the limiting factors.
Cow Creek above Middle Creek and the West Fork of Cow Creek	Not listed	100 yards above the confluence with Middle Creek.	**Severely impaired.** Biotic Index score = 18
Cow Creek below the West Fork of Cow Creek	Mouth to the West Fork of Cow Creek/Habitat Modification and Temperature	1 mile downstream from the confluence with the West Fork of Cow Creek.	**Severely impaired.** Biotic Index score = 18
West Fork of Cow Creek	Mouth to Wilson Creek/ Temperature	100 yards above the confluence with Cow Creek.	**Severely/Moderately impaired** Biotic Index score = 20

h. Nitrogen

Forest fertilization can impact water quality by increasing nitrogen levels in streams. Nitrogen in streams can lead to an increase in primary productivity, particularly algal blooms. Algae accumulations in streams may affect pH. Aquatic organisms release carbon dioxide at night causing stream pH to decrease. During the day aquatic organisms use carbon dioxide and hydrogen during photosynthesis causing stream pH to increase. Aquatic organism respiration can lead to large changes in pH between night and day. Peak nitrogen concentrations coinciding with optimum growing conditions for aquatic organisms would have the greatest effect on a stream (Fredriksen et al. 1975). However, maximum nitrogen concentrations and losses have been measured in the winter when the water was cold and photosynthesis was minimal (Fredriksen et al. 1975).

Studies have measured less than 0.5 percent of the total nitrogen applied reached stream with adequate buffers, whereas two to three percent of the applied nitrogen was measured in streams with inadequate buffers (Moore 1975). Water samples collected from Russell Creek and a tributary to Middle Creek in 1998 indicated nitrogen levels did not increase after fertilization.

E. Stream Channel

Stream channels provide a means of assessing the overall health of a watershed. Aquatic Habitat Surveys and Pfankuch stream channel stability surveys were conducted in the Lower Cow Creek WAU to assess aquatic habitat, channel conditions, and stability. These surveys are not designed to provide a thorough, comprehensive assessment of erosional processes within stream channels. However, selected elements from the Pfankuch protocol provide some insight into erosional processes in headwater streams and document current conditions in the WAU.

Although forest management has not changed peak flows in Cow Creek from reference conditions, channel conditions have changed because of timber harvesting and road construction in riparian areas and the removal of large woody debris. The decrease in peak flows after Galesville Reservoir was completed may have changed the channel equilibrium to an energy limited system. In such a system, channel aggradation (deposition) occurs when channel maintaining flows decrease.

Key identifiers of channel stability from the Pfankuch Stream Channel Condition and Stability Inventory are shown in Table 45. The key identifiers include mass wasting of upper stream banks, lower stream bank cutting, and deposition of fine sediment (including sand, silt, and clay-sized particles) within the channel. A cumulative score of eleven would indicate the most stable stream condition and 44 the most unstable stream condition. Differences are considered meaningful when ranking, e.g., from good to fair, changes (see Table 46).

Table 45. Pfankuch Stream Channel Stability Survey Results for Selected Elements.

Stream Name **Subwatershed Mean Ranking**	Element Ranking			
	Mass Wasting	Bank Cutting	Deposition of Fines	Cumulative
South Fork of Middle Creek (Section 29)	3.0	6.0	8.0	17.0
Upper Middle Creek Subwatershed	3.0	6.0	8.0	17.0
Smith Creek (Section 25)	5.4	7.4	8.4	21.6
Martin Creek (Section 35)	6.0	7.0	9.3	22.3
Buck Creek (Section 35)	3.7	5.5	9.0	18.2
Middle Creek (Sections 1 and 33)	7.5	6.0	10.0	23.5
Lower Middle Creek Subwatershed	5.4	6.6	9.1	21.2
Dutchman Creek (Section 27)	5.0	4.8	8.0	17.8
Darby Creek (Section 23)	6.5	4.0	8.0	18.5
Union Creek (Section 13)	7.2	7.4	8.0	22.6
Upper Cow Creek Subwatershed	6.2	5.7	8.0	19.9
Cattle Creek (Section 17)	8.0	6.7	9.3	24.0
Little Dads Creek (Section 7)	5.5	8.0	10.3	23.8
Middle Cow Creek Subwatershed	6.3	7.6	10.0	23.9
Buck Creek (Section 27)	6.3	6.3	8.7	21.3
Cow Creek (Section 1)	6.0	5.0	10.0	21.0
Island Creek (Section 1)	7.2	7.0	9.2	23.4
Lower Cow Creek Subwatershed	6.6	6.1	9.4	22.1
Russell Creek (Section 11)	5.7	6.0	9.7	21.4
Riddle Subwatershed	5.7	6.0	9.7	21.4

Table 46. Pfankuch Ranking System.

Ranking	Mass Wasting	Bank Cutting	Deposition of Fines	Cumulative
Excellent	3.0 - 4.5	4.0 - 5.0	4.0 - 6.0	11 – 15.5
Good	4.6 - 7.5	5.1 - 9.0	6.1 - 10.0	15.6 – 26.5
Fair	7.6 - 10.5	9.1 - 14.0	10.1 - 14.0	26.6 – 38.5
Poor	10.6 - 12	14.1 - 16.0	14.1 - 16.0	38.6 – 44.0

The Pfankuch survey locations were selected to be representative of the WAU and differences in geomorphology and land management. The effect of land management on channel stability is an important question to be answered. However, a reference or pre-management condition was not available. The average values for the surveyed stream channels were rated as excellent or good, except mass wasting in Cattle Creek (Section 17) and fine sediment deposition in Little Dads Creek (Section 7) were rated as fair. Overall, the stream channels are stable, efficiently processing flow and sediment without excessive mass wasting, stream bank scour, or instream deposition of fine sediment.

The Pfankuch surveys indicate channel stability has not been affected by increased peak flows, even in drainages where HRP values indicate water quality and fish habitat may be impacted by rain-on-snow generated peak flows. Aquatic habitat surveys conducted by ODFW indicate the removal of large wood debris from streams has had a negative impact. Large wood in the stream channel creates complexity in the channel profile and increases habitat diversity. The lack of LWD is noticeable by the changes in riparian function and aquatic habitat.

VIII. Species and Habitats

A. Fisheries

1. Historic Fish Population Conditions

Accurate historic fish population data are not available since extensive fish population and distribution studies were not conducted in the Lower Cow Creek WAU. Aquatic habitat and fish populations in Cow Creek are similar to the South Umpqua River but on a smaller scale. Information from the South Umpqua River is included in this watershed analysis because it is the available data that is the closest to characterizing the historic fish population status in the Lower Cow Creek WAU.

The South Umpqua River historically supported healthy populations of resident and anadromous salmonid fish. A survey conducted by the Umpqua National Forest in 1937 reported salmon, steelhead, and cutthroat trout were abundant throughout many reaches of the South Umpqua River and its tributaries (Roth 1937). Excellent fishing opportunities for resident trout and anadromous salmon and trout historically existed within the South Umpqua River (Roth 1937). These species survived in spite of the naturally low streamflows and warm water temperatures that occurred historically within the South Umpqua River Basin (Nehlsen 1994).

Historian, George Riddle wrote there were so many fish in Cow Creek the Native Americans could catch several hundred salmon in one night (Riddle 1953). When the fall rains came there would be hundreds of salmon in sight at one time. By 1953, there were few if any salmon in Cow Creek (Riddle 1953).

2. Current Fish Population Conditions

Ocean and freshwater conditions affect anadromous salmon populations because these fish live in both environments. Enhanced streamflows and nearshore ocean mixed layer conditions favor high Alaskan salmon productivity (Mantua et al. 1997). Generally, the converse appears to be true for Pacific Northwest salmon (Mantua et al. 1997).

Scientists are trying to evaluate the importance of suitable freshwater habitat in relationship to ocean conditions for sustaining healthy salmon populations. Decreased streamflows and water quality, dams, and spawning and rearing habitat degradation in Pacific Northwest streams has impacted salmon populations in the last fifty years. The South Umpqua River once supported abundant populations of chinook and coho salmon, steelhead, and cutthroat trout. A 1991 status report identified 214 native, naturally spawning fish stocks throughout the Pacific Northwest were vulnerable and at-risk of extinction (Nehlsen et al. 1991). According to this 1991 report, within the South Umpqua River, summer steelhead was considered to be extinct, spring chinook and coho salmon were considered to be at-risk of extinction, and winter steelhead and fall chinook salmon were not considered to be at-risk.

Winter steelhead and resident rainbow trout (Oncorhynchus mykiss), fall and spring chinook salmon (Oncorhynchus tshawytscha), coho salmon (Oncorhynchus kisutch), and sea-run and resident cutthroat trout (Oncorhynchus clarki) have been documented by the Oregon Department of Fish and Wildlife (ODFW) using the Lower Cow Creek WAU. Fish distribution limits and documented streams barriers in the Lower Cow Creek WAU have been mapped, using GIS (see Map 26). Distribution limits are determined by the extent fish are able to migrate upstream. Natural waterfalls, log or debris jams, beaver dams, and road crossings are potential barriers to fish migration. Other barriers to fish migration may occur because of water quality impairment, such as acid mine drainage in Middle Creek, high or low pH, or high water temperatures.

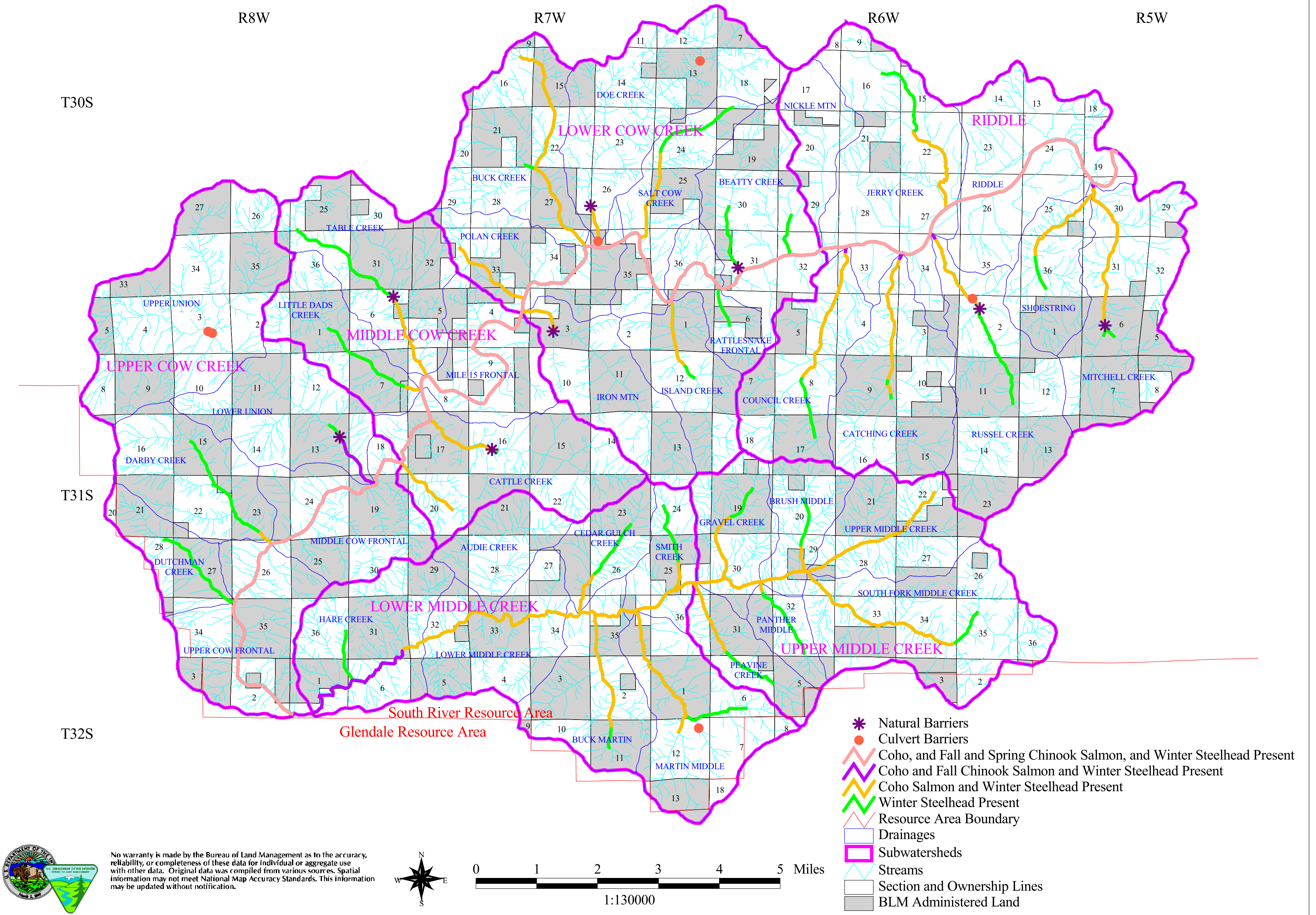
Electrofishing data showed juvenile steelhead numbers declined and very few juvenile coho were using Middle Creek after 1973 (Anderson 1979). Juvenile salmonids were using Middle Creek for rearing in 1984 and 1988 before the Formosa Mine was re-opened (see Table C-6 in Appendix C) (BLM unpublished data and Norecol Environmental Consultants 1988). The Oregon Department of Fish and Wildlife surveyed streams in 1993 for resident and juvenile anadromous fish use in the Lower Cow Creek WAU (see Table C-7 in Appendix C). The ODFW data shows juvenile coho, steelhead, cutthroat and rainbow trout using Middle Creek for rearing. The number of fish declined in the upper reaches of Middle Creek possibly because of acid mine drainage from the Formosa Mine, timber harvesting, and the removal of large woody debris from streams in the WAU.

Fish distribution surveys were conducted to determine the upper limits of resident fish use on BLM-administered land in the Lower Cow Creek WAU (BLM unpublished data 1995 and 1996). The survey data are summarized in Table C-8 in Appendix C. These surveys indicated cutthroat and steelhead juveniles use the upper reaches of most streams in the Lower Cow Creek WAU.

Galesville Dam was completed in 1985 on the upper portion of Cow Creek at River Mile 60.2, eight miles southwest of Canyonville. The dam blocked anadromous access to the upper reaches of Cow Creek. The fish population status before the dam was summarized by Cramer et al. (1997). The Oregon Game Commission treated the lower 74 miles of Cow Creek and 45 miles of its tributaries accessible to anadromous fish with rotenone in August 1970 (Casteel 1970). Cow Creek was restocked with anadromous salmonids but salmonid populations were extremely limited due to excessive summer water temperatures (Anderson 1979).

Thousands of coho and steelhead smolts are released below Galesville Dam every year to mitigate the effects of the dam on anadromous fish. Coho, steelhead, and fall chinook populations in Cow Creek appear to have benefitted from the relatively cool water the dam releases. The affect the dam has on cutthroat populations is difficult to evaluate. The Oregon Department of Fish and Wildlife began smolt trapping with a rotary screw trap at the mouth of Cow Creek after Galesville Dam was completed in 1986 to mitigate the effects of the dam on fish.

Map 26. Lower Cow Creek Watershed Analysis Unit
Fish Distribution and Documented Barriers



a. Steelhead

Historically, steelhead runs in the South Umpqua River were strongest in the winter (Roth 1937). Currently, winter steelhead are considered to be the most abundant anadromous salmonid in the South Umpqua River (Nehlsen 1994). In 1937, Roth reported summer steelhead above the South Umpqua Falls. Summer steelhead are now considered to be extinct in the South Umpqua River (Nehlsen et al. 1991).

No steelhead were caught on Cow Creek in 1986 (Campbell-Craven 1992, in Cramer et al. 1997). The natural production of steelhead in Cow Creek and perhaps in its tributaries was considered to be low at the time Galesville Dam was constructed. The number of steelhead increased sharply from 1988 to 1990, which may have been because steelhead began spawning in Cow Creek or production in its tributaries increased. Spawning in Cow Creek near Galesville Dam was observed (Cramer et al. 1997).

In 1999, 232 wild steelhead fry and 199 wild steelhead smolts were captured in the smolt trap at the mouth of Cow Creek (Oregon Department of Fish and Wildlife 1999). In 2000, 280 wild steelhead fry and 156 steelhead smolts were captured in the smolt trap at the mouth of Cow Creek (Oregon Department of Fish and Wildlife 2000). In 2000, 31,141 hatchery steelhead were released at Galesville Dam.

The Oregon Coast steelhead trout Evolutionary Significant Unit (ESU) is a candidate for listing under the Endangered Species Act (Federal Register, Vol.63 No.53/Thursday, March, 19, 1998/ Rules and Regulations). An ESU is defined as a distinct population or group of populations that are reproductively isolated from other population units and represent an important component in the evolutionary legacy of the species.

b. Chinook Salmon

Historically, the principal chinook run was in the late spring and summer (Roth 1937). The Oregon Department of Fish and Wildlife (ODFW) considered spring chinook runs to be depressed with 92 to 716 juvenile fish migrating to the ocean from 1985 to 1995 (ODFW unpublished data). The spring chinook run is considered to be at high risk of extinction (Nehlsen et al. 1991). Fall chinook runs are considered to be healthy by ODFW (Nehlsen 1994).

Spawning fall chinook salmon ranged between 25 and 369 from 1978 to1988. There were 1,636 fall chinook salmon spawning in Cow Creek in 1996. The number declined to 406 in 2000 (Oregon Department of Fish and Wildlife 1998). Stocking of hatchery-reared fall chinook in Cow Creek began in 1986 but ended in 1991 (Cramer et al.1997). Releases of hatchery fish were discontinued due to the steadily increasing number of fall chinook salmon. The fall chinook salmon returning to Cow Creek are considered to be wild fish.

Juvenile chinook salmon exhibit two general fresh water rearing patterns, stream-type rearing and ocean-type rearing. Stream-type chinook salmon do not migrate to the sea during their first year of life but delay migrating for one or two years (Healey 1983, as cited by Groot and Margolis1991). The stream-type chinook salmon often move out of the tributary streams and into the main river where they occupy deep pools or crevices between boulders and cobble during the winter. Ocean-type chinook salmon migrate to the sea during their first year of life, normally within three months.

The ODFW smolt trapping data show 2,325 fall chinook salmon were captured in 1999. About 6,654 fall chinook were captured in 2000. All of these chinook leave Cow Creek in a pre-smolt stage, spend some time rearing in the Umpqua River, and then migrate out to the ocean.

c. Coho Salmon

Coho salmon were considered abundant in the South Umpqua River Basin in 1972 by the Oregon State Game Commission (Lauman et al. 1972). About 4,000 coho salmon spawned in the South Umpqua River Basin with 1,450 spawning in Cow Creek. Coho salmon in the South Umpqua River Basin are suffering the same declines as other coastal stocks. These declines may be due to the degradation of coho salmon habitat, the effects of extensive hatchery releases, and overfishing (Nehlsen 1994). No coho salmon were observed in the upper stream reaches of the South Umpqua River Basin during the 1937 survey (Roth 1937). Coho salmon were documented in Jackson Creek, a major tributary to the South Umpqua River, in the summer of 1989 (Roper et al. 1994). The documentation of coho salmon in Jackson Creek suggests this species exists in other tributaries in the upper reaches of the South Umpqua River Basin.

Coho salmon have been observed in the Lower Cow Creek WAU. Extensive spawning surveys have not been conducted in Cow Creek. The densities of spawning coho observed in Cow Creek during the mid 1990s were well below the optimum (Cramer et al. 1997).

The ODFW smolt trapping data show 62 coho fry and 547 coho smolts were captured in 1999. About 1,044 coho fry and 1,370 smolts were captured in 2000.

The National Marine Fisheries Service (NMFS) listed the Oregon Coast Coho Salmon Evolutionary Significant Unit (ESU) as a threatened species in 1998 under the Endangered Species Act (ESA) of 1973 (Federal Register, Vol.63, No. 153/ Monday, August 10, 1998/Rules and Regulations). Critical habitat for Oregon Coast Coho Salmon was designated on February 16, 2000.

d. Cutthroat Trout

Cutthroat trout in the Lower Cow Creek WAU can be divided into three distinct groups based on differences in life histories. The three groups include resident, fluvial (in-river migratory), and anadromous (or sea-run). Resident cutthroat trout do not migrate long distances, instead they remain in tributaries near spawning and rearing areas and maintain small territories (Trotter 1989, as cited by Johnson et al.1994). They appear to be slower growing than their fluvial and sea-run counterparts, seldom growing larger than six to eight inches in length. Resident cutthroat trout rarely live longer than two or three years (Wyatt 1959, Nicholas 1978, as cited by Johnson et al. 1994).

Fluvial cutthroat trout rear in large river basins but do not migrate to the sea. Similar to sea-run cutthroat trout, fluvial cutthroat trout migrate into smaller tributaries to spawn. Little is known about fluvial cutthroat trout. This life history group was discovered only recently in the Umpqua River Basin. Fluvial cutthroat trout have been reported below barriers or in locations occupied by anadromous fish on rare occasions (Johnson et al. 1994).

Anadromous (sea-run) cutthroat trout rear in estuaries or make short ocean migrations and then return to freshwater streams to spawn. Unlike other anadromous salmonids, sea-run cutthroat trout do not overwinter in the ocean and rarely make long migrations across large bodies of water.

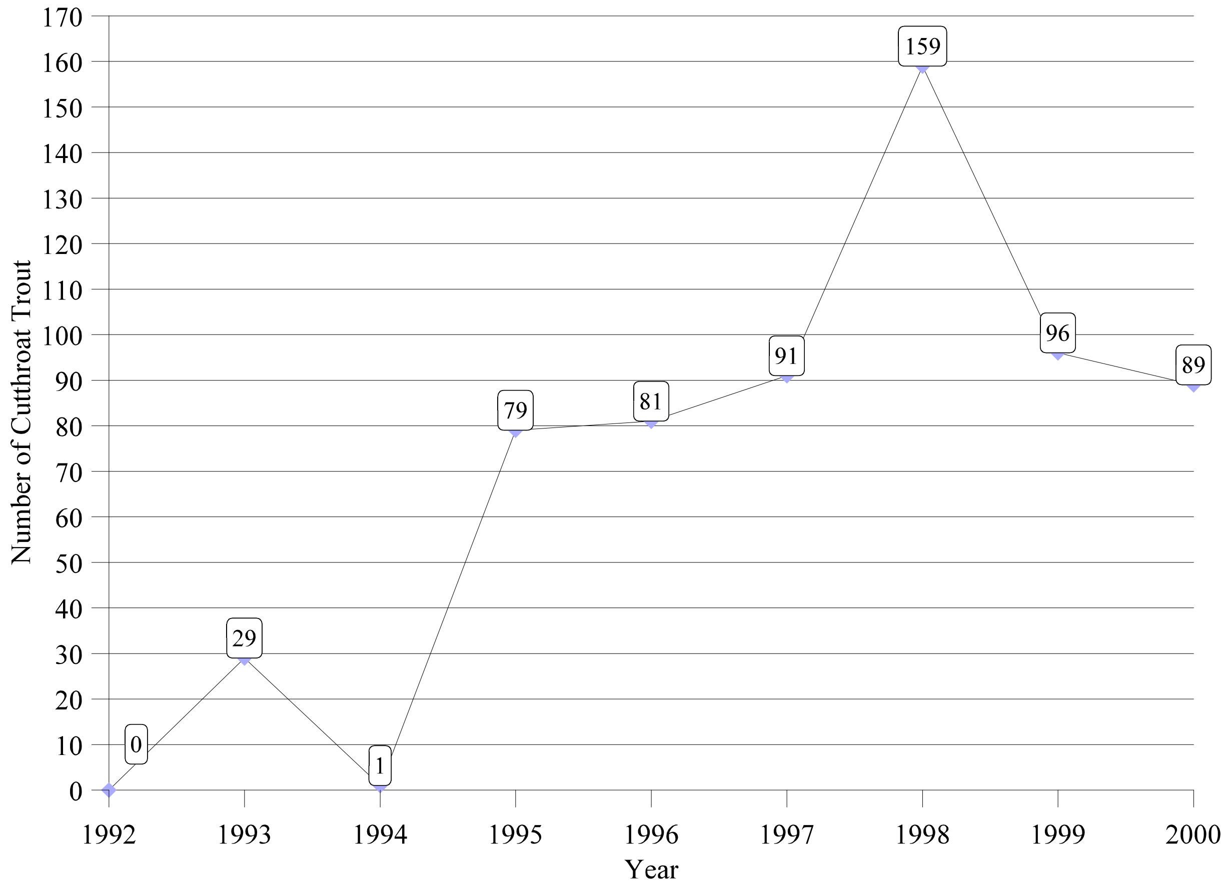
Sea-run cutthroat trout are assumed to be depressed from historic levels. Cutthroat trout were common or abundant throughout the stream segments surveyed in the South Umpqua Subbasin in 1937 (Roth 1937). Historical information about cutthroat trout population size in the South Umpqua River is limited.

The assumption that sea-run cutthroat trout abundance is currently below historic levels throughout the Umpqua River Basin is based upon the information provided by the fish counting station at Winchester Dam on the North Umpqua River. Between 1947 and 1957, sea-run cutthroat trout runs in the North Umpqua River averaged about 900 fish per year. The highest number of sea-run cutthroat trout returning to the North Umpqua River between 1947 and 1957 was 1,800 fish in 1954. The lowest number was 450 sea-run cutthroat trout in 1949. In the late 1950s, the sea-run cutthroat trout returns declined drastically.

The stocking of Alsea River cutthroat trout into the Umpqua River Basin began in 1961 and continued until the late 1970s. Introducing this genetically distinct trout stock into the Umpqua River Basin has apparently compounded the problem for sea-run cutthroat trout native to the Umpqua River Basin. Sea-run cutthroat trout returns have been extremely low since discontinuing the hatchery releases in the late 1970s. The levels of returns resemble prehatchery release conditions of the late 1950s, with an average return of less than100 fish per year (ODFW 1994 - overhead packet). Graph 7 shows the number of sea-run cutthroat trout that returned to the North Umpqua River from 1992 through 2000.

According to the data available, the South Umpqua River appears to have supported a larger run of sea-run cutthroat trout than the North Umpqua River. In 1972, 10,000 sea-run cutthroat trout were estimated to have returned to the South Umpqua River. Sea-run cutthroat trout populations have the highest occurrence in streams occupied by and accessible to coho salmon (Lauman et al. 1972). Sea-run cutthroat trout are currently limited to the upper reaches of the South Umpqua River and Cow Creek, one of the major tributaries to the South Umpqua River. Warm water temperatures, lack of over-summering pool habitats, and low flows prevent sea-run cutthroat trout from using the lower stream reaches of the South Umpqua Subbasin (Nehlsen 1994).

Graph 7. Number of Returning Adult Sea-run Cutthroat Trout Counted at Winchester Dam on the North Umpqua River From 1992 to 2000.



The ODFW smolt trap captured seven cutthroat trout in 1999 and ten in 2000. Sea-run cutthroat trout can avoid being captured in the trap because they are larger when they migrate. The low number of cutthroat trout being captured may indicate they are mostly resident or fluvial cutthroat trout in Cow Creek.

The Oregon Coast cutthroat trout ESU is being reviewed whether to consider it as a candidate species under the Endangered Species Act by the United States Fish and Wildlife Service (USFWS). Jurisdiction for the Oregon Coast cutthroat trout was transferred from the National Marine Fisheries Service to the USFWS on April 21, 2000 (Federal Register, Vol. 65, No.78/Friday, April 21, 2000).

e. Native Non-salmonid Species

The ODFW smolt trap captured native non-salmonid fish species inhabiting Cow Creek. These species included lamprey ammocete (unknown species), Pacific lamprey (Lampetra tridentata), Umpqua pikeminnow (Ptychocheilus oregonensis), redside shiner (Richardsonius balteatus hydrophlox), sculpin (Cottus spp.), speckled dace (Rhinichthys osculus), longnose dace (Rhinichthys cataractae dulcis), and coarse-scale sucker (Catostomus macrocheilus).

The Pacific lamprey (Lampetra tridentata) and Umpqua chub (Oregonichthys kalawatseti) are considered to be Species of Concern by the USFWS and Bureau Sensitive Species by the BLM. The Umpqua chub was considered to be common in Cow Creek in 1987 but had disappeared from two out of three of the same sampling sites in 1998 (Simon 1998). The decline in Umpqua chub populations may be a result of non-native species, such as smallmouth bass.

f. Non- native Species

Many non-native species, such as black crappie, brown bullhead, bluegill, and smallmouth bass inhabit Cow Creek. The stocking of ponds and releasing of game fish into the South Umpqua Subbasin have allowed non-native fish access to Cow Creek. The warm water temperatures in the Lower Cow Creek WAU are preferred by many non-native species.

3. Historic Stream Habitat Conditions

Over the last 150 years, salmonids have had to survive dramatic changes in the environment. Streams and rivers in the Pacific Northwest have been altered by European-American settlement, urban and industrial development, and land management practices. Modifications in the landscape and waters of the South Umpqua River Basin, beginning with the first settlers, have made the South Umpqua River less habitable for salmonid species (Nehlsen 1994).

Aquatic habitat studies have not been conducted in Cow Creek. Information from habitat conditions in the South Umpqua River can be used to characterize conditions in Cow Creek. The historical condition of the riparian zone along the South Umpqua River favored conditions typical of old-growth forests found in the Pacific Northwest (Roth 1937). Roth noted the shade component that existed along the surveyed stream reaches. The majority of the stream reaches surveyed were "arboreal" in nature, meaning "tall timber along the banks, shading most of the stream" (Roth 1937). The river and its tributaries were well shaded by the canopy closure associated with mature trees. Streambanks were provided protection by the massive root systems of these trees.

Since 1937, many changes have occurred within the South Umpqua River Basin and in the stream reaches surveyed by Roth. A comparative study conducted by the Umpqua National Forest during summer low flows between 1989 and 1993 surveyed the same stream reaches as in the 1937 report. The results of the study show that 22 of the 31 surveyed stream segments were significantly different than in 1937. Nineteen stream reaches were significantly wider while the remaining three stream segments were significantly narrower. Of the eight streams surveyed within designated wilderness areas, only one stream channel increased in width since 1937. Thirteen of the 14 stream reaches located in areas where timber harvesting occurred were significantly wider than in 1937.

The stream widening may have resulted from increased peak flows. Peak flows may occur after the removal of vegetation (tree canopy) and increases in compacted area within a watershed, especially within the transient snow zone (Meehan 1991). Peak flows can introduce sediment into the stream channel from upslope and upstream, which can simplify the channel by rearranging instream structure. Excessive sediment delivery to streams usually changes stream channel characteristics and configuration. These stream channel changes normally result in decreasing the depth and the number of pool habitats and reducing the space available for rearing fish (Meehan 1991).

Results from the most recent Umpqua National Forest study document changes in low flow channel widths that have occurred within the South Umpqua River Basin since 1937 (Dose and Roper 1994). Land management activities (road construction and timber harvesting) may have contributed to the changes in stream channel characteristics. These changes in channel condition may have contributed to the observed decline in three of the four anadromous salmonid stocks occurring in the South Umpqua River Basin (Dose and Roper 1994).

4. Current Stream Habitat Conditions

The ODFW conducted Aquatic Habitat Inventories on 22 streams in the Lower Cow Creek WAU. About 70 miles of approximately 1,165 stream miles in the Lower Cow Creek WAU were inventoried (see Table C-3 in Appendix C). The inventories are used to describe the current condition of the aquatic habitat with a focus on the fish bearing stream reaches. The data collected through the ODFW Aquatic Habitat Inventory can be used to analyze the components that may limit the aquatic habitat and the fishery resource from reaching their optimal functioning condition. Each stream contains different limiting factors. Limiting factors for the fishery resource may include reduced instream habitat structure, increased sedimentation, the absence of a functional riparian area, decreased water quantity or quality, or the improper placement of drainage (i.e. culverts) and erosion control devices associated with roads.

The Habitat Benchmark Rating System is a method developed by the Umpqua Basin Biological Assessment Team (BAT team) to rank aquatic habitat conditions. The BAT team consists of fisheries biologists from the Southwest Regional Office of the ODFW, Coos Bay BLM District, Roseburg BLM District, Umpqua National Forest, and Pacific Power Company. This group of local fisheries biologists address and resolve local questions and problems associated with the fisheries resource in the Umpqua River Basin. The matrix designed by the BAT team provides a framework to easily and meaningfully categorize habitat condition. This matrix is not intended to reflect equality of the habitat condition of each stream reach but to summarize the overall condition of the surveyed reaches. The matrix consists of four rating categories Excellent, Good, Fair, and Poor (see Table C-2 in Appendix C).

Data from the ODFW Aquatic Habitat Inventory conducted in the Lower Cow Creek WAU were analyzed to determine an overall Aquatic Habitat Rating (AHR) for each stream reach. How the ratings correlate with the NMFS Matrix of Pathways and Indicators is shown in Table 47. The Matrix of Pathways and Indicators is used to evaluate current stream conditions and what effects an action may have on those conditions during the Threatened and Endangered Species Section 7 consultation process (see Table C-5 in Appendix C).

Table 47. Comparison of the Aquatic Habitat Ratings (AHR) to the NMFS Matrix Ratings.

ODFW Aquatic Habitat Inventories	NMFS Matrix
Excellent or Good	Properly Functioning
Fair	At Risk
Poor	Not Properly Functioning

Fifty-two of the 67 stream reaches identified in the inventories were rated as being in fair condition (see Table C-3 in Appendix C). Two of the stream reaches were rated as being in good condition and seven of the reaches were rated as being in poor condition. Six of the seven stream reaches rated as poor were located in the Upper or Lower Middle Creek Subwatershed.

The lack of large woody debris (LWD) seemed to be the limiting factor in most of the stream reaches surveyed by ODFW. Excessive sediment, hardwood dominated riparian areas, the lack of large conifers available for future recruitment of the LWD, and the lack of shade contributing to higher stream temperatures were other limiting factors in some of the stream reaches. Large woody debris is an important component in stream function and aquatic habitat. Large woody debris traps and stores sediment and organic material, dissipates stream channel energy, and creates pools. Trapped sediments can be used by fish for spawning. The organic material trapped behind LWD is important to macroinvertebrates. Resident and juvenile anadromous fish depend on healthy macroinvertebrate populations as a food source. The backwater areas and deep pools created by LWD provide cover and resting areas for spawning salmonids. Rearing salmonids also use these areas for feeding and refugia from predatory fish and high flows. The low frequency and volume of instream large woody debris in the Lower Cow Creek WAU provides a limited amount of pool habitat for fish.

Other stream channel characteristics impacted by the lack of LWD include stream channel sinuosity, streambank stability, and floodplain interaction. Limiting a stream's ability to overflow onto the floodplain during high stream flow events inhibits stream channel hydraulics and channel dynamics. Normally, these conditions cause the channelization of stream flow and channel incision. Bureau of Land Management survey crews observed many of the streams on BLM-administered land in the Lower Cow Creek WAU are incised and disconnected from their floodplain. Floodplains are used by rearing fish as refugia.

Habitat Restoration

The BLM administers land along approximately two miles of Martin Creek, a major tributary to Middle Creek. In 1984, five instream gabion baskets were placed in Martin Creek in the SE$^1/_4$, SE$^1/_4$, of section 35, in T31S, R7W. The structures provided pool habitat and recruited and maintained spawning gravels in the stream. These structures remained in place until the winter of

1996-1997 when flood events caused three of the five structures to fail. The spawning gravels that had been recruited were washed downstream and pools that had developed were lost. The two remaining structures were heavily damaged and are causing lateral scour, which has caused channel widening. These structures were not properly keyed into the banks and the streambanks are eroding around the structures.

Restoration projects were constructed on Iron Mountain, Cattle, and Council Creeks in 1995. The Iron Mountain Creek and Council Creek culvert restoration projects were constructed to improve the integrity of the culverts while providing juvenile and adult fish passage. The Cattle Creek culvert was replaced with a bottomless arch structure. All of these projects are providing fish passage. Several culverts on tributaries of Middle Creek have been replaced by private land owners to provide fish passage.

5. Interpretation

Six of the seven stream reaches rated as poor in the Aquatic Habitat Inventories were located in the Upper or Lower Middle Creek subwatersheds. Middle Creek was designated a Tier 1 Key Watershed and approximately half of the Key Watershed is in a Late-Successional Reserve. These two designations make watershed improvements and restoration in the Middle Creek Tier 1 Key Watershed a priority for the fisheries and aquatic resources. Restoration goals would be to improve the aquatic habitat through LWD placement, instream rock weir placement, and reducing erosion from roads by decommissioning, obliterating, or renovating the roads, and improving upland conditions.

B. Wildlife

1. Historic and Current Wildlife Use of the Lower Cow Creek WAU

Many wildlife species use the different habitat types present in the WAU. The various vegetation types provide habitat to over 200 terrestrial vertebrate species and thousands of invertebrate species. One hundred sixteen animal species are of special concern by the Bureau of Land Management because they are Federally Threatened (FT), Federally Endangered (FE), Survey and Manage, Bureau Sensitive (BS), Bureau Assessment (BA), or Bureau Tracking (BT) species.

Management for Federally Threatened and Federally Endangered species comply with the Endangered Species Act of 1973, as amended. Survey and Manage Species were designated in the Record of Decision (ROD) for the Amendment to the Survey and Manage, Protection Buffer, and Other Mitigation Measures Standards and Guidelines (USDA and USDI 2001). Bureau Sensitive, Bureau Assessment, and Bureau Tracking species are designated by the Oregon/Washington BLM State Director.

a. Federally Threatened and Endangered Species

Four terrestrial species known to occur in the Roseburg BLM District are legally listed as Federally Threatened or Federally Endangered (see Table 48). These species include the American bald eagle (Haliaeetus leucocephalus) (FT), the Columbian white-tailed Deer (Odecoilus virginianus leucurus) (FE) the marbled murrelet (Brachyramphus marmoratus) (FT), and the northern spotted owl (Strix occidentalis caurina) (FT). The northern spotted owl is the only Federally listed wildlife species known to occur in the Lower Cow Creek WAU. Two other legally listed species, Fender's blue butterfly (FE) and the vernal pool fairy shrimp (Branchinecta lynchi) (FT) may occur in the Lower Cow Creek WAU.

Table 48. The Federal Register, Bureau, Oregon State, and Oregon Natural Heritage Program (ONHP) Status of Federally Listed Threatened or Endangered Wildlife Species.

Common Name (Scientific Name)	Species Status				Occurrence		Data Level
	Federal	Bureau	State	ONHP	District	WAU	
Arthropods							
Fender's Blue Butterfly (Icaricia icarioides fenderi)	FPEO	-	-	1	S	U	N
Vernal Pool Fairy Shrimp (Branchinecta lynchi)	FT	-	-	1	U	U	N
Birds							
Bald Eagle (Haliaeetus leucocephalus)	FT	-	ST	1	D	S	3
Marbled Murrelet (Brachyramphus marmoratus)	FT	-	ST	1	D	S	N
Northern Spotted Owl (Strix occidentalis caurina)	FT	-	ST	1	D	D	3
Mammals							
Columbian White-tailed Deer (Odocoileus virginianus leucurus)	FE	-	V	1	D	N	1

FT = Federal Threatened, FE = Federal Endangered, FPEO = Federal Proposed Endangered in Oregon, ST = State Threatened, V = Vulnerable Species, Not at Imminent Risk of Being Listed, ONHP Status 1 = Species Threatened with Extinction Throughout its Range, For Occurrence D = Documented, S = Suspected, U = Unknown, N = Not Expected To Occur, For Data Level N = No Surveys Done or Planned, 1 = Literature Search Only, 3 = Extensive or Protocol Surveys.

(1) The American Bald Eagle

Historic distribution of the bald eagle included the entire northwestern portion of the United States (California, Oregon, and Washington), Alaska, and western Canada. Bald eagle populations probably started declining in the 19th century but did not become noticeable until the 1940s (USDI 1986). Throughout the North American range, drastic declines in bald eagle numbers and reproduction occurred between 1947 and the 1970s. In many places, the bald eagle disappeared from the known breeding range. The reason for this decline was the impact organochloride pesticide (DDT) use had on the quality of egg shells produced by bald eagles (USDI 1986). Bald eagle numbers probably declined on the Roseburg BLM District because DDT was used in western Oregon from 1945 until the 1970s (Henny 1991). Other causes of the bald eagl e's decline included shooting, and habitat removal (Anthony et al. 1983). Historically, the removal of old-growth forests near major water systems (e.g., Cow Creek) contributed to habitat deterioration through the loss of bald eagle nesting, feeding, and roosting habitat.

The American bald eagle was listed as Federally Endangered on March 11, 1967 (Federal Register 32 FR 4001). The bald eagle was moved to the Federally Threatened species list on July 12, 1995 (Federal Register 60 FR 35999) and was proposed for delisting on July 6, 1999 (Federal Register 64 FR 36453).

Information collected during yearly inventories from 1971 to 1995 by Isaacs and Anthony of known bald eagle sites in Douglas County does not list any sites, nests, or territories within or near the Lower Cow Creek WAU (Isaacs and Anthony 1995). Midwinter surveys, from Days Creek to Melrose, have not detected bald eagles near the South Umpqua River-Cow Creek junction (Isaacs 1995). On occasion, bald eagles are observed during the fall, winter, or spring but the eagles do not stay and do not appear to use the area as a long term wintering ground. Nesting bald eagles have not been documented in the Lower Cow Creek WAU. Large, dominant trees with large limbs and broken tops, that are close to water, are often used by eagles for nesting and occur in some forest stands. About 1,823 acres of mature and old-growth forests within one mile of Cow Creek are potential bald eagle habitat.

(2) Columbian White-tailed Deer

The Lower Cow Creek WAU is outside the current and historical distribution range of the Columbian white-tailed deer (USDI 1983). The Columbian white-tailed deer is not present in the WAU. The known Columbian white-tailed deer population is restricted to an area northeast of Roseburg, approximately 20 air miles from the northern boundary of the Lower Cow Creek WAU (USDI 1983). The Columbian white-tailed deer was listed as Federally Endangered in 1978. The Roseburg population of Columbian white-tailed deer was proposed to be delisted as a Federal Endangered species on May 11, 1999 (Federal Register 64 FR 25263).

(3) Fender's Blue Butterfly

The Fender's blue butterfly was listed as a Federal Endangered species on January 25, 2000 (Federal Register 65 FR 3875). This butterfly is only known to occur in the Willamette Valley. Its historical distribution is unknown. The Fender's blue butterfly may occur in the Lower Cow Creek WAU since the plant species it is associated with, Kincaid's lupine (Lupinus sulphurous ssp. kincaidii), has been documented at two sites in the WAU.

The life cycle of Fender's blue butterfly is dependent on a few species of lupine, especially Kincaid's lupine. The caterpillar feeds on lupine during its growing period prior to changing into a butterfly. The presence of Kincaid's lupine indicates Fender's blue butterfly may occur in the Lower Cow Creek WAU.

(4) Marbled Murrelet

The marbled murrelet was listed as a Federal Threatened species in 1992 (USDI 1992c). Critical habitat for the recovery of the marbled murrelet was designated in 1996 (Federal Register 61(102):26256-26278). Information about the biology and inland nesting sites indicates that the marbled murrelet is unlikely to be found more than 50 miles from the Oregon Coast. Surveys for marbled murrelets are not required beyond the 50 mile zone. About half of the Lower Cow Creek WAU is within 50 miles of the Oregon Coast. There are approximately 11,390 acres of suitable marbled murrelet habitat in the Lower Cow Creek WAU (Map 27).

(5) The Northern Spotted Owl

The northern spotted owl was listed as a Federal Threatened species on June 26, 1990 (Federal Register 55 FR 26114). The northern spotted owl is found in the Pacific Northwest, from northern California to southern British Columbia, Canada. The geographic range of the northern spotted owl has not changed much from its historical boundaries. Nesting habitat historically used by northern spotted owls has changed to the point owl population numbers have declined and distribution rearranged. These changes are considered to be a result of habitat alteration and removal by timber harvesting, fire, and land development (Thomas et al. 1990).

(a) Known Sites

Suitable forest stands where northern spotted owls have been located are known as spotted owl activity centers or master sites. There are 42 known northern spotted owl master sites in the Lower Cow Creek WAU (see Table 49). A master site includes the original site where northern spotted owls were nesting and may include one or more alternate sites that the owls have subsequently occupied in the vicinity of the original location. Of the 42 total sites, 25 sites are found on BLM-administered lands (18 in the LSR and 7 in Matrix), 13 on private lands, and 4 sites with alternates on both BLM-administered LSR and private lands.

Map 27. Marbled Murrelet 50 Mile Zone and Suitable Habitat

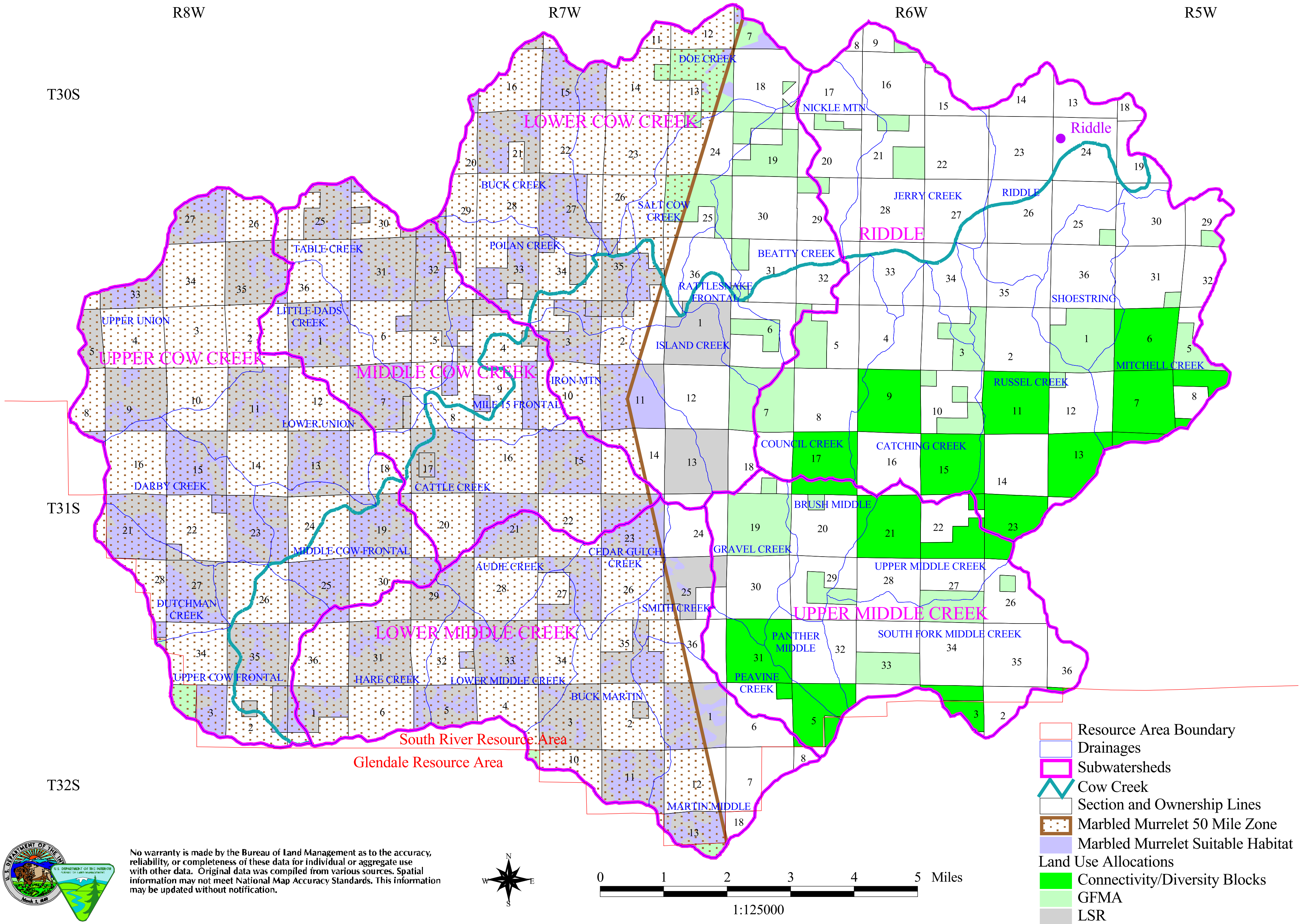


Table 49. Northern Spotted Owl Activity Center Ranking Data Within the Lower Cow Creek WAU in the South River Resource Area (as of 2001).

IDNO	Location Name	Year Site was Located	Last Year of Known Active Pair (Pair Status + Number of Juveniles)	Last Year Occupied (Pair Status)	Number of Years of Reproduction/ Pair Status Since 1985	Suitable Habitat Acres in Provincial Radius (1.3 Miles)	Suitable Habitat Acres in 0.7 Mile Radius	Land Use Allocation	Occupancy Rank	Acres Rank	History Rank	Matrix Rank	LSR Rank
0299	Mitchell Creek	1976	ND	ND	ND	1,113	500	M	3	A	3	3	-
0299A	Mitchell Creek	1985	1998(P+0)	1998(P)	3/10	1,132	613	M	2	A	2	3	-
0299B	Mitchell Creek	1999	2000(P+1)	2000(P)	2/2	1,232	652	M	2	A	1	3	-
0299(all)	Mitchell Creek (all)		2000(P+1)	2000(P)	5/12	1,317	827	M	1	A	1	3	-
0300	Rattlesnake Creek	1993	1993(P+0)	1997(M)	0/1	806	260	M	3	D	3	1	1
0301	Island Creek	1989	1998(P+1)	1998(P)	2/9	1,052	355	LSR	2	B	2	-	3
0301A	Island Creek	1998	1998(P+1)	1998(P)	1/1	1,157	402	LSR	2	B	1	3	3
0301(all)	Island Creek (all)		1998(P+1)	1998(P)	3/10	1,359	488	LSR	1	B	1	3	3
0302	Gravel Creek	1976	ND	ND	0/0	531	291	M	3	D	3	1	1
0302A	Gravel Creek	1986	1987(P+0)	1987(P)	1/2	543	235	M	3	D	3	1	1
0302B	Gravel Creek	1988	1988(P+0)	1988(P)	0/1	666	240	M	3	D	3	1	1
0302(all)	Gravel Creek (all)		1988(P+0)	1988(P)	1/3	873	313	M	3	D	3	1	1
0303	Upper Middle Creek	1997	1986(P+2)	1986(P)	1/1	901	438	M	3	D	2	3	-
0303A	Upper Middle Creek	1987	1988(P+0)	2000(M)	½	605	310	M	2	D	3	3	-
0303B	Upper Middle Creek	1990	1995(P+1)	1999(M+F)	4/5	943	437	M	2	D	1	3	-
0303C	Upper Middle Creek	1991	1991(P+1)	1991(P)	1/1	1,061	384	M	3	B	3	3	-
0303(all)	Upper Middle Creek (all)		1995(P+1)	2000(M)	7/9	1,140	505	M	1	A	1	3	-

Table 49. Northern Spotted Owl Activity Center Ranking Data Within the Lower Cow Creek WAU in the South River Resource Area (as of 2001).

IDNO	Location Name	Year Site was Located	Last Year of Known Active Pair (Pair Status + Number of Juveniles)	Last Year Occupied (Pair Status)	Number of Years of Reproduction/ Pair Status Since 1985	Suitable Habitat Acres in Provincial Radius (1.3 Miles)	Suitable Habitat Acres in 0.7 Mile Radius	Land Use Allocation	Occupancy Rank	Acres Rank	History Rank	Matrix Rank	LSR Rank
0308	Iron Mountain	1983	1999(P+2)	1999(P)	5/8	1,121	585	LSR	2	A	2	-	3
0308A	Iron Mountain	1992	1998(P+1)	1999(P)	3/4	1,135	560	LSR	2	A	2	3	3
0308B	Iron Mountain	1995	2000(P+U)	2000(P)	0/2	1,136	586	LSR	2	A	3	-	3
0308(all)	Iron Mountain (all)		2000(P+U)	2000(P)	8/14	1,350	629	LSR	1	A	1	3	3
0367	Cookhouse Creek	1987	1999(P+0)	2000(M)	0/4	774	429	LSR	1	D	2	-	2
0369	Upper Dice Creek	1977	ND	1995(M)	ND	566	199	LSR	3	D	3	-	1
0371	Brush Creek	1976	ND	1995(M)	ND	878	202	PV	3	D	3	1	-
0372	Lower Cattle Creek	1976	ND	ND	ND	1,102	201	PV	3	B	3	-	1
0373	Cattle Creek	1978	1993(P+2)	1993(P)	2/2	969	470	LSR	3	D	3	-	3
0373A	Cattle Creek	1984	1988(P+0)	1998(P)	1/5	1,031	352	LSR	3	B	2	-	3
0373B	Cattle Creek	1989	2000(P+0)	2000(P)	3/8	910	413	LSR	2	D	2	-	3
0373(all)	Cattle Creek (all)		2000(P+0)	2000(P)	6/15	1,238	507	LSR	1	A	1	-	3
0374	Lower Iron Mountain	1977	ND	ND	ND	681	273	LSR	3	D	3	-	1
0375	Darby Creek	1985	1998(P+0)	1998(P)	1/6	1,085	486	LSR	2	B	3	-	3
0375A	Darby Creek	1999	1999(P+1)	1999(P)	1/1	1,250	466	LSR	2	B	1	-	3
0375B	Darby Creek	2000	2000(P+2)	2000(P)	1/1	ND	ND	LSR	2	ND	1	-	3
0375(all)	Darby Creek (all)		2000(P+2)	2000(P)	3/8	1,303	521	LSR	1	A	1	-	3

Table 49. Northern Spotted Owl Activity Center Ranking Data Within the Lower Cow Creek WAU in the South River Resource Area (as of 2001).

IDNO	Location Name	Year Site was Located	Last Year of Known Active Pair (Pair Status + Number of Juveniles)	Last Year Occupied (Pair Status)	Number of Years of Reproduction/ Pair Status Since 1985	Suitable Habitat Acres in Provincial Radius (1.3 Miles)	Suitable Habitat Acres in 0.7 Mile Radius	Land Use Allocation	Occupancy Rank	Acres Rank	History Rank	Matrix Rank	LSR Rank
0376	Buck Creek	1986	1986(P+2)	1986(P)	2/2	442	76	LSR	3	D	3	1	1
0377	Upper Buck Creek	1987	ND	ND	ND	445	217	PV	3	D	3	1	1
0393	Cedar Gulch	1987	1996(P+Z)	1996(P)	1/3	933	442	LSR	3	D	3	-	2
0393A	Cedar Gulch	1991	ND	2000(M)	ND	682	285	LSR	2	D	3	-	2
0393B	Cedar Gulch	1997	1997(P+2)	1998(F)	1/1	915	366	LSR	2	D	3	2	2
0393(all)	Cedar Gulch (all)		1997(P+2)	2000(M)	2/4	1,272	722	LSR	2	A	2	2	2
1808	Little Dads Creek	1986	1988(P+0)	1988(P)	1/3	778	363	LSR		D	2	-	1
1808A	Little Dads Creek	1989	1993(P+0)	1993(P)	1/4	901	372	LSR	3	D	2	-	1
1808B	Little Dads Creek	1994	1994(P+2)	1995(F)	1/1	1,048	338	LSR	3	B	3	-	1
1808(all)	Little Dads Creek (all)		1994(P+2)	1995(F)	3/8	1,264	514	LSR	3	A	3	-	1
1910	Council Creek	1987	1998(A+U)	2000(M+F)	1/3	928	144	PV	2	D	2	2	-
1911	Hutch Creek	1987	1989(P+1)	1989(P)	1/2	349	191	PV	3	D	3	-	3
1911A	Hutch Creek	1990	2000(P+1)	2000(P)	4/7	1,295	288	PV	1	B	1	-	3
1911B	Hutch Creek	1991	1992(P+2)	1992(P)	1/2	899	330	LSR	3	D	3	-	3
1911(all)	Hutch Creek (all)		2000(P+1)	2000(P)	6/11	2,016	576	PV/LSR	1	A	1	-	3

Table 49. Northern Spotted Owl Activity Center Ranking Data Within the Lower Cow Creek WAU in the South River Resource Area (as of 2001).

IDNO	Location Name	Year Site was Located	Last Year of Known Active Pair (Pair Status + Number of Juveniles)	Last Year Occupied (Pair Status)	Number of Years of Reproduction/ Pair Status Since 1985	Suitable Habitat Acres in Provincial Radius (1.3 Miles)	Suitable Habitat Acres in 0.7 Mile Radius	Land Use Allocation	Occupancy Rank	Acres Rank	History Rank	Matrix Rank	LSR Rank
1912	Martin Creek	1987	2000(P+N)	2000(P)	3/9	954	381	LSR	1	D	2	3	3
1912A	Martin Creek	1992	1992(P+2)	1992(P)	1/1	844	329	PV	3	D	3	3	3
1912B	Martin Creek	1994	1994(P+0)	1994(P)	0/1	895	292	PV	3	D	3	3	3
1912(all)	Martin Creek (all)		2000(P+N)	2000(P)	4/11	1,274	645	PV/LSR	1	A	1	3	3
1913	Martin II	1987	1990(P+0)	1999(M+F)	1/2	775	233	PV	2	D	3	2	2
1913A	Martin II	1989	1993(P+2)	2000(M)	3/3	719	284	PV	2	D	2	2	2
1913B	Martin II	1992	1994(P+2)	1997(F)	2/2	757	287	LSR	3	D	3	2	2
1913(all)	Martin II (all)		1994(P+2)	2000(M)	6/7	1,067	416	PV/LSR	2	B	2	2	2
2000	Catching Creek	1988	1993(P+0)	1999(F)	3/4	963	547	M	2	C	1	3	-
2000A	Catching Creek	1990	2000(P+2)	2000(P)	3/3	886	406	M	2	D	1	3	-
2000B	Catching Creek	1998	1998(P+1)	1998(P)	1/1	838	352	M	2	D	1	3	-
2000(all)	Catching Creek (all)		2000(P+2)	2000(P)	7/8	1,114	593	M	1	A	1	3	-
2043	Cow Creek	1989	1999(P+0)	1999(P)	1/1	1,279	443	LSR	2	B	2	-	3
2043A	Cow Creek	1992	2000(P+2)	2000(P)	4/5	1,312	487	LSR	2	B	1	-	3
2043(all)	Cow Creek (all)		2000(P+2)	2000(P)	5/10	1,667	631	LSR	1	A	1	-	3
2044	Short Darby	1989	1990(P+2)	2000(M)	1/2	1,387	424	PV	3	B	3	-	1
2045	Silver Butte	1989	ND	ND	ND	1,113	367	M	3	D	3	1	-
2046	South Cow Creek	1989	ND	ND	ND	1,136	391	LSR	3	B	3	1	1

Table 49. Northern Spotted Owl Activity Center Ranking Data Within the Lower Cow Creek WAU in the South River Resource Area (as of 2001).

IDNO	Location Name	Year Site was Located	Last Year of Known Active Pair (Pair Status + Number of Juveniles)	Last Year Occupied (Pair Status)	Number of Years of Reproduction/ Pair Status Since 1985	Suitable Habitat Acres in Provincial Radius (1.3 Miles)	Suitable Habitat Acres in 0.7 Mile Radius	Land Use Allocation	Occupancy Rank	Acres Rank	History Rank	Matrix Rank	LSR Rank
2094	Audie Creek	1989	2000(P+0)	2000(P)	3/7	929	87	PV	1	D	1	-	3
2094A	Audie Creek	1991	1991(P+1)	1993(M)	1/1	927	130	PV	3	D	3	-	3
2094(all)	Audie Creek (all)		2000(P+0)	2000(P)	4/8	1,021	161	PV	1	B	1	-	3
2096	Peavine Creek	1989	2000(P+2)	2000(P)	3/7	884	284	LSR	1	D	1	3	3
2101	Calf Creek	1989	2000(P+1)	2000(P)	2/3	814	307	LSR	1	D	1	-	3
2101A	Calf Creek	1991	1994(P+0)	1994(P)	1/2	821	414	LSR	3	D	3	-	3
2101(all)	Calf Creek (all)		2000(P+1)	2000(P)	3/5	1,108	675	LSR	1	A	1	-	3
2149	Table Creek	1989	1999(P+0)	1999(P)	0/1	558	210	LSR	2	D	3	-	2
2149A	Table Creek	2000	2000(P+0)	2000(P)	0/1	ND	ND	LSR	2	ND	3	-	2
2149(all)	Table Creek (all)		2000(P+0)	2000(P)	0/2	558	210	LSR	2	D	3	-	2
2205	Lower Catching Creek	1990	1997(P+0)	2000(F)	3/7	656	177	PV	2	D	2	2	-
2209	No Name	1990	1998(P+0)	1998(P)	3/8	1,031	268	PV	2	B	1	-	3
2209A	No Name	1997	1997(P+2)	1997(P)	1/1	935	302	LSR	3	D	1	-	3
2209B	No Name	1999	2000(P+N)	2000(P)	1/2	935	298	PV	2	D	1	-	3
2209(all)	No Name (all)		2000(P+N)	2000(P)	5/11	1,326	551	LSR	1	A	1	-	3
2298	Hare Creek	1990	2000(P+U)	2000(P)	1/5	1,090	256	PV	2	B	2	-	1
2538	Smith Creek	1976	1999(P+0)	1999(P)	0/1	790	306	LSR	2	D	3	3	3
2538A	Smith Creek	1991	1998(P+0)	1998(P)	2/7	750	265	LSR	2	D	2	3	3
2538B	Smith Creek	1997	2000(P+2)	2000(P)	2/2	775	251	LSR	2	D	1	3	3
2538(all)	Smith Creek (all)		2000(P+2)	2000(P)	4/10	1,106	338	LSR	1	B	1	3	3

Table 49. Northern Spotted Owl Activity Center Ranking Data Within the Lower Cow Creek WAU in the South River Resource Area (as of 2001).

IDNO	Location Name	Year Site was Located	Last Year of Known Active Pair (Pair Status + Number of Juveniles)	Last Year Occupied (Pair Status)	Number of Years of Reproduction/ Pair Status Since 1985	Suitable Habitat Acres in Provincial Radius (1.3 Miles)	Suitable Habitat Acres in 0.7 Mile Radius	Land Use Allocation	Occupancy Rank	Acres Rank	History Rank	Matrix Rank	LSR Rank
3903	Etc	1994	1994(P+1)	1997(M)	1/1	484	46	PV	3	D	3	1	1
4016	Crawford Creek	1993	1998(P+0)	1998(P)	1/6	172	26	PV	2	D	2	1	-
4047	Quartzite	1992	1999(P+0)	1999(P)	0/4	669	367	LSR	2	D	2	-	1
4049	Polan Creek	1992	1997(P+1)	1999(F)	2/2	737	145	PV	2	D	2	-	1
4053	Dads Table	1994	1995(P+0)	2000(M)	0/2	952	279	PV	2	D	3	-	1
4054	Russell Creek	1994	2000(P+2)	2000(P)	2/6	1,057	371	M	1	B	1	3	-
4505	Mad Martin	1995	2000(P+1)	2000(P)	3/5	674	120	PV	1	D	1	3	3
4507	Stanchion Creek	1997	1999(P+0)	2000(M)	1/3	1,013	318	LSR	1	B	2	-	2

Table 49 Definitions
Last Year of Known Active Pair - Shows the year, pair status, and number of young produced. NP = Site has not had a pair. ND = No Data.
Pair Status - M = Male; F = Female; J = Juvenile; P = Pair Status; (M+F) = Two Adult Birds, Pair Status Unknown; PU = Pair Status Undetermined; S = Single Owl; ND = Incomplete or No Data.
Number of Years of Reproduction/Pair Status Since 1985 - The first number represents the number of years with northern spotted owl reproduction at this site since 1985. The second number refers to the number of years for the entire history of the site since 1985 (including the original and alternate sites, i.e. 1090A). ND = No Data.
Occupancy Rank - 1: Sites with this ranking have current occupancy and have been occupied by a single northern spotted owl or pair of northern spotted owls for the last three years; 2: Sites with this ranking have been occupied in the past, show sporadic occupancy by a single northern spotted owl or a northern spotted owl pair, may be currently occupied; 3: Sites with this ranking have not been occupied during the last three years.
Acres Rank - These acres are in regards to suitable northern spotted owl habitat. A: These sites have more than 1,000 acres in the provincial radius and more than 500 acres within the 0.7 mile radius; B: These sites have more than 1,000 acres in the provincial radius but less than 500 acres within the 0.7 mile radius; C: These sites have less than 1,000 acres in the provincial radius and more than 500 acres in the 0.7 mile radius; D: These sites have less than 1,000 acres in the provincial radius and less than 500 acres in the 0.7 mile radius.
History Rank - This ranking includes occupancy ranking, reproduction data, acres ranking, habitat evaluation, and field experience about the site (location, quality, and forest structure). 1: A site considered stable due to consistent occupation by northern spotted owls, which have been producing young consistently; 2: Site is consistently used by northern spotted owls but reproduction is sporadic; 3: Northern spotted owls have reproduced some, occupation has been sporadic, or site has not been occupied. Private = Site is located on private land. State = Site is located on Oregon State Lands.
* These sites are occupied by a pair of barred owls or a pair composed of a female barred owl and a male northern spotted owl.

(b) Nesting, Roosting, and Foraging Habitat

Forest habitat important to the northern spotted owl was identified by Roseburg BLM District wildlife biologists. Using on-the-ground knowledge, inventory descriptions of forest stands, and known characteristics of the forest structure, suitable nesting, roosting, and foraging habitat was identified in the WAU. The suitable northern spotted owl habitat was divided into two types named Habitat 1 (HB1) and Habitat 2 (HB2). Habitat 1 describes forest stands that provide nesting, foraging, and resting components. Habitat 2 describes forest stands that provide foraging and resting components but lack nesting components. Other forest stands not included in the HB1 or HB2 categories and greater than 40 years old are called dispersal habitat. Dispersal habitat provides cover, roosting, foraging, and dispersal components northern spotted owls use while moving from one area to another (Thomas et al. 1990, USDI 1992a, and USDI 1994). There are 8,846 acres of HB1, 13,086 acres of HB2, and 16,686 acres of dispersal habitat on BLM-administered land in the Lower Cow Creek WAU (see Map 28).

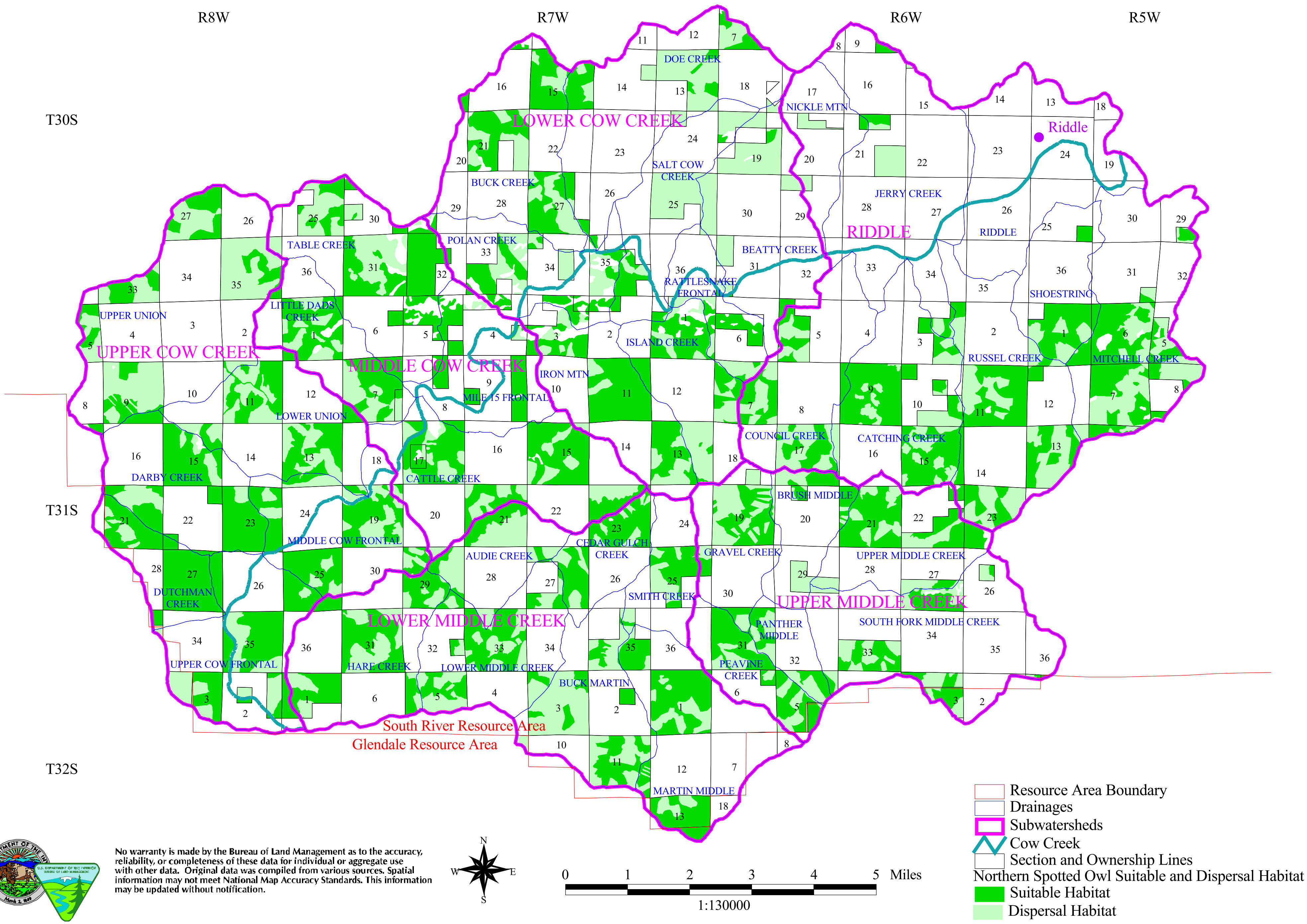
(c) Critical Habitat for the Recovery of the Northern Spotted Owl

Portions of two Critical Habitat Units (CHU) designated by the United States Fish and Wildlife Service for the recovery of the northern spotted owl are located in the Lower Cow Creek WAU (USDI 1992b). They are Critical Habitat Units CHU-OR-62 and CHU-OR-63 (Map 29). Critical habitat unit CHU-OR-62 consists of 99,649 acres and CHU-OR-63 has 10,986 acres. Approximately 52,463 acres of CHU-OR-62 and about 7,338 acres of CHU-OR-63 are inside the Lower Cow Creek WAU. The portion of the Lower Cow Creek WAU overlapping CHU-OR-62 has approximately 14,170 acres of suitable northern spotted owl habitat (HB1 and HB2) and approximately 9,114 acres of dispersal habitat on BLM-administered land. The area in the WAU overlapping CHU-OR-63 has approximately 3,808 acres of suitable habitat and approximately 2,228 acres of dispersal habitat on BLM-administered land.

(6) The Vernal Pool Fairy Shrimp

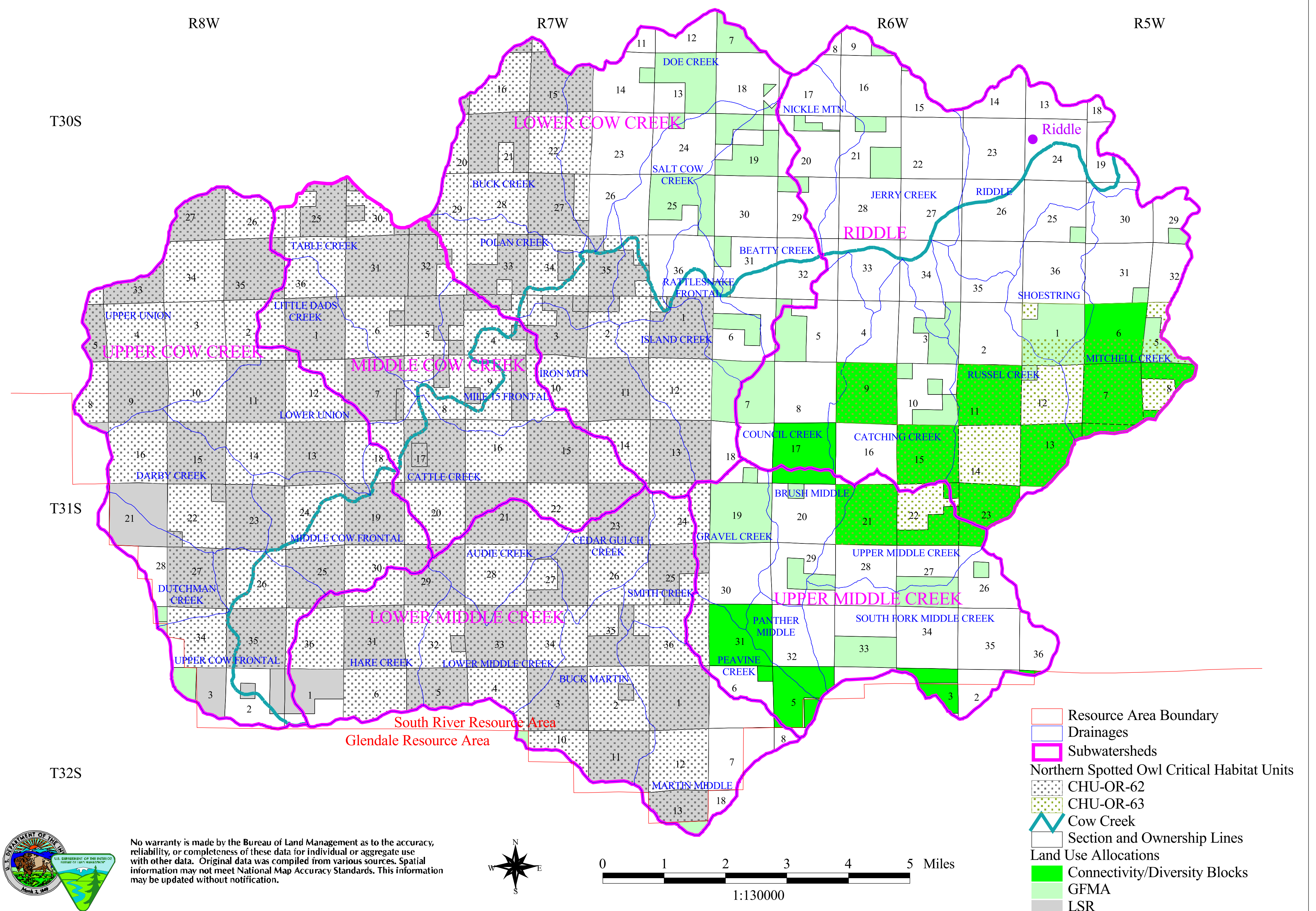
The vernal pool fairy shrimp was listed as a Federal Threatened species on September 19, 1994 (Federal Register 65 FR 18026). The vernal pool fairy shrimp (Branchinecta lynchi) inhabits temporary pools of water found in grass or mud bottom swales (Federal Register 1994). The primary distribution range is in the Central Valley of California. However, the vernal pool fairy shrimp has been located on the Medford BLM District, near Table Mountain. The vernal pool fairy shrimp is not expected to occur on BLM-administered land in the WAU due to the lack of suitable vernal pool habitat. Inventories have not been conducted for this species or its habitat in the Roseburg BLM District. However, pond surveys for amphibians and invertebrates in the WAU in 1999 and 2000 did not find any vernal pool fairy shrimp (see Map 30).

Map 28. Lower Cow Creek Watershed Analysis Unit
Northern Spotted Owl Suitable and Dispersal Habitat on BLM Administered Land



No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data was compiled from various sources. Spatial information may not meet National Map Accuracy Standards. This information may be updated without notification.

Map 29. Lower Cow Creek Watershed Analysis Unit
Northern Spotted Owl Critical Habitat Units



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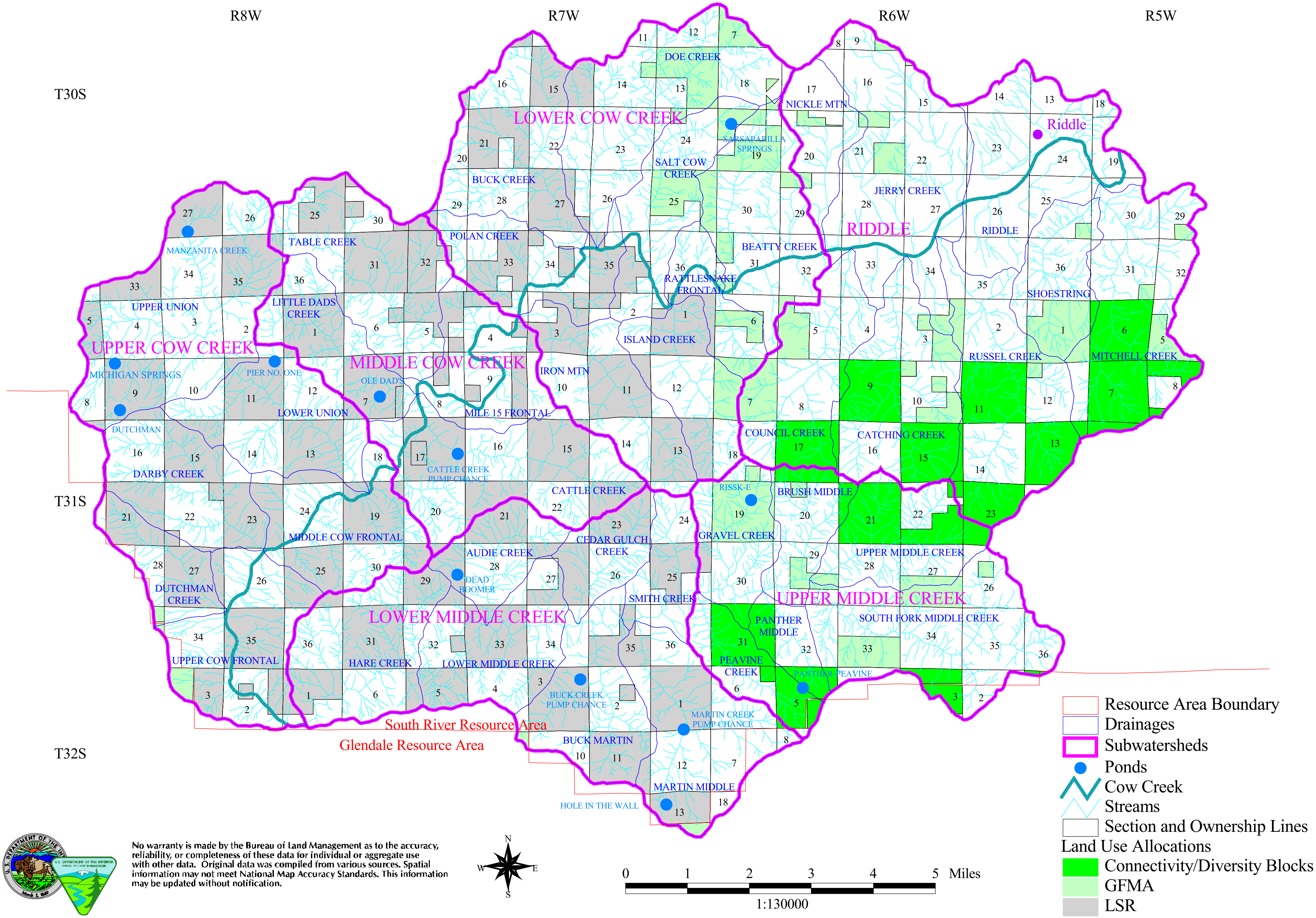
Map 30. Lower Cow Creek Watershed Analysis Unit
Ponds



No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data was compiled from various sources. Spatial information may not meet National Map Accuracy Standards. This information may be updated without notification.

b. Survey and Manage Species

Six Survey and Manage wildlife species may occur in the WAU. Table 50 lists the Survey and Manage species that may occur in the WAU.

Table 50. The Federal Register, Bureau, Oregon State, and Oregon Natural Heritage Program (ONHP) Status of Survey and Manage Wildlife Species.

Common Name (Scientific Name)	Species Status				Occurrence		Data Level
	Federal	Bureau	State	ONHP	District	WAU	
Amphibians							
Del Norte Salamander (Plethodon elongatus)	XC	Survey and Manage, BTO	V	3	D	D	3
Birds							
Great Gray Owl (Strix nebulosa)	-	Survey and Manage, BT	V	4	D	S	3
Mammals							
Oregon Red Tree Vole (Arborimus longicaudus)	-	Survey and Manage	-	-	D	D	3
Mollusks							
Oregon Shoulderband (Helminthoglypta hertleini)	-	Survey and Manage	-	-	D	S	3
Oregon Megomphix (Megomphix hemphilli)	-	Survey and Manage	-	-	D	D	3
Crater Lake Tightcoil (Pristiloma articum crateris)	-	Survey and Manage	-	-	S	U	3

XC = Former Federal Candidate, BT = Bureau Tracking in Washington and Oregon, BTO = Bureau Tracking in Oregon, V = Vulnerable Species, Not at Imminent Risk of Being Listed, ONHP Status 3 = More Information Needed Before Status Can Be Determined, 4 = Taxa of Concern But Not Currently Threatened or Endangered, For Occurrence D = Documented, S = Suspected, U = Unknown, For Data Level 3 = Extensive or Protocol Surveys.

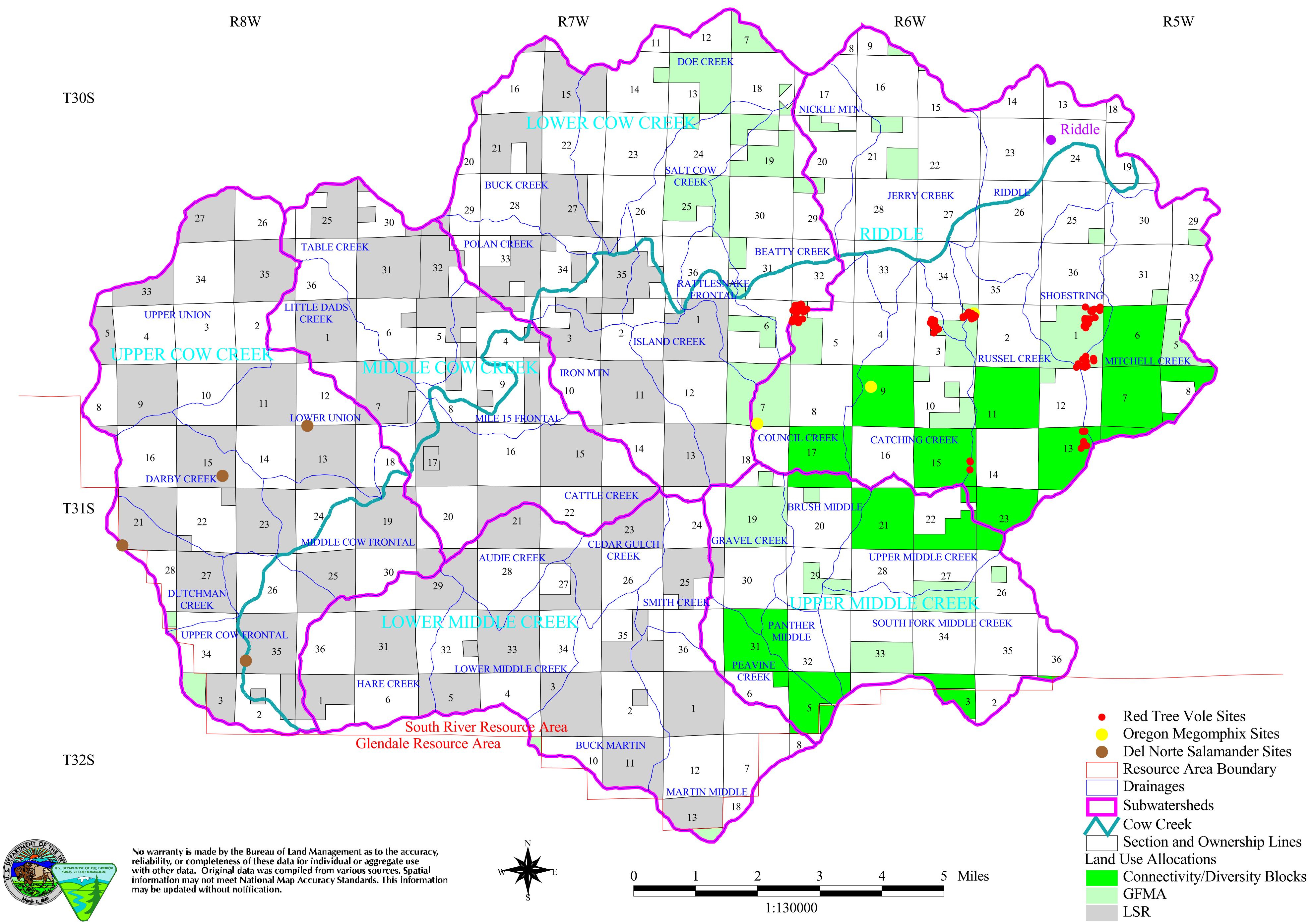
(1) Del Norte Salamander

There are three known Del Norte salamander (Plethodon elongatus) sites located in the Lower Cow Creek WAU (see Map 31). Optimal Del Norte salamander habitat includes rocky soils dominated by cobbles in older forests, surface rock deposits, or fissured rock outcrops. The Del Norte salamander needs cool, moist conditions with most surface activity occurring when the air temperature is between 40 and 77 degrees Fahrenheit (IM-OR-2000-004). The known range of the Del Norte salamander includes the southwest portion of the Lower Cow Creek WAU.

(2) Mollusks

Two terrestrial mollusks species, the Oregon shoulderband (Helminthoglypta hertleini) and the Oregon Megomphix (Megomphix hertleini) occur in the Roseburg BLM District (IM-OR-98-097). The Oregon Megomphix occurs at three documented sites and the Oregon shoulderband is suspected

Map 31. Lower Cow Creek Wateshed Analysis Unit
Known Survey and Manage Wildlife Species Sites



to occur in the Lower Cow Creek WAU (see Map 31). The Lower Cow Creek WAU is outside of the range of the Crater Lake tightcoil (Pristiloma articum ssp. crateris) and is not expected to occur in the WAU (IM-OR-98-097). There are no aquatic Survey and Manage mollusk species known to occur within the Lower Cow Creek WAU.

(3) Red Tree Vole

Eleven red tree vole (Arborimus longicaudus) nest trees have been identified on 251acres of timber sale clearance surveys in the Lower Cow Creek WAU (see Map 31). An additional 82 potential red tree vole nests have been identified but not confirmed as red tree vole nests. Red tree voles are more likely to be found in the Douglas-fir vegetation zone in the Lower Cow Creek WAU. Red tree vole nest density is expected to be greater in older, structurally diverse stands than in younger, less complex stands. The Interior Valleys and Foothills Zone in the WAU probably would not have substantial red tree vole populations since their primary food is Douglas-fir needles (see Map 32). However, western hemlock and grand fir needles are also eaten by red tree voles (Biswell, personal communication and IM-OR-2000-037).

c. Bureau Sensitive, Assessment, and Tracking Species

Bureau Sensitive Species (see Table 51) are designated by the BLM State Director and includes species that could become endangered or extinct in a state as defined by Bureau 6840 policy. Bureau Sensitive Species are restricted in range and have natural and human threats to survival. Bureau Assessment Species (see Table 52) are of concern in Oregon and may need protection or mitigation from BLM activities. Bureau Tracking Species (see Table 53) are designated to encourage BLM districts to collect information on species when it is convenient. Bureau Tracking Species could be designated as Special Status Species in the future.

Although there is information about the biology and habitat requirements of some Bureau Sensitive and Bureau Assessment species, population levels and current distribution are either unclear or unavailable. Many of these species use unique habitat features such as ponds, seeps, caves, or talus found throughout the landscape. The distribution, number, and quality of unique features is unknown for the WAU and the Roseburg BLM District.

Map 32. Lower Cow Creek Watershed Analysis Unit
Red Tree Vole Distribution in Relation to Vegetation Zones

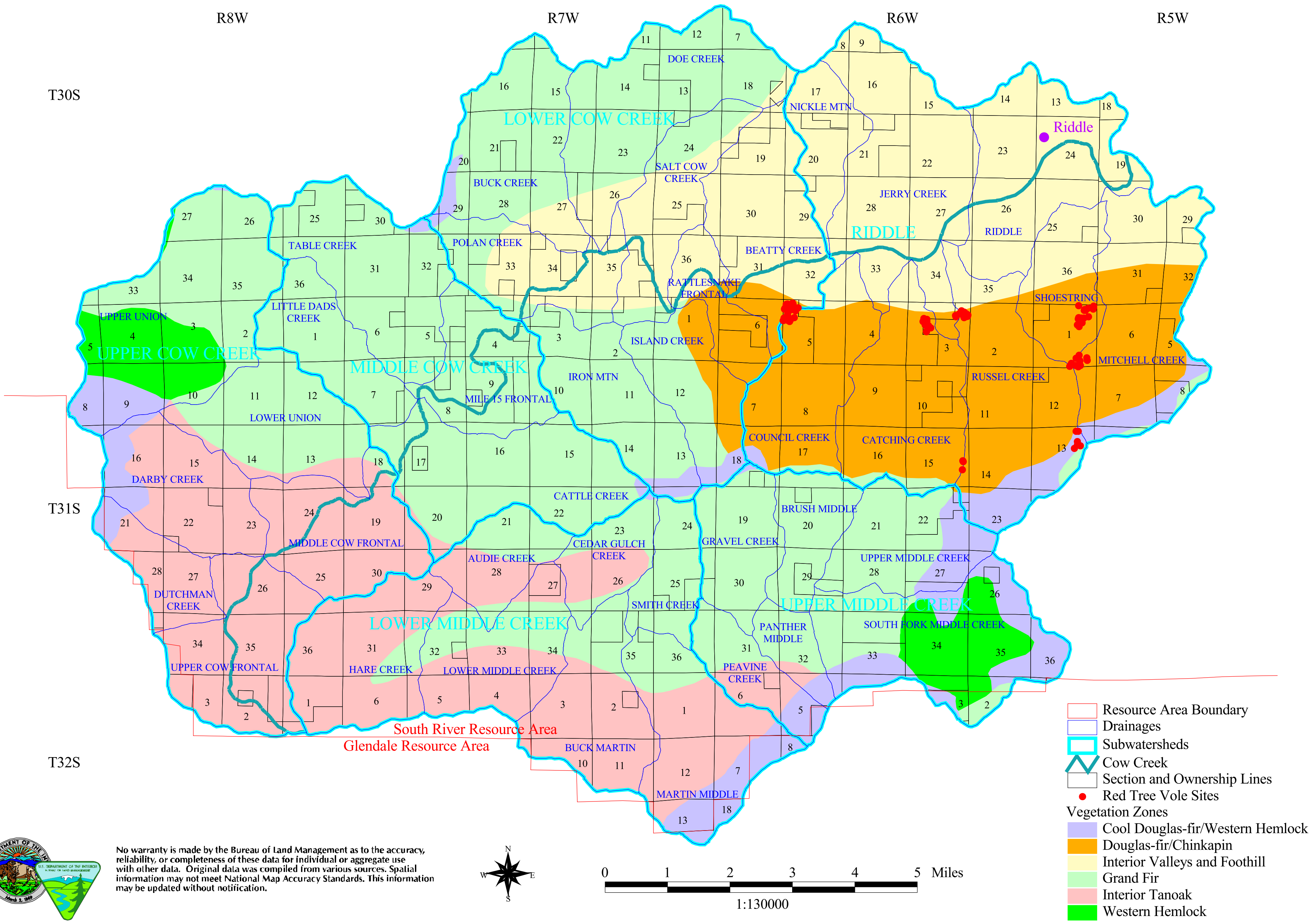


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Table 51. The Federal Register, Bureau, Oregon State, and Oregon Natural Heritage Program (ONHP) Status of Bureau Sensitive Wildlife Species.

Common Name (Scientific Name)	Species Status				Occurrence		Data Level
	Federal	Bureau	State	ONHP	District	WAU	
Annelids							
Oregon Giant Earthworm (Driloleirus macelfreshi)	XC	BSO	-	1	S	S	N
Arthropods							
American Acetropis Grass Bug (Acetropis americana)	-	BSO	-	1	U	U	N
Franklin's Bumblebee (Bombus franklini)	XC	BSO	-	1	S	S	N
Insular Blue Butterfly (Plebejus saepiolus insulanus)	-	BSO	-	1	S	S	N
Birds							
Burrowing Owl (Speotyto cunicularia hypugaea)	XC	BSO	C	3	S	S	N
Lewis' Woodpecker (Melanperes lewis)	-	BSO	C	3	D	U	N
Northern Goshawk (Accipiter gentilis)	XC	BSO	C	3	D	U	3
Oregon Vesper Sparrow (Pooecetes gramineus affinus)	-	BSO	C	3	D	U	N
Peregrine Falcon (Falco peregrinus anatum)		BS			D	D	3
Purple Martin (Progne subis)	-	BSO	C	3	D	U	N
Streaked Horned Lark (Eremophila alpestris strigata)	-	BSO	C	3	U	U	N
Mammals							
Fisher (Martes pennanti)	XC	BSO	C	2	D	N	N
Townsend's Big-Eared Bat (Corynorhinus townsendii)	XC	BSO	C	2	D	S	3
Molluscs							
Crater Lake Tightcoil (Pristiloma arcticum crateris)	-	BSO	-	1	D	N	3
Deschutes Sideband (Monadenia fidelis sub sp. nov.)	-	BSO	-	1	U	U	3
Disc Oregonian (Cryptomastix sp. nov.)	-	BSO	-	1	U	U	3
Green Sideband (Monadenia fidelis beryllica)	-	BSO	-	1	D	N	3
Indian Ford Juga (Juga hemphilli ssp. nov.)	-	BSO	-	1	U	U	3
Oregon Megomphix (Megomphix hemphilli)	-	BSO	-	1	D	S	3
Oregon Shoulderband (Helminthoglypta hertleini)	-	BSO	-	1	D	S	3
Rotund Lanx (Lanx subrotundata)	-	BSO	-	1	D	S	3
Traveling Sideband (Monadenia fidelis celeuthia)	-	BSO	-	1	S	S	3
Reptiles							
Northwestern Pond Turtle (Clemmys marmorata)	XC	BSO	C	2	D	D	3

XC = Former Federal Candidate, BSO = Bureau Sensitive in Oregon, C = Critical, Listing as Threatened or Endangered is Pending, ONHP Status 1 = Species Threatened With Extinction Throughout its Range, 2 = Species Threatened With Extinction in Oregon, 3 = More Information Needed Before Status Can Be Determined, For Occurrence D = Documented, S = Suspected, U = Unknown, N = Not Expected to Occur, For Data Level N = No Surveys Done or Planned, 3 = Extensive or Protocol Surveys.

Table 52. The Federal Register, Bureau, Oregon State, and Oregon Natural Heritage Program (ONHP) Status of Bureau Assessment Wildlife Species.

Common Name (Scientific Name)	Species Status				Occurrence		Data Level
	Federal	Bureau	State	ONHP	District	WAU	
Arthropods							
Coronis Fritillary Butterfly (Speyeria coronis coronis)	-	BAO	-	2	U	U	N
Birds							
Harlequin Duck (Histrionicus histrionicus)	XC	BAO	U	2	D	N	N
Western Least Bittern (Ixobrychus exilis hesperis)	XC	BAO	P	2	D	N	N
Mammals							
Brazilian Free-Tailed Bat (Tadarida brasiliensis)	-	BAO	-	2	D	S	3
Molluscs							
Blue-Grey Tail Dropper (Prophysaon coeruleum)	-	BAO	-	2	D	D	3
Brown Juga (Juga sp. nov.)	-	BAO	-	2	U	U	3
Papillose Tail Dropper (Prophysaon dubium)	-	BAO	-	2	D	D	3
Siskiyou Hesperian (Vespericola sierranus)	-	BAO	-	2	U	U	3

XC = Former Federal Candidate, BAO = Bureau Assessment in Oregon, P = Species Whose Oregon Populations are on the Periphery of Their Range or are Naturally Rare, U = Undetermined Status of Species, ONHP Status 2 = Species Threatened With Extinction in Oregon, For Occurrence D = Documented, S = Suspected, U = Unknown, N = Not Expected to Occur, For Data Level N = No Surveys Done or Planned, 3 = Extensive or Protocol Surveys.

Table 53. The Federal Register, Bureau, Oregon State, and Oregon Natural Heritage Program (ONHP) Status of Bureau Tracking Wildlife Species.

Common Name (Scientific Name)	Species Status				Occurrence		Data Level
	Federal	Bureau	State	ONHP	District	WAU	
Amphibians							
Cascades Frog (Rana Cascadae)	XC	BT	V	3	D	S	3
Cascade Torrent Salamander (Rhyacotriton cascadae)	-	BT	V	3	D	S	3
Clouded Salamander (Aneides ferreus)	-	BTO	U	3	D	S	3
Del Norte Salamander (Plethodon elongatus)	XC	BTO	V	3	D	D	3
Foothill Yellow-Legged Frog (Rana boylii)	XC	BTO	V	3	D	S	3
Northern Red-Legged Frog (Rana aurora aurora)	XC	BTO	U	3	D	D	3
Oregon Slender Salamander (Batrachoseps wrighti)	-	BTO	U	3	D	S	3
Southern Torrent Salamander (Rhyacotriton variegatus)	XC	BTO	V	3	D	S	3
Tailed Frog (Ascaphus truei)	XC	BT	V	3	D	D	3

Table 53. The Federal Register, Bureau, Oregon State, and Oregon Natural Heritage Program (ONHP) Status of Bureau Tracking Wildlife Species.

Common Name (Scientific Name)	Species Status				Occurrence		Data Level
	Federal	Bureau	State	ONHP	District	WAU	
Arthropods							
Alsea Ochrotrichian Micro Caddisfly (Ochrotrichia alsea)	-	BTO	-	3	S	S	N
American Boreostolus Bug (Boreostolus americanus)	-	BTO	-	3	U	U	N
Ashlock-Obrien's Seed Bug (Malezonotus obrieni)	-	BTO	-	3	U	U	N
Boreal Caridiastethus Pirate Bug (Caridiasthethus borealis)	-	BTO	-	3	U	U	N
California Clubtail Dragonfly (Gomphus kurilis)	-	BTO	-	3	U	U	N
California Giant Damselfly (Archilestes californica)	-	BTO	-	4	U	U	N
California Scutellarid (Vanduzeeina borealis californicus)	-	BTO	-	3	U	U	N
Cascades Apatanian Caddisfly (Apatania tavala)	XC	BTO	-	3	S	S	N
Cooley's Acalypta Lace Bug (Acalypta cooleyi)	-	BTO	-	3	U	U	N
Dendrocoris Stink Bug (Dendrocoris arizonensis)	-	BTO	-	3	U	U	N
Douglas-fir Platylyngus (Platylyngus pseudotsugae)	-	BTO	-	3	U	U	N
Essig's Macrotylus Plant Bug (Macrotylus essigi)	-	BTO	-	3	U	U	N
Fender's Rhyacophilan Caddisfly (Rhyacophila fenderi)	-	BTO	-	4	U	U	N
Foliaceous Lace Bug (Derephysia foliacea)	-	BTO	-	3	U	U	N
Garita Skipper Butterfly (Oarisma garita)	-	BTO	-	3	U	U	N
Gold-Hunter's Hairstreak Butterfly (Satyrium auretorium)	-	BTO	-	3	U	U	N
Gray-Blue Butterfly (Agriades glandon podarce)	-	BTO	-	3	U	U	N
Hatch's Snail-Eating Carabid Beetle (Scaphinotus hatchi)	-	BTO	-	4	S	S	N
Indian Paintbrush Bug (Polymerus casteilleja)	-	BTO	-	3	S	S	N
Lillianis Moss Bug (Acalypta lillianis)	-	BTO	-	3	U	U	N
Marsh Ground Beetle (Acupalpus punctulatus)	-	BTO	-	3	U	U	N
Marsh Nabid (Nabicula propinqua)	-	BTO	-	3	U	U	N
Montane Bog Dragonfly (Tanypteryx hageni)	-	BTO	-	4	U	U	N
Mt. Hood Brachycentrid Caddisfly (Eobrachycentrus gelidae)	XC	BTO	-	3	D	U	N
Oregon Acetropis Bug (Ceratocapsus oregana)	-	BTO	-	3	U	U	N
Oregon Cave Amphipod (Stygobromus oregonensis)	-	BTO	-	3	U	U	N
Oregon Halticotoma Plant Bug (Halticotoma sp. nov.)	-	BTO	-	3	U	U	N

Table 53. The Federal Register, Bureau, Oregon State, and Oregon Natural Heritage Program (ONHP) Status of Bureau Tracking Wildlife Species.

Common Name (Scientific Name)	Species Status				Occurrence		Data Level
	Federal	Bureau	State	ONHP	District	WAU	
Oregon Trunk-Inhabiting Plant Bug (Eurychilopterella sp. nov.)	-	BTO	-	3	U	U	N
Pale Teratocoris Sedge Bug (Teratocoris paludim)	-	BTO	-	3	U	U	N
Piper's Carabid Beetle (Nebria piperi)	-	BTO	-	3	U	U	N
Sagehen Creek Goeracean Caddisfly (Goeracea oregona)	XC	BTO	-	3	S	S	N
Salien Plant Bug (Criocoris saliens)	-	BTO	-	3	U	U	N
Schuh's Microcanthia Shore Bug (Micracanthia schuhi)	-	BTO	-	3	U	U	N
Siskiyou Copper Butterfly (Lycaena mariposa)	-	BTO	-	3	U	U	N
Siuslaw Sand Tiger Beetle (Cicindela hirticollis siuslawe)	-	BTO	-	3	U	U	N
Small Blue Butterfly (Philotiella speciosa)	-	BTO	-	3	U	U	N
Tombstone Prairie Farulan Caddisfly (Farula reapiri)	XC	BTO	-	3	S	S	N
True Fir Pinalitus (Pinalitus solivagus)	-	BTO	-	3	U	U	N
Umbrose Seed Bug (Atrazonotus umbrosus)	-	BTO	-	3	U	U	N
Vertree's Cercalean Caddisfly (Cercalea vertreesi)	XC	BTO	-	3	D	S	N
Vertree's Ochrotrichian Micro Caddis (Ochrotrichia vertreesi)	XC	BTO	-	3	D	S	N
Western Chorosoma (Chorosoma sp. nov.)	-	BTO	-	3	U	U	N
Birds							
Acorn Woodpecker (Melanerpes formicivorus)	-	BT	-	3	D	D	N
Allen's Hummingbird (Selasphorus sasin)	-	BTO	-	4	D	D	N
Bank Swallow (Riparia riparia)	-	BTO	U	4	D	D	N
Blue-Grey Gnat-Catcher (Polioptila caerulea)	-	BTO	-	3	S	S	N
Great Grey Owl (Strix nebulosa)	-	BT	V	4	D	D	N
Olive-Sided Flycatcher (Contopus cooperi)	XC	BTO	V	3	D	D	N
Pileated Woodpecker (Dryocopus pileatus)	-	BT	V	4	D	D	N
Western Bluebird (Sialia mexicana)	-	BT	V	4	D	D	N
White-Tailed Kite (Elanus leucurus)	-	BTO	-	3	D	D	N
Willow Flycatcher (Empidonax traillii brewsteri)	XC	BT	V	3	D	D	N

Table 53. The Federal Register, Bureau, Oregon State, and Oregon Natural Heritage Program (ONHP) Status of Bureau Tracking Wildlife Species.

Common Name (Scientific Name)	**Species Status**				**Occurrence**		**Data Level**
	Federal	**Bureau**	**State**	**ONHP**	**District**	**WAU**	
Mammals							
American Martin (Martes americana)	-	BTO	V	3	S	S	N
Fringed Myotis (Myotis thysanodes)	XC	BT	V	3	D	D	3
Long-Eared Myotis (Myotis evotis)	XC	BT	U	4	D	D	3
Long-Legged Myotis (Myotis volans)	XC	BT	U	3	D	D	3
Pallid Bat (Antrozous pallidus)	-	BT	V	3	D	D	N
Ringtail (Bassariscus astutus)	-	BTO	U	3	D	D	N
Silver-Haired Bat (Lasionycteris noctivagrans)	-	BTO	U	3	D	D	3
Western Gray Squirrel (Sciurus griseus)	-	BTO	U	3	D	D	N
White-Footed Vole (Phenacomys albipes)	XC	BTO	U	3	D	D	N
Yuma Myotis (Myotis yumanensis)	XC	BTO	-	4	D	D	3
Molluscs							
California Floater (Anodonta californiensis)	XC	BT	-	3	D	D	3
Pristine Springsnail (Pristinicola hemphilli)	-	BTO	-	3	D	D	3
Puget Oregonian (Cryptomastix devia)	-	BT	-	3	S	S	3
Shiny Tightcoil (Pristiloma wascoense)	-	BTO	-	3	S	S	3
Western Pearlshell (Margaritifera falcata)	-	BTO	-	3	D	D	3
Western Ridge Mussel (Gonidea angulata)	-	BTO	-	3	D	D	3
Reptiles							
California Mountain Kingsnake (Lampropeltis zonata)	-	BT	V	3	D	D	2
Common Kingsnake (Lampropeltis getulus)	-	BTO	V	3	D	D	2
Sharp-Tailed Snake (Contia tenuis)	-	BT	V	4	D	D	2

XC = Former Federal Candidate, BT = Bureau Tracking, BTO = Bureau Tracking in Oregon, V = Vulnerable Species, Not at Imminent Risk of Being Listed, U = Undetermined Status of Species, ONHP Status 3 = More Information Needed Before Status Can Be Determined, 4 = Taxa of Concern But Not Currently Threatened or Endangered, For Occurrence D = Documented, S = Suspected, U = Unknown, For Data Level N = No Surveys Done or Planned, 2 = Limited Surveys, 3 = Extensive or Protocol Surveys.

(1) Bats

During the summer of 1994, a survey to identify the bat species present in the South River Resource Area was conducted by Dr. Steve Cross of Southern Oregon College in Ashland, Oregon. Bat species use caves, cliffs, snags, and trees for roosting, hibernating, and maternity sites. In addition, bats use ponds, creeks, and streams to search for food and as a source of water. Special status bat species are present on the Roseburg BLM District and are expected to occur in the Lower Cow Creek WAU (see Tables 51 and 52).

(2) Northern Goshawk

The northern goshawk is a Bureau Sensitive Species. Information about the northern goshawk is available (Marshall 1991). However, most of the information about the northern goshawk was collected east of the Cascade Mountains. Current geographic distribution suggests the northern goshawk would not be expected to occur in most of the Roseburg BLM District. Observations recorded since 1984 show the northern goshawk occurs north of the expected distribution range in Josephine County, Oregon. Two nest sites were found on the Roseburg BLM District in the early 1980s but were not located within the Lower Cow Creek WAU. Northern goshawks have been observed but there are no known nesting sites in the WAU.

(3) Northwestern Pond Turtle

The northwestern pond turtle is a Bureau Sensitive Species reptile that has been documented occurring in the Lower Cow Creek WAU. There is a sizeable northwestern pond turtle population along Cow Creek. Northwestern pond turtles use quiet waters (e.g., ponds and back waters of small rivers) with suitable nesting and basking opportunities. Nest sites typically are excavated in dry soil with a high proportion of silt or clay in areas vegetated with forbs and grasses. Nests are an average of 49 meters (160 feet) from the water body the turtle inhabits but nests have been found as far as 402 meters (1,319 feet) away (Holland 1994). Eggs are deposited in the nest from May through July hatching between 80 and 130 days later, depending on conditions (Holland 1994). Hatchlings require calm waters with ample cover (e.g., vegetation or boulders) to avoid predators (Holland 1991 and Reese 1996). Northwestern pond turtles inhabiting rivers and streams usually overwinter in upland habitats up to 500 meters (1,640 feet) away while those living in ponds usually overwinter within the pond (Reese 1996).

(4) The Peregrine Falcon

Historically, peregrine falcons were a "common breeding resident" along the Pacific coastline and present in many other areas, including southwestern Oregon (Haight 1991). Peregrine falcon populations in the Pacific Northwest declined from historical numbers because of organochloride pesticide use, other chemicals (avicides, such as organophosphate) used to kill other bird species considered to be pests, shooting, and habitat disturbance (loss of wetlands and fresh water marsh environments in interior valleys and increased rural development) (Aulman 1991).

The peregrine falcon (Falco peregrinus anatum) was listed as a Federal Endangered species on October 13, 1970 (Federal Register 35 FR 16047) and was delisted due to recovery on August 25, 1999 (Federal Register 64 FR 46541). The Bureau of Land Management policy is to place delisted species on the Bureau Sensitive Species list for at least five years after delisting as a Federal Threatened or Endangered Species (IM-2000-022).

Several areas in the Lower Cow Creek WAU have exposed bedrock due to erosion and other geological processes. An evaluation of aerial photographs and on-the-ground surveys determined rock outcrops or cliff habitats are present in the WAU. The potential exists for peregrine falcons to use these habitats. One habitat location known as PR2 is used by at least one adult peregrine falcon for perching. Surveys are continuing to document the status of this site.

d. Other Species and Habitats of Concern

(1) Big Game Species (Roosevelt Elk and Deer)

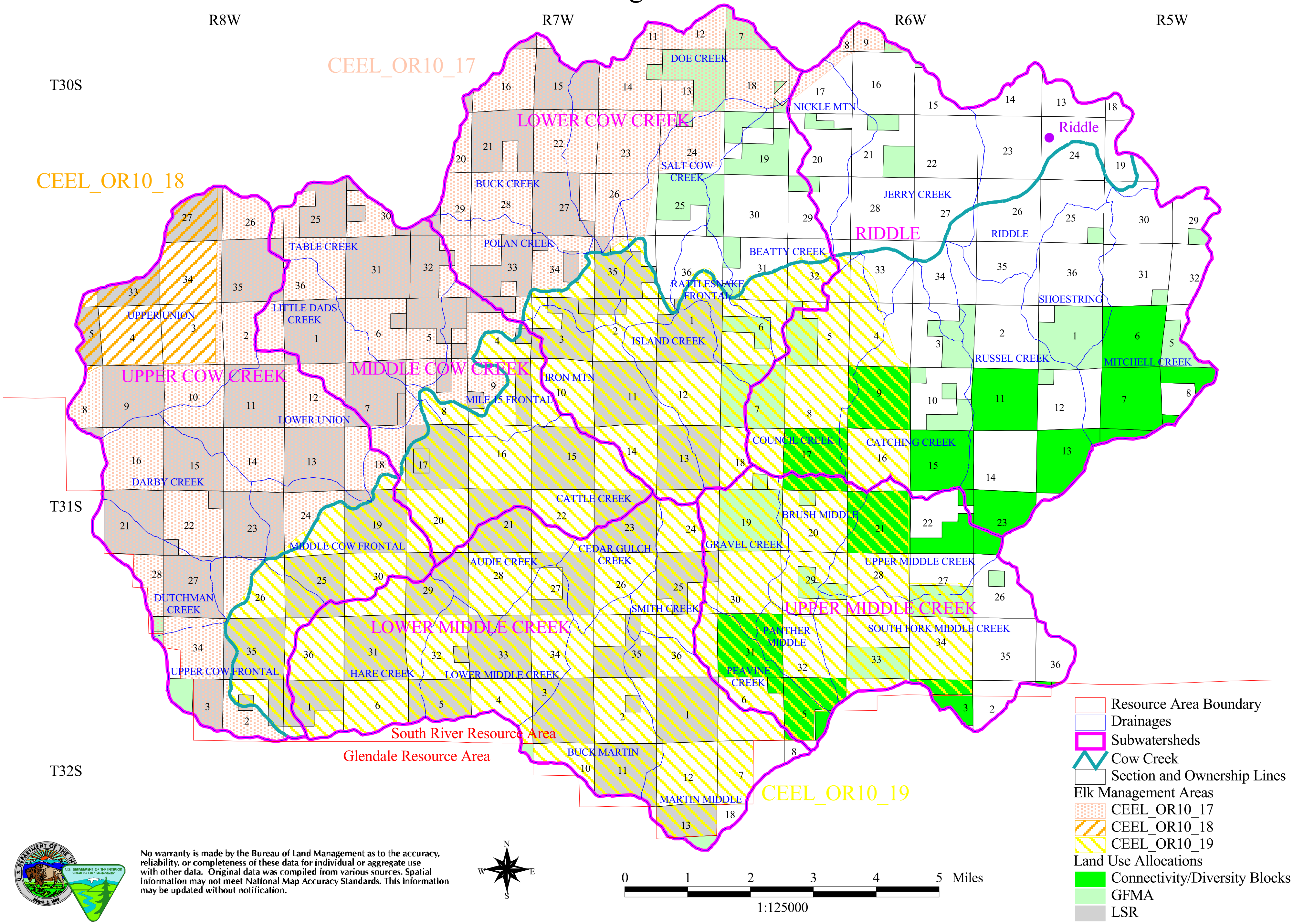
Historically, the range of Roosevelt elk (Cervus elaphus) extended from the summit of the Cascade Mountains to the Oregon Coast. In 1938, the elk population was estimated to be 7,000 animals (Graf 1943). Elk numbers and distribution changed as people settled in the region. Over time, elk habitat areas shifted from the historical distribution to "concentrated population centers which occur as islands across forested lands of varying seral stages" (South Umpqua Planning Unit 1979). Information about the historical distribution of elk within the Lower Cow Creek WAU and the Dixon management unit designated by ODFW is not available. Due to the increased number of people, road construction, home construction, and timber harvesting, it is suspected the elk population has decreased as reported in other parts of the region (Brown 1985).

The Lower Cow Creek WAU includes part of three elk management areas identified in the Roseburg District Proposed Resource Management Plan (USDI 1994). The elk management areas are shown on Map 33. However, management direction for these elk management areas were not discussed in the Roseburg District ROD/RMP (USDI 1995).

The quality of elk habitat in these management areas was evaluated in the Roseburg District Proposed Resource Management Plan (USDI 1994). Cover quality, forage quality and road density indices were calculated using the Wisdom model (Wisdom et al. 1986). All three indices were below the minimum levels considered optimum for use by elk. The habitat indices are general guides for elk management.

The current, as well as historic, black-tailed deer range is throughout Oregon. During the logging that occurred after WWII, suitable young seral age stands (less than 20 years old) were abundant and black-tailed deer populations increased to the point that liberal hunting seasons were permitted. Overall, black-tailed deer numbers remained stable through the late 1970s in the South Umpqua Planning Unit (South Umpqua Planning Unit 1979). Creation of early seral stands as a result of timber harvesting benefitted deer and elk as a byproduct and not as part of a specific management

Map 33. Lower Cow Creek Watershed Analysis Unit
Elk Management Areas



plan for these game species. Current numbers of Roosevelt Elk and black-tailed deer in the Lower Cow Creek Watershed are not available (Personal communication from ODFW). Both species are present and use similar habitats. Elk and deer forage for food in open areas where the vegetation includes grass-forb, shrub, and open sapling communities. Both species use a range of vegetation age classes for hiding. This hiding component is provided by large shrub, open sapling, closed sapling, and mature or old-growth forest communities (Brown 1985).

(2) Invasive Species in Ponds

Ten ponds (including pump chances) were surveyed for amphibian, macroinvertebrate, and fish species in the Lower Cow Creek WAU in 1999 and 2000 (see Map 30). The surveys were conducted to assess the existing condition for potential restoration of these water bodies. Four out of the 10 surveyed ponds had invasive fish species in them (see Appendix A). Exotic fish species may have impacted amphibian communities by direct predation. Centrarchids (e.g., bluegill and bass) are quite adept at preying upon other aquatic vertebrates' eggs, because they are highly maneuverable and can find larval amphibians in vegetative refugia. Analysis of the life history data for a generalized Ambystoma lifecycle suggested that the aquatic egg and larval stages may be the most susceptible to predation pressures (McGraw 1997).

Pond maintenance (e.g., excavation and dredging) is destructive to riparian and aquatic habitats associated with the pond. Consequently, wetland and riparian habitat for wildlife is also degraded. Ponds could be managed for multi-resources, such as wildlife, fish, and fire suppression.

Amphibian inventories were conducted in the South River Resource Area in 1994 and 1997 (Bury 1995). These inventories documented amphibian species in the area. The spotted frog is not expected to occur in the Lower Cow Creek WAU and was not found during the 1994 inventory. Species like the Southern torrent salamander (Rhyacotriton variegatus), western red-backed salamander (Plethodon vehiculum), Dunn's salamander (Plethodon dunni), and other regional species have been documented as occurring in the WAU.

The northern red-legged frog, foothill yellow-legged frog, and clouded salamander use unique habitats often found within the vegetation types found in the WAU. Features like large down woody material, talus slopes, creeks, seeps, ponds, and wetlands are often used by amphibian species in southwestern Oregon. Because these features are found in the Lower Cow Creek WAU, these amphibian species are expected to occur here.

(3) Neotropical Bird Species

Bird species that migrate and spend winter south of the North American Continent are considered to be neotropical bird species. Bird species that live on the North American Continent year round are called resident birds. Widespread concern for neotropical bird species, related habitat alterations, impacts due to pesticide use, and other threats began in the 1970s and 1980s (Peterjohn et al. 1995).

Oregon has over 169 bird species considered to be neotropical migrants. Population trends of neotropical migrants in Oregon show decreases and increases. Over 25 species have been documented to be declining in numbers (Sharp 1990). Oregon populations of 19 bird species show statistically significant declining trends while nine species show significant increasing trends (Sharp 1990). Including all species showing declines, increases, or almost statistically significant trends, there are 33 species decreasing and twelve species increasing in number in Oregon (Sharp 1990).

From 1993 through 1999, neotropical birds were captured and banded and habitat evaluations were conducted in the South River Resource Area. However, this work was not conducted in the WAU. Results from the banding station two miles from the WAU show that neotropical bird species use the available habitat types during migration and the breeding season. The Lower Cow Creek WAU supports populations of neotropical species. Given the different vegetation zones, the WAU may provide habitat for more neotropical species than those species located at the banding station. The unique and diverse habitats found in the Interior Valleys and Foothills vegetative zone have hardwood, shrub, and conifer species that function as habitat for many neotropical birds.

(4) Ospreys and Other Raptors

The Lower Cow Creek WAU supports bird of prey species common to the region but estimates of local populations are not available. Raptor species occur where there is suitable habitat. Some information is available about ospreys. Osprey nesting habitat occurs along Cow Creek. Osprey surveys along Cow Creek documented five osprey territories in the WAU but only one nest site was active in 1997. One osprey nest occurs on BLM-administered land in the Lower Cow Creek WAU.

2. Interpretation

a. Federally Threatened and Endangered Species

(1) Marbled Murrelet

Ninety-nine percent of the marbled murrelet habitat in the Lower Cow Creek WAU is inside the LSR (see Map 27). One hundred thirteen acres of marbled murrelet habitat within the WAU are located outside of the LSR. Eighty-four of the 113 acres are located outside the 50 mile zone from the Oregon Coast and do not require two year protocol surveys for marbled murrelets prior to implementation of projects that modify their habitat. General surveys for marbled murrelets have not been conducted in the Lower Cow Creek WAU.

(2) Northern Spotted Owl

Based on management direction in the RMP, activity centers on Matrix lands located before January 1, 1994, must be protected by maintaining the best 100 acres of suitable habitat near known northern spotted owl sites (USDI 1995). Nineteen northern spotted owl sites occur within the LSR portion of the WAU.

Land Use Allocations in the Lower Cow Creek WAU consist of Matrix, Riparian Reserves, and LSR. The Roseburg BLM District RMP (USDI 1995) identified Matrix lands for timber management while providing for forest connectivity, various habitat types, a variety of forest successional stages, and ecological functions like dispersal of organisms. Managing the timing and spacing of harvest activities in the Matrix is important to minimize impacts to northern spotted owls and other species associated with late-successional habitat. Late-Successional Reserves are to be managed for late-successional, old-growth forests and the species that use these forests. The amount of suitable habitat on private lands surrounding BLM-administered land in the LSR is low. Future actions by private land owners would probably reduce the amount of suitable habitat on private lands.

The northern spotted owl is a species that requires habitat connectivity, dispersal areas, and nesting areas. To assist in the decision making process and to guide the selection of areas where projects such as timber harvesting, road construction, or recreation sites may be located, a ranking of northern spotted owl sites using the provincial radius (1.3 miles) and the 0.7 mile radius surrounding each site is presented in Table 49. The ranking is to provide managers with a guide and does not represent clearance as needed or a may affect determination as required by section 7 of the Endangered Species Act of 1973, as amended. Criteria used to assign the rankings for northern spotted owl sites are presented in Appendix E.

Two critical habitat units (CHU-OR-62 and CHU-OR-63) lie within the Lower Cow Creek WAU. The two critical habitat units are about two miles from each other. This distance is made up of alternating sections of private and BLM-administered land. About nine sections of BLM-administered land within CHU-OR-63 are designated as Connectivity/Diversity Blocks. All of the BLM-administered land in CHU-OR-62 are designated as Late-Successional Reserve. Riparian Reserves make up about 50 percent of the BLM-administered land that lies between these two CHUs. The Riparian Reserves connect at section corners but lack connection to other BLM-administered land. Critical habitat objectives are to provide suitable habitat for a recovering population. The checkerboard ownership in both Critical Habitat Units (CHU-OR-62 and CHU-OR-63) probably would continue to have a fragmented pattern of northern spotted owl habitat in the future. Managing forest stands to improve connections between habitat in CHU-OR-63 would help maintain the functioning habitat in this Critical Habitat Unit.

b. Survey and Manage Species

(1) Del Norte Salamander

The Del Norte salamander was placed in category "D" by the Survey and Manage ROD where pre-disturbance surveys are practical but not necessary to meet management objectives (USDA and USDI 2001). This species should have sufficient habitat (including current sites) to stabilize in a pattern similar to their reference distribution with varying levels of uncertainty (USDA and USDI 2000a). The known sites in the WAU are to be managed as high priority sites for the benefit of the species under the current management direction.

(2) Mollusks

The Oregon shoulderband was placed in category "A" by the Survey and Manage ROD where surveys are required prior to habitat disturbing activities and all known sites must be managed for the benefit of the species (USDA and USDI 2001). Surveys for the Oregon shoulderband should focus on areas with rock, talus, and bedrock outcrops. Coarse woody debris and hardwood litter in close proximity to the rock, talus, and bedrock outcrops should also be surveyed. Oregon shoulderband sites that are discovered should be protected according to the current management direction for the species (IM-OR-2000-003).

The Oregon Megomphix was placed in category "F" by the Survey and Manage ROD where pre-habitat disturbing surveys are not required by protocol but all known sites discovered before September 19, 1999 must be protected (USDA and USDI 2001). The three sites in the Lower Cow Creek WAU were discovered between November 11, 1998 and April 15, 1999, so they would be protected according to the management direction for the species (IM-OR-2000-003).

(3) Red Tree Vole

The red tree vole was placed in category "D" by the Survey and Manage ROD (USDA and USDI 2001). All known, active red tree vole sites would be managed as high priority sites and protected following the survey protocol and management direction (IM-OR-2000-037, IM-OR-2001-132, and USDA and USDI 2001). All red tree vole sites would be regarded as high priority sites under the current guidelines. The definition and criteria of a high priority site may be redefined by the designated interdisciplinary (USFS, BLM, and USFWS) taxa team. Management of red tree vole sites would typically involve establishing a ten acre habitat area (IM-OR-2001-132). Areas where habitat disturbing activities are planned would be surveyed following the protocol guidelines for red tree voles (IM-OR-2000-037). Commercial thinning aged and older stands with an average diameter greater than ten inches are generally considered to be red tree vole habitat. Although, red tree voles may utilize young commercial thinning aged stands as dispersal habitat, late-successional and old-growth conifer stands are considered to be their optimal habitat since the older stands offer greater structural diversity and stability (Biswell, personal communication).

c. Bureau Sensitive, Assessment, and Tracking Species

Bureau of Land Management policy is to not contribute to the need to list Bureau Sensitive Species. Bureau Assessment Species are to be protected and managed so their status is not elevated to any higher level of concern. Bureau Tracking Species are not considered Special Status Species for management purposes and do not require mitigation.

d. Other Species and Habitats of Concern

Big Game Species (Roosevelt Elk and Deer)

Goals for the Elk Management Areas in the WAU have not been developed. Some potential management activities designed to improve elk habitat conditions may support LSR objectives and others may conflict. Managing for optimal cover (basically late-successional/old-growth stands) and thermal cover are similar to LSR objectives. Closing roads may also benefit LSR goals by providing more connected habitat for late-successional/old-growth forest related species, minimizing the loss of habitat, and reducing the risk of human-caused fires. Creating or maintaining early seral stands for forage may conflict with LSR objectives, depending on the extent of the treatment. Treatments to create or maintain early seral stands within the LSR may not be necessary, since private lands will probably continue to provide elk foraging habitat.

C. Plants

1. Special Status Plants

Surveys have been conducted for Special Status Plants on portions of the Lower Cow Creek WAU. However, many Survey and Manage species do not have survey protocols developed. Appendix J2 of the Final Supplemental Environmental Impact Statement (FSEIS) was the source for information on fungi, lichens, and bryophytes and their habitats. At the watershed analysis level, identifying locations of species suspected to occur in the WAU would be based on habitat. Ten Special Status Plant species have been documented occurring in the WAU.

Vascular Plants

Aster vialis (Wayside Aster), Bureau Sensitive and Survey and Manage Species
Aster vialis is a rare locally endemic plant known only from Lane, Linn, and Douglas Counties, in Oregon. It occurs primarily along ridges between Eugene and Roseburg. Plant succession resulting in canopy closure of the forest over these plants could be a significant management concern. Long term survival of this species may depend on controlled disturbance of the habitat to allow light to penetrate the canopy and improve conditions for Aster vialis reproduction. The role of fire is probably important in maintaining viability. Aster vialis thrives in openings within old-growth stands or associated with edge habitat (Alverson and Kuykendall 1989).

Allium bolanderi (Bolander's Onion), Bureau Assessment Species
Allium bolanderi grows on stony slopes and gravelly flats on serpentine soils below 3,000 feet in elevation. Distribution ranges from Douglas County, Oregon to Lake County, California.

Astragalus umbraticus (Woodland Milk Vetch), Bureau Assessment Species
Woodland milk vetch grows in open woods at low to mid elevations from southwest Oregon to northwest California. Woodland milk vetch has been observed to grow in areas impacted by fire and logging. It is likely this species has become rarer because of fire suppression activities.

Cypripedium montanum (Mountain Lady's Slipper), Bureau Tracking and Survey and Manage Species
Cypripedium montanum populations are small and scattered. Less than 20 exist west of the Cascade Mountains. Small populations may reflect the slow establishment and growth rate of this species. Cypripedium montanum persists in areas that have been burned. The species ranges from southern Alaska and British Columbia to Montana, Idaho, Wyoming, Oregon, and California. Survival of the species may depend on protecting known populations and developing a conservation plan (USDA and USDI 1994a).

Dichelostemma ida-maia (Firecracker Plant), Bureau Tracking Species
The firecracker plant grows in open woods, on grassy hillsides, and on roadsides at elevations between 1,000 and 4,000 feet. Distribution ranges from Douglas County, Oregon south through the

Siskiyou Mountains into California, where it is more common. It has been found in clearcuts, road cuts, and areas impacted by fire. Avoid ground disturbance at known sites.

Lupinus sulphureus var. kincaidii (Kincaid's Lupine), Federal Threatened Species
This is one of the three varieties of Lupinus sulphureus found in Oregon. It grows in the Willamette Valley and south into Douglas County, with a disjunct population reported in Lewis County, Washington (Eastman 1990). Lupinus sulphureus has been observed growing in road cuts and jeep trails. Long term survival of this species may depend on controlled disturbance of the habitat to allow light to penetrate the canopy and improve conditions for lupine reproduction (Kaye et al. 1991).

Mimulus douglasii (Kellogg's Monkeyflower), Bureau Assessment Species
Mimulus douglasii grows in open woods and meadows below 4,000 feet in elevation. It grows in gravelly soil that is moist in the spring. The plant often grows on serpentine soils. Avoid ground disturbance at known sites.

Phacelia verna (Spring Phacelia), Bureau Tracking Species
Phacelia verna is an annual forb in the waterleaf family that blooms from April to June. Its distribution range is southwest Oregon. It grows on mossy sparsely vegetated rock outcrops and balds between 500 and 6,600 feet in elevation.

Polystichum californicum (California Shield Fern), Bureau Assessment Species
Polystichum californicum grows on rock outcrops beneath forest canopies or on slopes at low and mid elevations. It often grows on overhanging rocks or shear bluffs and cliffs. Distribution ranges from British Columbia south to Santa Cruz County, California.

Pseudoleskeella serpentinense (Pseudoleskeella), Bureau Sensitive Species
Pseudoleskeella serpentinense is a bryophyte that grows on rock outcrops on serpentine soils.

Table 54 lists the Survey and Manage fungi, lichens, and bryophyte species that have been documented as occurring in the Lower Cow Creek WAU.

Table 54. Plant Species and Category Assignment Included in the January 2001, Table 1-1 for Amendments to the Survey and Manage, Protection Buffer, and Other Mitigation Measures Standards and Guidelines.

Taxa Group	Category
FUNGI	
Bondarzewia mesenterica (Bondarzewia montana)	B
Craterellus tubaeformis (syn. Cantharellus tubaeformis)	D
Galerina atkinsoniana	B
Helvella maculata	B
Hydnum umbilicatum	B
Neournula pouchetii	B
Otidea onotica	F
Pithya avulgaris	D
Ramaria abietina	B
Rhizopogon flavofibrillosus	B
LICHENS	
Chaenotheca ferruginea	B
Chaenotheca furfuracea	F
Chaenothecopsis pusilla (syn. Chaenothecopsis subpusilla, Calcium asikkalense, Calcium floerkei, Calcium pusillum, Calcium subpusillum)	E
Dendriscocaulon intricatulum	B
Pannaria saubinetii	F
Ramalina thrausta	A
BRYOPHYTES	
Buxbaumia viridis	D[1]

1. Although Pre-Disturbance Surveys are deemed practical for these species, continuing pre-disturbance surveys is not necessary in order to meet management objectives.

2. Noxious Weeds

Noxious weed encroachment has reduced natural resource values in the Lower Cow Creek WAU. The introduction and establishment of noxious weeds can affect native plant communities by reducing the diversity, abundance, and distribution of native plants (Bedunah 1992).

Yellow Starthistle (Centaurea solstitialis) and Rush Skeletonweed (Chondrilla juncea) have been documented as occurring in the WAU. Both of these noxious weed species have been designated as Target noxious weeds by the Oregon Department of Agriculture (ODA). They occur along and to the west of Interstate 5. There is a high potential Yellow Starthistle may spread within the WAU.

The intent of the integrated weed management program is to maintain and restore desirable plant communities and healthy ecosystems. Preventing the establishment and spread of new noxious weed populations is the best protection method. New noxious weeds would be removed before they spread to the point where eradication is not possible. Treatments in following years may be needed to eradicate invading noxious weeds. Established invasions may not allow practical or economical eradication treatments. Treatments to contain existing large populations and eradicate small, outlying populations would be used to control established invasions.

The BLM has an agreement with the Oregon Department of Agriculture (ODA) where locations of noxious weed invasions are identified and monitored by the BLM and control measures are administered by ODA. Biological controls have been approved and are used to slow or reduce the spread of established populations of widespread noxious weeds, such as non-native thistles, Saint John's wort, and Scotch broom. Mechanical and chemical treatments have been used to prevent the spread of Scotch broom and decrease visibility hazards on forest roads.

The following goals are important to minimize or avoid the spread of nonnative species.

-Inventory by species
-Identification of potential invaders
-Monitoring
-Prioritization of noxious weed species
-Habitat management and restoration
-Revegetate bare soil following disturbance
-Develop rock source management plans
-Keep records of rock surfaced roads that may have noxious weed seed
-Equipment cleaning

IX. Synthesis

The Bureau of Land Management administers approximately 39 percent of the Lower Cow Creek WAU. About 61 percent of the WAU is privately owned. Timber harvesting activities on BLM-administered lands through the year 2024 are estimated to affect about one percent of the WAU.

About 11 percent of the WAU is nonforested (mostly agricultural land). The WAU has about the same amount of agricultural land as in 1936. The amount of nonforested land affects the vegetation patterns in the WAU. The nonforested land may also be a barrier to the movement of some wildlife species and affect the distribution of those species.

Historically, between 16 and 86 percent of the WAU consisted of mid and late seral stands. In 2001, about 50 percent of the WAU consisted of mid and late seral stands. About 34 percent of the WAU is currently in late seral stands. Assuming all private lands would be less than 80 years old, the WAU would be estimated to consist of about 34 percent in late seral stands in 80 years.

Land management practices, roads, and timber harvesting can affect stream channels and the hydrology of the WAU. When precipitation is routed to stream channels faster, it may cause increased peak flows and less water to be stored as groundwater. Reducing road densities, replacing culverts, improving roads, conducting stream restoration projects, and thinning in Riparian Reserves would address water quality and stream channel conditions in the WAU. Stream temperatures, dissolved oxygen, sediment, fish passage, and peak flows are water quality and fisheries conditions that could be improved by reducing road densities, replacing culverts, improving roads, and constructing stream restoration projects. Thinning in Riparian Reserves would allow trees adjacent to stream channels to grow and provide recruitment of LWD faster than without management.

Timing and spacing of timber harvesting activities could help minimize impacts on wildlife, peak flows, and streams. Timber harvesting may be used to help with the cost of conducting watershed restoration opportunities.

X. Recommendations

A. Vegetation

Conduct silviculture activities, such as reforestation, establishment, maintenance, precommercial thinning, pruning, fertilization, commercial thinning, density management, regeneration harvest, and protection and maintenance of healthy POC in conformance with the Northwest Forest Plan, Roseburg and Medford BLM District RMPs, Port-Orford-Cedar Management Guidelines and Late-Successional Assessment. The potential number of acres to precommercially thin, prune, and commercially thin or density manage within the next ten years in the WAU are shown in Table 55.

Table 55. Potential Number of Acres by Land Use Allocation to Precommercially Thin, Prune, or Commercially Thin or Density Manage Within the Next Ten Years in the WAU.

Land Use Allocation	Acres		
	Precommercially Thin	Prune	Commercially Thin or Density Manage
GFMA	749	367	746
Connectivity/Diversity Blocks	410	320	183
LSR	3,105	645	1,399
Total	4,264	1,320	2,328

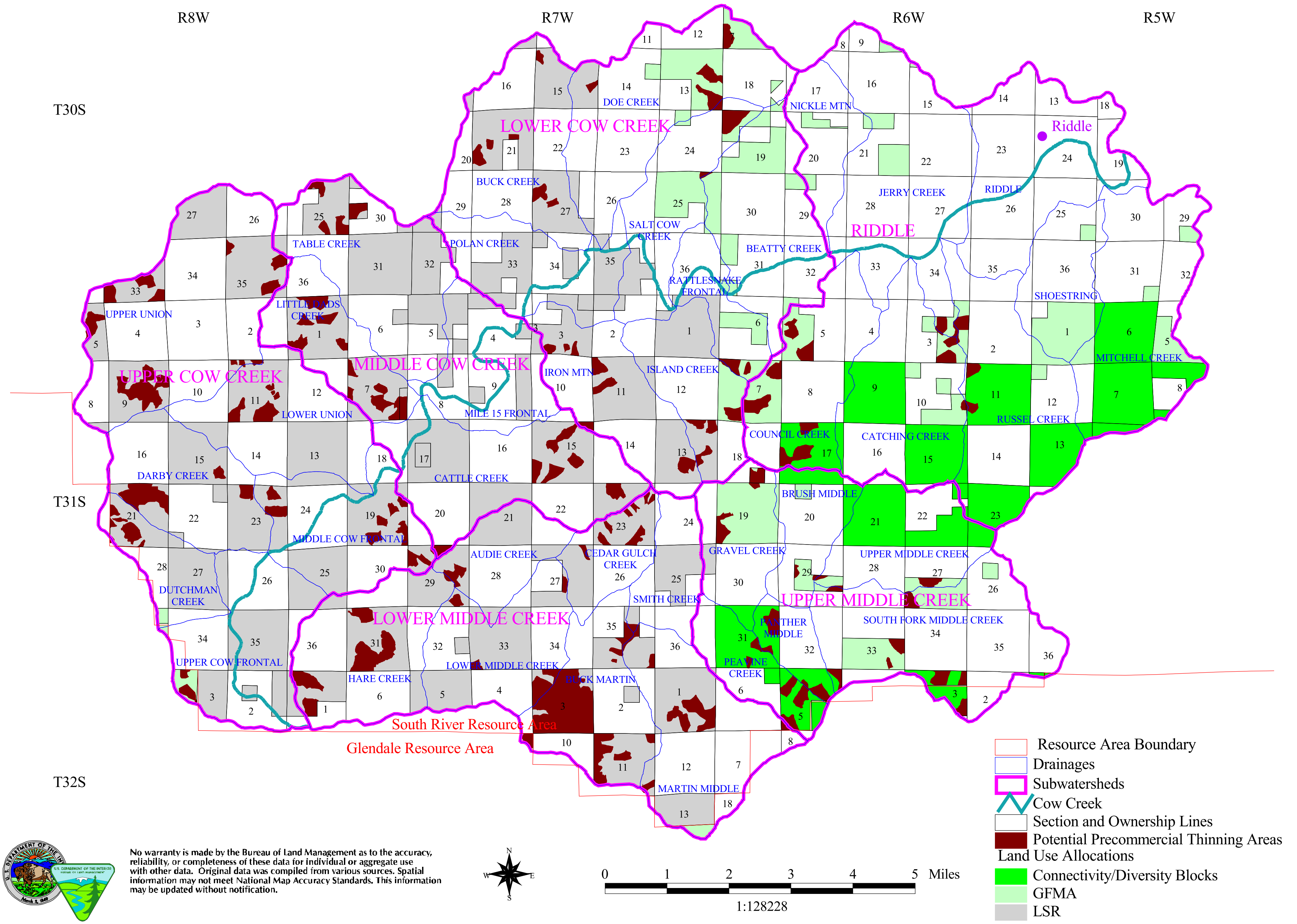
Plant and re-plant areas and conduct silvicultural activities when necessary.

About 4,264 acres in the WAU are between five and 15 years old and could be precommercially thinned within the next ten years. Units that have been precommercially thinned would be considered for fertilization. The potential precommercial thinning units in the Lower Cow Creek WAU is shown on Map 34. A list of the potential units is in Appendix F.

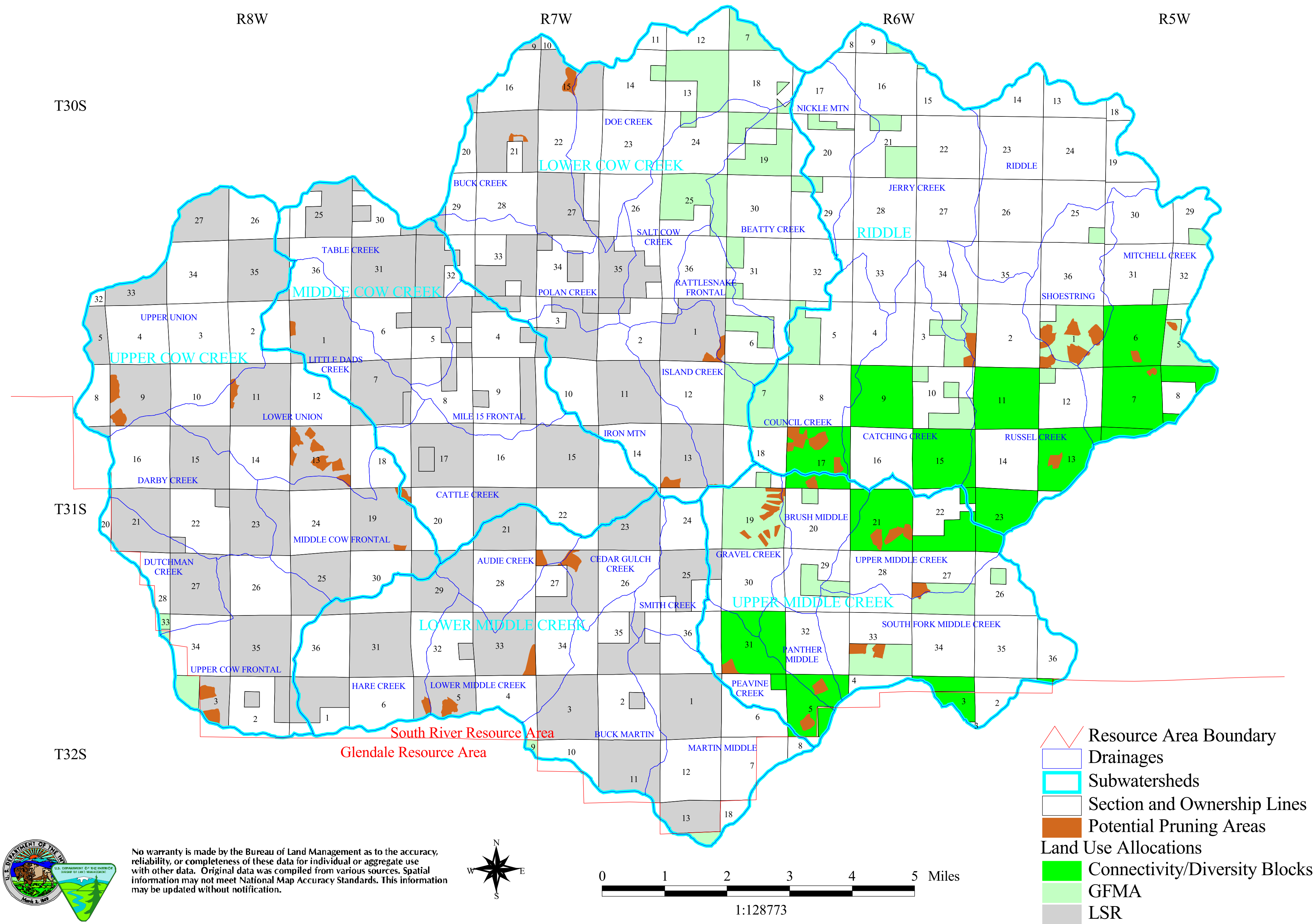
Stands that have been precommercially thinned would be considered for pruning. About 1,320 acres in the Lower Cow Creek WAU could be pruned in the next ten years. Potential pruning units in the Lower Cow Creek WAU are shown on Map 35. A list of potential pruning units is in Appendix F.

Stands that are candidates for thinning would be based on volume, density, and age depending on the land use allocation (LUA). Potential commercial thinning and density management areas in the Lower Cow Creek WAU are shown on Map 36. A list of potential units is in Appendix F.

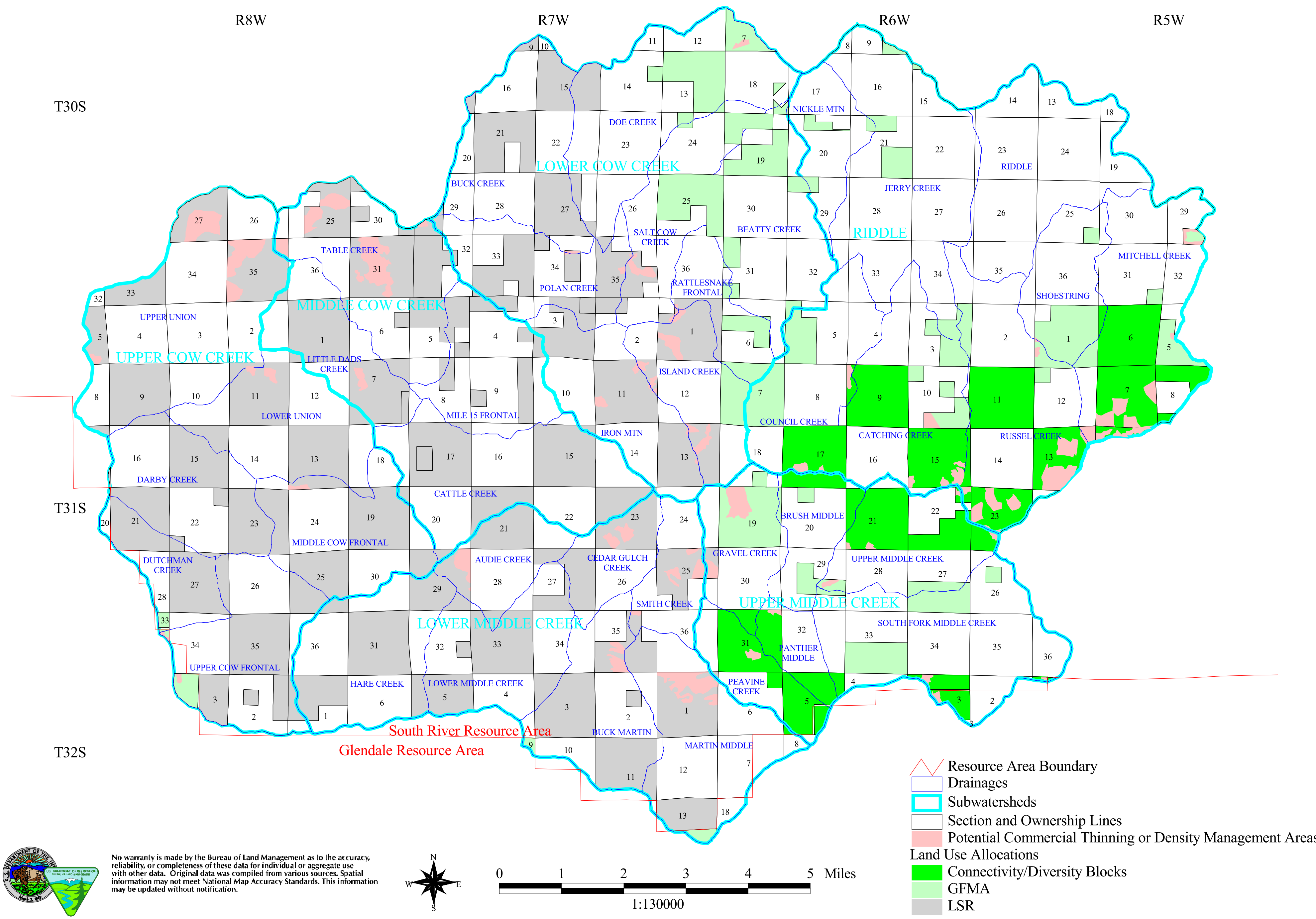
Map 34. Lower Cow Creek Watershed Analysis Unit
Potential Precommercial Thinning Areas



Map 35. Lower Cow Creek Watershed Analysis Unit
Potential Pruning Areas



Map 36. Lower Cow Creek Watershed Analysis Unit
Potential Commercial Thinning or Density Management Areas



1. Port-Orford-Cedar Root Disease

a. Road Treatments

(1) Gating, Decommissioning, or Blocking Roads

Restricting vehicle use on BLM-administered land or roads accessing areas with infected POC would help reduce spread of the disease to healthy POC. Doe Creek and Salt Creek (at the junction of the 30-7-36.0 and 30-7-25.0 roads) are areas to consider restricting access to help protect the healthy POC in the Beatty Creek Research Natural Area (RNA).

(2) Improving Roads

Consider improving these road segments 30-6-7.2A, 30-6-18.0A, 30-7-13.0B, 30-7-23.0C, 30-7-25.0B, 30-7-36.0B1, 30-7-36.0B2, 30-7-36.0B3, 30-8-25.1B, 31-8-11.4C, 31-8-12.2C, 30-8-35.0A3, 31-8-3.0B, 31-8-3.1A, 31-8-3.1C, 31-8-13.1A, 31-8-15.1A to limit the spread of Port-Orford-cedar root disease by reducing the amount of soil transported by vehicles. Some are natural and some are rock surfaced roads.

b. Water Sources

Pump chances may contain water contaminated by the Port-Orford-cedar root disease. The disease may be spread to uninfected POC when contaminated water is used for fire suppression or other projects. The Pier Number One pump chance in T31S, R8W, Section 11 and Cattle Creek pump chance in T31S, R7 W, Section 17 may be contaminated and the use of the water should be restricted.

Two pump chances, Hole Number Five in T30S, R6W, Section 9 and Bear Trap Pond in T29S, R8W, Section 35 are outside of the WAU but should be considered for restricted use because they may be contaminated.

c. Rock Quarries

Port-Orford-cedar root disease spores can be transported from contaminated rock quarries. Two rock quarries in T31S, R8W, Section 11 are suspected to be contaminated with the Port-Orford-cedar root disease. Rock from the quarries at the junction of the 31-8-11.3 and 31-7-19 roads and 400 feet northwest of the junction of the 31-8-11.3 and 31-7-19 roads on the 31-7-19 road should be restricted in use.

d. Testing

Individual Port-Orford-cedar, quarries, and pump chances should be tested for signs of the root disease. Port-Orford-cedar seedlings could be planted near quarries and pump chances to test for presence of the root disease.

B. Fire and Fuels Management

Broadcast and pile burning should continue to be used for site preparation to reduce vegetative competition and hazardous fuel accumulations. Site preparation may include broadcast burning regeneration harvest units and burning hand or machine piled logging slash and landing decks. Burning activity fuels may also reduce wildfire hazards. When other resource concerns eliminate using prescribed fire, mechanical or manual fuels treatments may be necessary to achieve fuels management objectives. Fuels treatments can rarely be justified as the primary reason for reducing the risk of wildfire. Consider reducing wildfire risks when forest management activities create high fire risk conditions. Site preparation prescriptions should be written to achieve the silviculture objectives and reduce the fuel hazards as a secondary objective.

Consider the timing and size of forest management activities to avoid increasing the risk of unplanned wildland fire. Consider leaving some areas untreated or manipulating fuels in precommercial thinning stands. Providing fuel breaks and creating a variety of fuel types, such as by not thinning some stands, could allow wildfires to be suppressed at a smaller size.

C. Soils

Best Management Practices (BMPs) should be applied during all ground and vegetation disturbing activities. See Appendix D, Roseburg District Record of Decision and Resource Management Plan (USDI 1995) for a list and explanation of BMPs. Along with the BMPs, the Standards and Guidelines in the SEIS Record of Decision (USDA and USDI 1994b) should be implemented in order to achieve proper soil management. Best Management Practices should be monitored for implementation and effectiveness to document that soil goals are being achieved.

Minimize soil compaction and the loss of topsoil and organic matter.

Consider using methods other than prescribed fire for reducing vegetative competition on Category 1 Soils unless considered essential for resource management, such as habitat improvement, tree seedling establishment, or reducing fire risks.

Maintain or enhance long term soil productivity while achieving silvicultural objectives.

Follow mechanical site preparation management direction for track type equipment.

Use existing skid trails or disturbed areas, when possible. Keep skid trail widths to the minimum standards necessary to achieve the goal.

Minimize road construction in areas with high surface erosion rates or are susceptible to slope failure (e.g. granitic, mica schist, conglomerate, serpentine).

Stabilize existing roads, when needed.

Locate, design, construct, and maintain roads to standards that meet management objectives.

Conduct road, culvert, and stream surveys to help prioritize restoration and road maintenance activities. These surveys would include analyzing road diversion potential, culvert placement, and road encroachment on streams.

Prioritize maintenance on roads identified to be eroding or having slope stability problems. Consider obliterating or fully decommissioning these roads if alternate routes on more stable sites can be found. Minimize the amount of sediment entering streams.

Engineering concerns of subsoiling roads is that it decompacts the road subgrade reducing its strength and allows it to become saturated. If the road is on a steep potentially unstable slope, tillage can increase the probability of subgrade failure and landslides.

When removing culverts, match the cut slopes to the stream gradient and channel banks that exist above and below the culvert removal area. Stabilize stream beds and banks to control erosion.

Channel water from cut bank seeps off of the road so it won't saturate the tilled roadbed.

Do not till wet seepage areas.

Do not till road fill slopes considered to be unstable.

Do not till roads if there is less than 20 inches of tillable soil above bedrock.

Consider tilling in the spring rather than in the fall.

D. Hydrology

Monitor water quality parameters listed by ODEQ as water quality limited in the WAU and those affected by the Formosa mine. Monitor the effectiveness of the Formosa mine reclamation on water quality in Middle Creek.

Monitor stream channel morphology to establish trends in channel form.

Perform channel condition analyses, such as the Pfankuch Channel Stability Inventory and Proper Functioning Condition (PFC) assessments, to identify stream channel condition.

Management in Riparian Reserves should improve riparian function or habitat conditions. Activities to consider include density management to maintain or improve tree growth for future stream side shade and potential LWD, placing LWD in the stream channel to manipulate channel form and improve aquatic habitat diversity, and decommissioning or obliterating roads and re-establishing riparian vegetation and valley bottom form.

Road decommissioning, full decommissioning, and obliteration should be considered for roads that are current and potential sources of sediment and channel network extension to stream channels.

Renovate roads to reduce the risk of erosion and sediment delivery to stream channels, culverts plugging, flow diversion at stream crossings, and channel network extension. Consider designing road and stream crossings to allow large woody debris to be transported downstream past the road crossing.

E. Fisheries

1. Restoration

The two existing instream project sites on Martin Creek should be removed and replaced with other structures such as rock weirs. The gabion baskets are falling apart and directing the stream flow into the bank, causing streambank erosion.

The fisheries restoration priority in this WAU is to remove human-made barriers to fish passage (i.e. culverts) and replace them with structures that provide fish passage (i.e. bridges or bottomless arch pipes). These culverts are identified on Map 26.

Monitor and maintain the culvert restoration work completed in the summer of 1995 on Iron Mountain, Cattle, and Council Creeks.

Continue the Formosa mine reclamation to correct the acid mine drainage problems. Restoration activities in Middle Creek should be conducted to mitigate the impacts from the Formosa mine. Monitor the project area after winter storms. Maintain the instream projects in Middle Creek.

The Upper Middle Creek and Lower Middle Creek subwatersheds would benefit from stream and riparian restoration. Conduct surveys to identify the need for instream (LWD placement and weir construction), riparian, or upslope (i.e. road improvement, decommissioning, slope stabilization) restoration projects. Areas to consider surveying first before conducting restoration activities include Martin Creek, Peavine Creek, Iron Mountain Creek, Union Creek, and upper Middle Creek.

Consider removing non-native fish and frog species from ponds in the WAU. Consider evaluating wetland restoration in ponds.

2. Monitoring

Continue coho spawning surveys in Middle Creek and Martin Creek.

Consider conducting spawning surveys in Buck Creek, Smith Creek, and Hare Creek, and in the Martin Creek tributary located in the SW$^1/_4$, of the SE$^1/_4$, of Section 1, in T32S, R7W.

Monitor fish use in Middle Creek, upstream from the confluence with the South Fork of Middle Creek to evaluate the effects of the Formosa Mine.

Continue operating a smolt trap at the mouth of Cow Creek, if Douglas County stops operating one, to provide life history and population size information for anadromous species and resident salmonids, as well as the species diversity in Cow Creek.

Conduct habitat surveys on Cow Creek to provide useful information for making management decisions.

F. Wildlife

1. Federally Threatened, Endangered, and Proposed Species

a. American Bald Eagle

Forest stands within one mile of and facing Cow Creek should be managed to provide habitat characteristics used by bald eagles. Management objectives for the LSR would maintain current habitat and allow other forest stands to attain characteristics important for bald eagle habitat. Management on lands having a direct line of sight to Cow Creek should consider maintaining or developing habitat characteristics of five to seven large conifers (greater than 50 inches DBH) per acre, a multi-storied canopy with at least 60 percent crown closure, and an average conifer diameter of 24 inches and density of 50 to 70 trees per acre (USDI 1995). Bald eagle winter surveys should be conducted along Cow Creek since this is a potential wintering area. Use of the area for nesting is not likely, based on the absence of bald eagle observations during several years of osprey surveys in this watershed.

b. Marbled Murrelet

Terms and conditions from the USFWS should be followed to mitigate disturbance to potential marbled murrelet sites when project areas (LSR or Matrix) are located within 1/4 mile of unsurveyed suitable marbled murrelet habitat. Consider evaluating and surveying the identified suitable marbled murrelet habitat in the Lower Cow Creek Watershed.

c. Fender’s Blue Butterfly

Although the Lower Cow Creek WAU is outside the known range of Fender’s blue butterfly, consider surveying the two documented Kincaid’s lupine sites to determine if the Fender’s blue butterfly occurs in the WAU. Consider conducting general surveys for Kincaid’s lupine and Fender’s blue butterfly in the Lower Cow Creek WAU.

d. Northern Spotted Owl

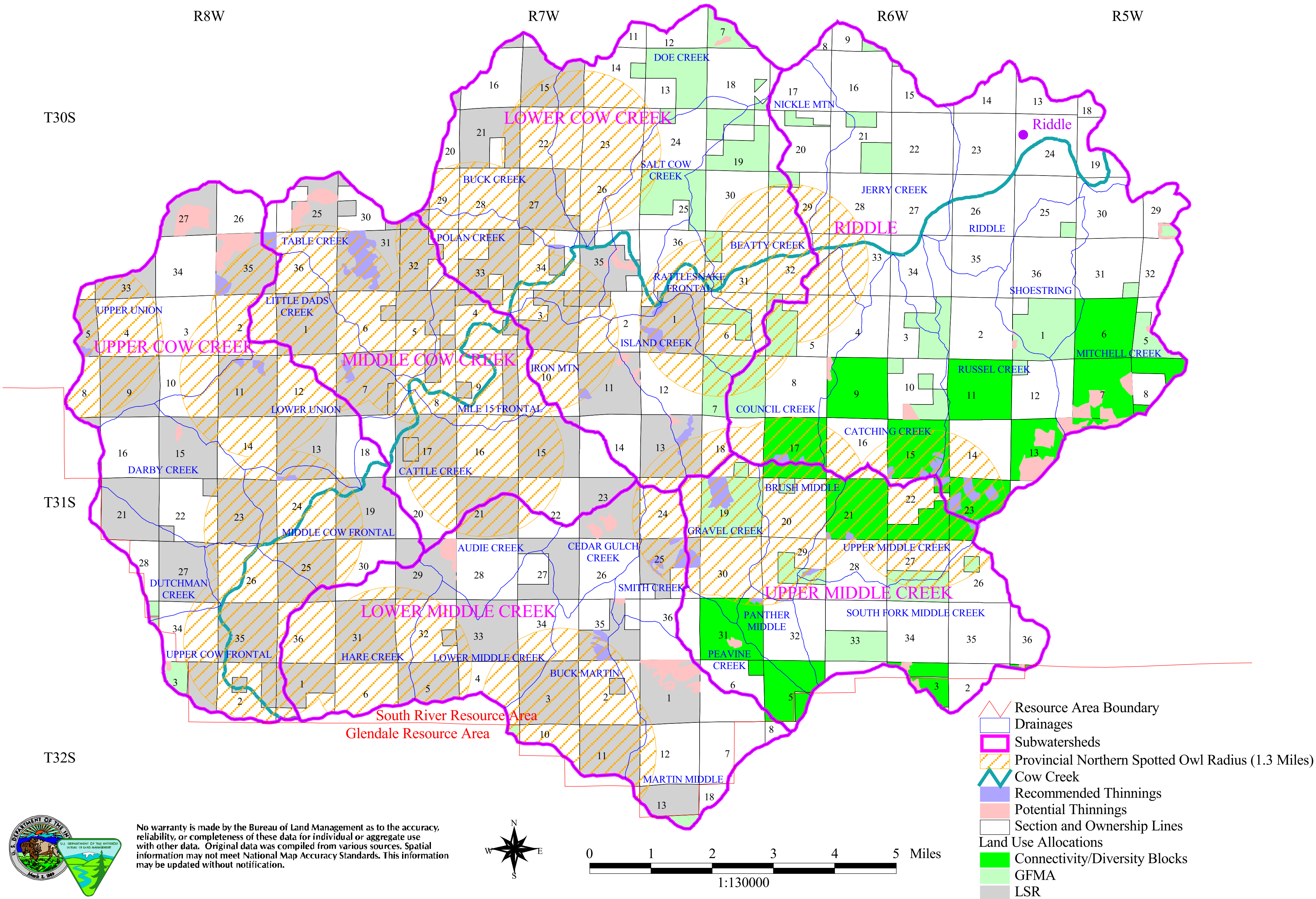
Northern spotted owl sites were ranked to provide management with a guide for planning and conducting activities around owl sites. When planning projects that manipulate suitable spotted owl habitat, project areas may be selected based on the ranking of owl sites in the Lower Cow Creek WAU (see Table 49). Table 49 provides information about habitat acres, occupation, and reproduction success of owls in the Lower Cow Creek WAU. The ranking was developed to evaluate the connectivity and fragmentation of northern spotted owl habitat and site history. The ranking can be used to locate project areas while considering the location of active northern spotted owl sites.

Activities in the Matrix that modify or remove suitable northern spotted owl habitat should be considered first in areas outside of known northern spotted owl territories. When it is not possible to avoid modifying or removing suitable habitat within a northern spotted owl territory, then sites ranked “1" should be first, "2" should be second, and "3" should be last. For northern spotted owl sites in the LSR, the rankings are where habitat evaluation should be considered before manipulating stands to improve habitat. Sites in the LSR with a rank of "1" should be considered first for habitat evaluation, "2" should be second, and "3" should be last. Habitat evaluation would determine which LSR objectives (increasing late seral age forests, increasing physical connections between late-successional forests, reducing fragmentation, or habitat connection) apply to a particular area.

Stands between 30 and 60 years old within the provincial radius of a northern spotted owl site with a rank of “1” could be treated to accelerate the development of late seral characteristics (see Map 37). These stands occur where the amount of suitable northern spotted owl habitat and owl occupation and reproduction are the poorest. Density management may improve the habitat and promote northern spotted owl occupation and reproduction.

The checkerboard ownership in Critical Habitat Units OR-62 and OR-63 is expected to maintain a fragmented pattern of late-successional/old-growth habitat. Matrix lands that overlap CHU-OR-63 should be managed so fragmentation does not reduce or eliminate the function of critical habitat.

Map 37. Lower Cow Creek Watershed Analysis Unit
Potential Commercial Thinning/Density Management
Areas Within Northern Spotted Owl Provincial Radius Based on Rankings



No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data was compiled from various sources. Spatial information may not meet National Map Accuracy Standards. This information may be updated without notification.

2. Survey and Manage Species

Mollusks

Surveys for the Oregon sideband should be conducted according to established protocol guides before habitat disturbing activities are conducted (IM-OR-98-097). Consider conducting general surveys to document species presence, abundance, range of occurrence, and habitat use in the WAU.

3. Bureau Sensitive, Assessment, and Tracking Species

a. Bats

Townsend's big-eared bat roosts and hibernacula would be protected by a 600 foot buffer to maintain the integrity of colonies (USDI 1995). Pesticide use would be restricted within the normal hunting range of known Townsend's big-eared bat colonies in order to reduce detrimental effects on the bats' prey base (USDI 1995).

b. Northern Goshawk

Consider conducting surveys to determine if goshawks occur in the WAU. If a northern goshawk nest is discovered in the WAU, human activity should be restricted within 1/4 mile of the nest site between March and August or until the young have dispersed (USDI 1995). In addition, 30 acres of undisturbed habitat should be retained around active and alternate nest sites (USDI 1995).

c. Northwestern Pond Turtle

Northwestern pond turtles are vulnerable to habitat loss or degradation. Loss of nesting, rearing, and overwintering habitat from disturbance or direct mortality by recreation activities along Cow Creek is a concern. At least a 50 meter protective buffer around reaches with northwestern pond turtle occupancy would decrease nesting habitat disturbance and loss. Risks to upland habitat should be considered when planning projects near known northwestern pond turtle populations. Northwestern pond turtles may use the pools and cover objects created by constructing or placing structures in streams for anadromous fishes. The northwestern pond turtle population along Cow Creek appears to be relatively stable compared to populations in other areas (e.g. the Willamette Valley) but they are still vulnerable to habitat loss and disturbance. A northwestern pond turtle conservation strategy is being developed by the USFS, BLM, and Corps of Engineers, which should be referred to when it is completed.

d. Peregrine Falcon

Management guides include locating a no activity buffer around an active peregrine falcon site, seasonal restrictions during the peregrine falcon breeding season from March 1 to July 15, or maintaining the integrity of medium to high potential sites (USDI 1995). The buffer should include a no activity area of a least a quarter mile radius around known occupied sites. A secondary zone with a ½ to 1½ mile radius reflecting the shape of primary zone should be considered where no management activities, such as timber harvesting, road construction, or helicopters would be allowed during the peregrine falcon breeding season. Activities may resume in the secondary zone 14 days after fledgling or nest failure is confirmed. To maintain the integrity of a medium to high potential peregrine falcon nesting site, it should be managed as if it was occupied. Projects that require a disturbance, such as blasting, near any medium to high potential habitat, discovered in the future should be surveyed before project initiation.

4. Other Species of Concern

a. Big Game Species (Elk and Deer)

Maintaining stands up to 20 years old from developing into older age classes and planning regeneration harvest units to be less than 40 acres would support use by elk and deer. Creating or maintaining early seral stands as foraging habitat may conflict with LSR objectives, depending on the extent of the treatment. Creating or maintaining early seral stands within the LSR may not be necessary, since private lands would probably continue to provide foraging habitat. Decreasing road density, increasing cover, and creating or maintaining foraging habitat would benefit elk and deer. Information about distribution and use of the Lower Cow Creek WAU by elk and deer would help with managing these species.

b. Invasive Species in Ponds

Controlling populations of non-native fish species in ponds may benefit native amphibian populations. The only amphibian species observed to live in ponds with non-native fish were rough skinned newts and Pacific giant salamander larvae. Other pond breeding amphibians would be expected in ponds but the non-native fish may have excluded them. Northwestern salamanders are very vulnerable to fish predation. Temporary draining of the ponds with non-native fish species would remove the fish and would simulate an ephemeral forest pond.

Construction of a shallow littoral zone would provide optimal habitat for native pond-dwelling amphibians. Planting appropriate, native vegetation in the littoral zone and riparian areas may increase amphibian habitat. The activities could be done in conjunction with pond maintenance. Functioning littoral zone and riparian areas should be retained so they continue to provide habitat for native fauna and flora. Expansion of the pond (vertically or horizontally) may be necessary to compensate for the loss of available water for fire suppression or other purposes when habitat is retained.

A wildlife biologist, fisheries biologist, hydrologist, fire management specialist, and engineer should be part of any pond altering activity. Restoration measures could restore a pond and its riparian area to the form and function of a naturally occurring pond.

c. Neotropical Birds

Activities that modify habitat impact neotropical birds. This usually changes the bird species composition using a particular area. Broadcast burning, brushing, regeneration harvesting, and precommercial and commercial thinning activities impact neotropical birds by removing habitat and physically displacing birds. Displacement includes removing occupied habitat during the breeding season.

Ways to benefit neotropical birds would be to reduce impacts from management activities that manipulate habitat. Scheduling management activities to avoid disturbing birds during nesting and breeding periods should be considered. Local populations of neotropical birds start breeding in April and May and continue through the end of August. However, most species have young capable of flying by the beginning of July or August. Consider implementing projects impacting nesting habitat before April 1or after July 30 of any given year.

Another way to reduce impacts is to consider the goals of Riparian Reserves when brushing, precommercial thinning, or broadcast burning areas. Consider including different prescriptions when brushing or thinning in Riparian Reserves. The different prescriptions could exclude Riparian Reserves from the activity or increase the number of shrubs and non-commercial tree species that are retained.

Matrix lands outside of Riparian Reserves also contain brush and non-commercial tree species used by neotropical birds. Consider retaining brush and non-commercial tree species that are not competing with the desired conifer species. Some projects using these recommendations have been completed. The results should be reviewed and evaluated.

d. Ospreys and Other Raptors

Within 1/4 mile of known osprey nest sites, nest trees and perch trees should be protected and disturbance restricted between March 20 and August 31 (USDI 1995). Adequate nest and perch replacement trees should be retained within 1/4 mile of nest sites (USDI 1995). Known and future raptor nests not protected by other management recommendations should be provided suitable habitat buffers and seasonal disturbance restrictions (USDI 1995). General information about raptor species using the habitat in the WAU should be collected.

XI. Summary of Recommendations

Table 56 summarizes the recommendations, based on the main concerns of current conditions in the Lower Cow Creek WAU and identifies the planning objectives to be met by implementing the management strategies and potential activities. The intent of Table 56 was to show the connection between resource management concern and the management strategies and recommended activities. The planning objectives are based on the management direction and policy addressed in the RMP (USDI 1995) and SEIS ROD (USDA and USDI 1994b). The management strategy is intended to describe general methods for meeting the objectives. The management activities are more specific opportunities that may be implemented in order to achieve the management strategy. The information presented in Table 56 is discussed in more detail throughout the watershed analysis.

Table 56. Summary Table of Resource Management Concerns in the Lower Cow Creek WAU.
Vegetation/Silviculture

Concern	Existing Situation	RMP/NFP Planning Objective	Management Strategy	Management Activity
What opportunities exist to manage overstocked stands, which have slower growth rates, are more susceptible to insects and diseases, and have an increased risk of loss due to wind and fire? How can stand density and species composition be influenced to achieve desired late-successional characteristics in the Riparian Reserves?	Approximately 7,912 acres of well stocked or overstocked stands on BLM-administered land could be treated during the next ten years to maintain growth and healthy stands.	RMP (Appendix E pp.145-154) - Riparian Reserves - Apply silvicultural practices for Riparian Reserves to control stocking and acquire desired vegetation characteristics needed to attain ACS objectives. Matrix - Precommercial and commercial thinning and fertilization would be designed to control stand density, influence species dominance, maintain stand vigor, and place stands on developmental paths. LSR - Protect and enhance conditions of late-successional and old-growth forest ecosystems.	Apply silvicultural treatments to produce, over time, forests which have the desired species composition, structural characteristics, and distribution of seral or age classes to meet Matrix, LSR, and ACS objectives.	Precommercial thinning and density management in the Riparian Reserves. Precommercial and commercial thinning, and density management in Matrix. Consider precommercially thinning approximately 4,264 acres within the next ten years. Consider commercial thinning approximately 929 acres in Matrix within the next ten years. Consider density management of approximately 1,399 acres in the LSR within the next ten years. Consider fertilizing precommercially or commercially thinned, or slow growing, overstocked stands in the Matrix. Consider pruning approximately 1,320 acres within the next ten years. Consider manipulating precommercial thinning slash in all Land Use Allocations. Provide breaks in continuous stand types.

Table 56. Summary Table of Resource Management Concerns in the Lower Cow Creek WAU.
Vegetation/Silviculture

Concern	Existing Situation	RMP/NFP Planning Objective	Management Strategy	Management Activity
Are there opportunities for Matrix lands within this WAU to provide a sustainable supply of timber and other forest commodities?	Approximately 3,983 acres of late seral stands and approximately 1,032 acres of mid seral stands on BLM-administered land in Matrix are available to help provide a sustainable supply of timber and other forest commodities.	RMP (p. 33) - Objectives for Matrix lands are to produce a sustainable supply of timber and other forest commodities and provide early-successional habitat.	Harvest timber and other forest products on Matrix lands with suitable forest lands. Manage for the production and sale of special forest products when demand is present.	Conduct commercial thinning and regeneration harvest on Matrix lands in conformance with the RMP. When regeneration harvesting, retain six to eight green trees on GFMA lands and 12 to 18 green trees in Connectivity/Diversity Blocks.

Table 56. Summary Table of Resource Management Concerns in the Lower Cow Creek WAU.
Roads

Concern	Existing Situation	RMP/NFP Planning Objective	Management Strategy	Management Activity
Are BLM managed roads eroding and delivering excess sediment to stream channels and adversely affecting water quality and fish? Are BLM-managed roads changing peak flows, impacting stream morphology, or adding to the drainage network in the WAU?	Some BLM roads are eroding or have slope stability concerns. Average road density of 4.89 miles per square mile and stream crossing density of 2.49 crossings per stream mile in the WAU may produce sediment in streams that is outside the range of natural variability. Data Gap - No information if BLM managed roads are causing increased sediment in streams, peak flows, or the drainage network. The intermingled ownership pattern makes it difficult to reduce road densities.	RMP (pp. 72-74) - Develop and maintain a transportation system to meet the needs of users in an environmentally sound manner. RMP (p. 72) - Correct problems associated with high road density by emphasizing the reduction of minor collector and local road densities where those problems exist. RMP (pp. 19-20, ACS) - Maintain and restore the sediment regime. Elements of the sediment regime include the timing, magnitude, duration and spatial distribution of peak, high, and low flows.	Minimize new road construction in areas with high surface erosion rates or slope stability problems. This would help reduce impacts to soils, water quality, and fisheries. Stabilize existing roads where they have adverse effects on these resources. Locate, design, construct and maintain roads to standards meeting management objectives in the district road management plan. Prioritize and address erosion or slope stability concerns caused by roads, based on current and potential impacts to riparian resources and the ecological value of the affected riparian resources. Minimize sediment delivery to streams.	Consider conducting road and stream surveys, which would include looking at downcutting of stream channels, road encroachment, and culvert surveys. Possible restoration activities could include decommissioning or improving roads, replacing culverts, or placing LWD in streams. Prioritize and schedule maintenance on roads identified to be eroding or having slope stability problems. Consider closing, stabilizing, or decommissioning roads identified to be eroding or having slope stability problems, while considering short-term and long-term transportation and resource management needs.

Table 56. Summary Table of Resource Management Concerns in the Lower Cow Creek WAU.
Soils

Concern	Existing Situation	RMP/NFP Planning Objective	Management Strategy	Management Activity
What management activities have the potential for reducing site productivity on highly sensitive (Category 1) soils?	Category 1 Soils are highly sensitive to the effects of prescribed slash burning. There are approximately 12,942 acres (32 percent) of Category 1 Soils on BLM-administered land in the WAU.	RMP (p. 35) - Improve and/or maintain soil productivity.	Annual Program Summary and Monitoring Report-FY 2001 (pp. 68-69) - Maintain soil productivity and water quality while meeting resource management objectives. Burn under conditions when a light or moderate burn can be achieved on all units to protect soil productivity. Minimize consumption of litter, duff, and large woody debris on Category 1 Soils (highly sensitive, those soils recognized as unusually erodible, nutrient deficient, or with low organic matter). RMP Appendix D (pp. 129-143) contains a summary of management guidance for fragile sites.	Use appropriate methods for reducing vegetative competition on Category 1 Soils. Design treatments considered essential to meet resource management objectives to minimize consumption of litter, duff, and large woody debris. Mineral soil exposed by burning will be less than 15 percent of the unit surface area.

Table 56. Summary Table of Resource Management Concerns in the Lower Cow Creek WAU.
Soils

Concern	Existing Situation	RMP/NFP Planning Objective	Management Strategy	Management Activity
What management activities have the potential to reduce soil productivity due to compaction or the removal or disturbance of organic matter.	About 29 percent of the Lower Cow Creek WAU contains BLM-administered land that could be harvested with ground based equipment. About 45 percent of the Lower Cow Creek WAU contains TPCC fragile soil sites.	RMP (p. 35) - Improve and/or maintain soil productivity.	RMP (pp. 36-37) - Apply BMPs during all ground and vegetation disturbing activities. Use silvicultural systems that are capable of maintaining or improving long-term site productivity of soils. Minimize disturbance of identified fragile sites. Design logging systems to avoid or minimize adverse impacts to soils. RMP (pp.61-62) - Select logging systems based on the suitability and economic efficiency of each system for the successful implementation of the silvicultural prescription, for protection of soil and water quality, and for meeting other land use objectives. SEIS ROD (p. C-44) - Modify site treatment practices, particularly the use of fire and pesticides, and modify harvest methods to minimize soil and litter disturbance.	Minimize soil compaction and the amount of bare soil when using ground based timber harvesting methods. Follow BMPs in Appendix D of the RMP. Follow mechanical site preparation guidelines for track type equipment. Locate new roads on existing trails or disturbance when practical. Construct roads to the minimum standards necessary to meet objectives.

Table 56. Summary Table of Resource Management Concerns in the Lower Cow Creek WAU.
Wildlife

Concern	Existing Situation	RMP/NFP Planning Objectives	Management Strategy	Management Activity
How can suitable habitat around northern spotted owl sites be managed following the Standards and Guidelines to minimize effects on the northern spotted owl?	Forty-nine northern spotted owl pairs are located in the WAU. Many of the sites are below threshold levels of 40 percent suitable habitat within a 1.3 mile radius around the owl activity center.	RMP (p. 41) - Protect, manage, and conserve Federal listed and proposed species and their habitats to achieve their recovery in compliance with the Endangered Species Act, approved recovery plans, and Bureau special status species.	RMP (p.48) - Retain 100 acres of the best northern spotted owl habitat as close to the nest site or owl activity center as possible for all known (as of January 1, 1994) spotted owl activity centers. Human activity within 1/4 mile of nest sites which could disturb owl nesting activities will be restricted, especially the use of large power equipment and falling of trees. Restrictions will apply from March 1 to September 30 or until non-nesting status is confirmed using protocol procedures. The retention of adequate habitat conditions for dispersal of the northern spotted owl will be taken into account during watershed analysis that addresses the issue of adjusting Riparian Reserve widths.	Consider using timing and location of habitat removal or modification on the landscape to reduce effects within known territories. Plan timber harvesting activities that consider owl site condition, connection to other habitat, and the ranking of the owl sites in this analysis. Consider conducting near future timber harvesting activities outside of known 1.3 mile territories or in the periphery of the territory and outside of the 0.7 mile radius of known activity centers, when possible.

Table 56. Summary Table of Resource Management Concerns in the Lower Cow Creek WAU.
Wildlife

Concern	Existing Situation	RMP/NFP Planning Objectives	Management Strategy	Management Activity
Are there survey and manage species present in the WAU?	Two survey and manage mollusk species and the red tree vole have been documented occurring in the WAU.	RMP (p. 41) - Protect SEIS Special Attention Species so as not to elevate their status to any higher level of concern.	Collect information on distribution and abundance of survey and manage species present in the WAU. Identify what type of or how much habitat is necessary for species to survive.	Conduct clearance surveys prior to implementing ground disturbing activities. Consider conducting general surveys in all LUAs using established protocols to identify distribution across the landscape. Consider retaining suitable habitat features in regeneration harvest units to maintain habitat connectivity. Consider conducting pre- and post-harvest surveys to monitor effects on mollusks.
Is there potential Del Norte salamander habitat within the WAU? Is the Del Norte salamander present in the WAU?	Three known Del Norte salamander sites occur in the WAU.	RMP (p.41) - Protect SEIS Special Attention Species so as not to elevate their status to any higher level of concern.	Identify and manage high-priority sites to provide for a reasonable assurance the Del Norte salamander will persist.	Conduct surveys using protocol methods to determine if suitable habitat occurs in the WAU.

Table 56. Summary Table of Resource Management Concerns in the Lower Cow Creek WAU.
Wildlife

Concern	Existing Situation	RMP/NFP Planning Objectives	Management Strategy	Management Activity
The northern goshawk is a Bureau Sensitive Species. Is there northern goshawk habitat within the WAU?	The northern goshawk is not common in the Roseburg BLM District but the district is within the geographic range.	RMP (p. 41) - Manage for the conservation of Federal Candidate and Bureau Sensitive species and their habitats so as not to contribute to the need to list and to recover the species.	RMP (p. 49) - Retain 30 acre buffers of undisturbed habitat around active and alternative nest sites. Restrict human activity and disturbance within 1/4 mile of active sites between March and August or until such time as young have dispersed. Consider this species when planning or implementing ground disturbing projects.	Consider conducting field reviews to verify and evaluate potential habitat using standard protocol survey methods. Consider identifying and managing a post fledgling area around an activity center.
The northwestern pond turtle is a Bureau Sensitive Species. Does this species occur in the WAU?	The northwestern pond turtle occurs in the WAU.	RMP (p. 41) - Manage for the conservation of Federal Candidate and Bureau Sensitive species and their habitats so as not to contribute to the need to list and to recover the species.	RMP (p. 41) - Conduct field surveys according to protocols and established procedures. Review all proposed actions to determine whether or not Special Status Species occupy or use the affected area or if the habitat for such species is affected.	Consider conducting field reviews to verify and evaluate potential habitat.
Fender's blue butterfly is listed as a Federal Endangered Species. Is there Fender's blue butterfly habitat present in the WAU?	Potential Fender's blue butterfly habitat occurs in the WAU. Surveys have not been conducted to determine if this butterfly occurs in the WAU.	RMP (p. 41) - Protect, manage, and conserve Federal listed and proposed species and their habitats to achieve their recovery in compliance with the Endangered Species Act, approved recovery plans, and Bureau special status species.	RMP (p. 41) - Conduct field surveys according to protocols and established procedures. Review all proposed actions to determine whether or not Special Status Species occupy or use the affected area or if the habitat for such species is affected.	Consider conducting surveys for Fender's blue butterfly where Kincaid's lupine occurs in the WAU.

Table 56. Summary Table of Resource Management Concerns in the Lower Cow Creek WAU.
Wildlife

Concern	Existing Situation	RMP/NFP Planning Objectives	Management Strategy	Management Activity
The peregrine falcon is a Bureau Sensitive Species. Do peregrine falcons occur in or near the WAU?	The peregrine falcon was delisted as a Federal Endangered Species. One habitat location in the WAU has been used by a peregrine falcon.	RMP (p. 37) - Enhance and maintain biological diversity and ecosystem health to contribute to healthy wildlife populations. RMP (p. 41) - Manage for the conservation of Federal Candidate and Bureau Sensitive species and their habitats so as not to contribute to the need to list and to recover the species.	Develop a Habitat Management Plan for peregrine falcon nest sites on BLM-administered land.	Manage known and potential nesting sites to maintain site integrity. Comply with site specific habitat management plans.
Do special habitat features used by bats occur in the WAU?	Bats are expected to occur in the WAU since caves, mine adits, and other special habitats occur in the WAU.	RMP (p. 39) - Identify special habitat areas and determine relevance for management. RMP (p. 47) - Conduct surveys of crevices in caves, mines, and abandoned bridges and buildings for the presence of roosting bats. Develop mitigation measures in project or activity plans to protect sites.	Survey for the presence of roosting bats in special habitat features, such as crevices in caves, mines, and abandoned bridges and buildings in the WAU. Prohibit timber harvesting within 250 feet of an occupied bat site and develop other management direction as necessary.	Coordinate with and support research on habitat use by bats. Conduct non-intrusive surveys of special habitat features, such as crevices in caves, mines, and abandoned bridges and buildings and occupied sites. Develop management direction to protect bat roosting sites.

XII. Monitoring

General objectives of monitoring are:
1) To determine if the plan is being implemented correctly,
2) Determine the effectiveness of management practices at multiple scales, ranging from individual sites to watersheds,
3) Validate whether ecosystem functions and processes have been maintained as predicted.

The Roseburg RMP, Appendix I provides monitoring guidelines for various Land Use Allocations and resources. Some implementation, effectiveness, and validation monitoring questions are addressed. Management actions on the Roseburg BLM District may be monitored prior to project initiation and following project completion, depending on the resource or activity being monitored.

Some key resource elements that may be monitored in the Lower Cow Creek WAU are as follows:

A. All Land Use Allocations

Is the management action for the Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines being implemented as required?
Are high priority sites for species management being identified?

B. Riparian Reserves

Is the width and integrity of the Riparian Reserves maintained?
Are management activities within Riparian Reserves consistent with SEIS ROD Standards and Guidelines, RMP management direction, and Aquatic Conservation Strategy objectives?
Has Watershed Analysis been completed prior to on-the-ground actions being initiated in Riparian Reserves?

C. Matrix

Are suitable numbers of snags, coarse woody debris, and green trees being left following timber harvesting as called for in the SEIS ROD Standard and Guidelines and Roseburg RMP management direction?
Are timber sales being designed to meet ecosystem objectives for the Matrix?
Are forests growing at a rate that will produce the predicted yields?
Are forests in the Matrix providing for connectivity between Late-Successional Reserves?

D. Late-Successional Reserves

What activities were conducted or authorized within the LSR and how were they compatible with objectives of the LSR Assessment?
Were activities consistent with the SEIS ROD Standards and Guidelines, Roseburg and Medford RMP management direction, the LSR Assessment, and REO review requirements?
What is the status of development and implementation plans to eliminate or control non-native species which adversely impact late-successional objectives?
Are projects conducted in the LSR designed to maintain, improve, or attain LSR objectives?

E. Key Watersheds

Was watershed analysis completed prior to implementation of management activities?
Has the number of miles of roads been reduced or at least no net increase in roads been achieved?
Are at-risk fish species and stocks being identified?
Are fish habitat restoration and enhancement activities being designed and implemented which contribute to attainment of Aquatic Conservation Strategy objectives?
Are potential adverse impacts to fish habitat and fish stocks being identified?

XIII. Revisions to the Watershed Analysis and Data Gaps

Watershed analysis is an ongoing, iterative process designed to help define important resource information needed for making sound management decisions. This watershed analysis would, generally, be updated as existing information is refined, new data becomes available, new issues develop, when significant changes occur in the WAU, or as management needs dictate.

Some data gaps identified in the watershed analysis include the condition of roads and culverts at stream crossings, water quality data of streams on BLM-administered land, stream type classifications, and if some Special Status Species occur in the WAU.

Appendix A

Glossary

Appendix A

Glossary

Age Class - One of the intervals into which the age range of trees is divided for classification or use.

Anadromous Fish - Fish that are born and reared in freshwater, move to the ocean to grow and mature, and return to freshwater to reproduce. Salmon, steelhead, and shad are examples.

Aquatic Conservation Strategy - Plan developed in Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl, designed to maintain and restore ecosystem health at watershed and landscape scales to protect habitat for fish and other riparian-dependent species and resources and restore currently degraded habitats.

Beneficial Use - The reasonable use of water for a purpose consistent with the laws and best interest of the peoples of the state. Such uses include, but are not limited to, the following: instream, out of stream and groundwater uses, domestic, municipal, industrial water supply, mining, irrigation, livestock watering, fish and aquatic life, wildlife, fishing, water contact recreation, aesthetics and scenic attraction, hydropower, and commercial navigation.

Best Management Practices (BMPs) - Methods, measures, or practices designed to prevent or reduce water pollution. Not limited to structural and nonstructural controls, and procedures for operations and maintenance. Usually, Best Management Practices are applied as a system of practices rather than a single practice.

Bureau Assessment Species - Plant and animal species on List 2 of the Oregon Natural Heritage Data Base, or those species on the Oregon List of Sensitive Wildlife Species (OAR 635-100-040), which are identified in BLM Instruction Memo No. OR-91-57, and are not included as federal candidate, state listed or Bureau sensitive species.

Bureau Sensitive Species - Plant or animal species eligible for federal listed, federal candidate, state listed, or state candidate (plant) status, or on List 1 in the Oregon Natural Heritage Data Base, or approved for this category by the State Director.

Candidate Species - Those plants and animals included in Federal Register "Notices of Review" that are being considered by the United States Fish and Wildlife Service (FWS) for listing as threatened or endangered.

> Category 1. Taxa for which the Fish and Wildlife Service has substantial information on hand to support proposing the species for listing as threatened or endangered. Listing proposals are either being prepared or have been delayed by higher priority listing work.

Commercial Thinning - The removal of merchantable trees from an even-aged stand to encourage growth of the remaining trees.

Connectivity - A measure of the extent to which conditions between late-successional/old-growth forest areas provide habitat for breeding, feeding, dispersal, and movement of late-successional/old-growth-associated wildlife and fish species.

Connectivity/Diversity Block - A land use classification under Matrix lands managed on 150 year area control rotations. Periodic timber sales will leave 12 to 18 green trees per acre.

Core Area - That area of habitat essential in the breeding, nesting and rearing of young, up to the point of dispersal of the young.

Critical Habitat - Under the Endangered Species Act, (1) the specific areas within the geographic area occupied by a federally listed species on which are found physical and biological features essential to the conservation of the species, and that may require special management considerations or protection; and (2) specific areas outside the geographic area occupied by a listed species when it is determined that such areas are essential for the conservation of the species.

Density Management - Cutting of trees for the primary purpose of widening their spacing so that growth of remaining trees can be accelerated. Density management harvest can also be used to improve forest health, to open the forest canopy, or to accelerate the attainment of old growth characteristics if maintenance or restoration of biological diversity is the objective.

District Defined Reserves (DDR) - Areas designated for the protection of specific resources, flora and fauna, and other values. These areas are not included in other land use allocations nor in the calculation of the Probable Sale Quantity.

Endangered Species - Any species defined through the Endangered Species Act as being in danger of extinction throughout all or a significant portion of its range and published in the Federal Register.

Endemic - Native or confined to a certain locality.

Environmental Assessment (EA) - A systematic analysis of site-specific BLM activities used to determine whether such activities have a significant effect on the quality of the human environment and whether a formal environmental impact statement is required; and to aid an agency's compliance with National Environmental Protection Agency when no Environmental Impact Statement is necessary.

Ephemeral Stream - Streams that contain running water only sporadically, such as during and following storm events.

Fluvial - Migratory behavior of fish moving away from the natal stream to feed, grow, and mature then returning to the natal stream to spawn.

General Forest Management Area (GFMA) - Forest land managed on a regeneration harvest cycle of 70-110 years. A biological legacy of six to eight green trees per acre would be retained to assure forest health. Commercial thinning would be applied where practicable and where research indicates there would be gains in timber production.

Geographic Information System (GIS) - A computer based mapping system used in planning and analysis.

Intermittent Stream - Any nonpermanent flowing drainage feature having a definable channel and evidence of scour or deposition. This includes what are sometimes referred to as ephemeral streams if they meet these two criteria.

Issue - A matter of controversy or dispute over resource management activities that is well defined or topically discrete. Addressed in the design of planning alternatives.

Land Use Allocations - Allocations which define allowable uses/activities, restricted uses/activities, and prohibited uses/activities. They may be expressed in terms of area such as acres or miles etc. Each allocation is associated with a specific management objective.

Late-Successional Forests - Forest seral stages which include mature and old-growth age classes.

Late-Successional Reserve (LSR) - A forest in its mature and/or old-growth stages that has been reserved.

Matrix Lands - Federal land outside of reserves and special management areas that will be available for timber harvest at varying levels.

Mitigating Measures - Modifications of actions which (a) avoid impacts by not taking a certain action or parts of an action; (b) minimize impacts by limiting the degree or magnitude of the action and its implementation; (c) rectify impacts by repairing, rehabilitating or restoring the affected environment; (d) reduce or eliminate impacts over time by preservation and maintenance operations during the life of the action; or (e) compensate for impacts by replacing or providing substitute resources or environments.

Monitoring - The process of collecting information to evaluate if objectives and anticipated or assumed results of a management plan are being realized or if implementation is proceeding as planned.

Nonpoint Source Pollution - Water pollution that does not result from a discharge at a specific, single location (such as a single pipe) but generally results from land runoff, precipitation, atmospheric deposition or percolation, and normally is associated with agricultural, silvicultural and urban runoff, runoff from construction activities, etc. Such pollution results in the human-made or human-induced alteration of the chemical, physical, biological, radiological integrity of water.

Orographic - Of or pertaining to the physical geography of mountains and mountain ranges.

Peak Flow - The highest amount of stream or river flow occurring in a year or from a single storm event.

Perennial Stream - A stream that has running water on a year round basis.

Phenotypic - Of or pertaining to the environmentally and genetically determined observable appearance of an organism.

Precommercial Thinning (PCT) - The practice of removing some of the trees less than merchantable size from a stand so that remaining trees will grow faster.

Probable Sale Quantity (PSQ) - Probable sale quantity estimates the allowable harvest levels for the various alternatives that could be maintained without decline over the long term if the schedule of harvests and regeneration were followed. "Allowable" was changed to "probable" to reflect uncertainty in the calculations for some alternatives. Probable sale quantity is otherwise comparable to allowable sale quantity (ASQ). However, probable sale quantity does not reflect a commitment to a specific cut level. Probable sale quantity includes only scheduled or regulated yields and does not include "other wood" or volume of cull and other products that are not normally part of allowable sale quantity calculations.

Proposed Threatened or Endangered Species - Plant or animal species proposed by the U.S. Fish and Wildlife Service or National Marine Fisheries Service to be biologically appropriate for listing as threatened or endangered, and published in the Federal Register. It is not a final designation.

Resident Fish - Fish that are born, reared, and reproduce in freshwater.

Resource Management Plan (RMP) - A land use plan prepared by the BLM under current regulations in accordance with the Federal Land Policy and Management Act.

Riparian Reserves - Designated riparian areas found outside Late-Successional Reserves.

Riparian Zone - Those terrestrial areas where the vegetation complex and microclimate conditions are products of the combined presence and influence of perennial and/or intermittent water, associated high water tables and soils which exhibit some wetness characteristics. Normally used to refer to the zone within which plants grow rooted in the water table of these rivers, streams, lakes, ponds, reservoirs, springs, marshes, seeps, bogs and wet meadows.

Stream Order - A hydrologic system of stream classification. Each small unbranched tributary is a first order stream. Two first order streams join to form a second order stream. A third order stream has only first and second order tributaries, and so on.

Stream Reach - An individual first order stream or a segment of another stream that has beginning and ending points at a stream confluence. Reach end points are normally designated where a tributary confluence changes the channel character or order. Although reaches identified by BLM are variable in length, they normally have a range of ½ to 1-1/2 miles in length unless channel character, confluence distribution, or management considerations require variance.

Survey and Manage - Those species that are listed in Table C-3 of the Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl for which four survey strategies are defined.

Tillage - Breaking up the compacted soil mass to promote the free movement of water and air using a self drafting individual tripping winged subsoiler.

Transportation Management Objectives (TMO) - An evaluation of the current BLM transportation system to assess future need for roads, and identify road problem areas which need attention, and address future maintenance needs.

Watershed - The drainage basin contributing water, organic matter, dissolved nutrients, and sediments to a stream or lake.

Watershed Analysis - A systematic procedure for characterizing watershed and ecological processes to meet specific management and social objectives. Watershed analysis is a stratum of ecosystem management planning applied to watersheds of approximately 20 to 200 square miles.

Appendix B
References

Appendix B - References

Agee, J. K. 1993. Fire Ecology of Pacific Northwest Forests. Island Press, Washington, D.C. p. 493.

Agee, J. K. 1990. The Historical Role of Fire in Pacific Northwest Forests. p. 25-38. In Walstad, J. D. et al. (eds.). Natural and Prescribed Fire in Pacific Northwest Forests. Oregon State University Press, Corvallis, Or. 317 pp.

Agee, J. K. 1981. Fire Effects on Pacific Northwest Forests: Flora, Fuels, and Fauna. p. 54-66. In Proc., Northwest Fire Council 1981.

Agee, J. K. and M. H. Huff. 2000. The Role of Prescribed Fire in Restoring Ecosystem Health and Diversity in Southwest Oregon: Part 1. Ecological Conditions. Report to Pacific Northwest Research Station Director's Office. Northwest Forest Plan Issue.

Alverson, E. A. and K. Kuykendall. 1989. Field Studies on Aster vialis. Unpublished Report on File at the Bureau of Land Management, Eugene District Office, Eugene, Oregon.

Aulman, D. L. 1991. The Impacts and Pressures on West Coast Peregrines. pp. 55-63. In: Rogue National Forest. 1991. J. E. Pagel (ed.). Proceedings. Symposium on Peregrine Falcons in the Pacific Northwest. January 16-17. Ashland, OR.

Anderson, D. 1979. Proposed Construction of Galesville Dam on Cow Creek, Douglas County, Oregon. Manuscript Report. ODFW. Roseburg, OR.

Anthony, R. G., F. B. Isaacs, and R. W. Frenzel. 1983. Proceedings of a Workshop on Habitat Management for Nesting and Roosting Bald Eagles in the Western United States. Oregon State University, Corvallis, OR.

Beckham, S.D. 1986. Land of the Umpqua: A History of Douglas County, Oregon. Douglas County Commissioners, Douglas County, Oregon.

Bedunah, D. 1992. The Complex Ecology of Weeds, Grazing, and Wildlife. Western Wildlands 18:2.

Benda, L.E. and T. Dunne. 1997. Stochastic Forcing of Sediment Routing and Storage in Channel Networks. Water Resources Research. Volume 33. Number 12:2865-2880.

Boyd, Robert, editor. 1899. Indians, Fire and the Land in the Pacific Northwest. Oregon State University Press, Corvallis, Oregon.

Brady, Nyle C. 1974. The Nature and Properties of Soils. Eighth Edition. MacMillan Publishing Company, Inc. New York.

Brown, E. R., tech. ed. 1985. Management of Wildlife and Fish Habitats in Forests of Oregon and Washington. Part 1 & 2 (Appendices). Publ. R6-F&WL-192-1985. Portland, OR. USDA, Forest Service, Pacific Northwest Region.

Bury, R. B. 1995 (unpublished). Amphibians and Reptiles of the BLM Roseburg District, Oregon. Final Report to the Roseburg District BLM. 101 pp.

Bury, R. Bruce. 1997. Terrestrial Herpetological Surveys in the Cow Creek Watershed of BLM-Roseburg District, Spring 1997. Draft. November 21, 1997. 21 pp.

Casteel, J. 1970. Summer Report: Cow Creek Rehabilitation Project. Manuscript Report. ODFW. Roseburg, OR.

Christner, J. and R.D. Harr. 1982. Peak Streamflows From the Transient Snow Zone, Western Cascades Oregon. Proceedings of the 50th Western Snow Conference. Colorado State University. Fort Collins. pp. 27-38.

Cramer, S. P. and Associates, Inc. 1997. Effects of the Galesville Hydroelectric Project on Fish and Their Habitat in Cow Creek, Umpqua Basin, Oregon.

Curtiss. 1982. An Evaluation of Suspended Sediment and Turbidity in Cow Creek, Oregon. Open-File Report 82-364. U.S. Geological Survey. 65 pp.

Dose, J. J. and B. B. Roper. 1994. Long-term Changes in Low-Flow Channel Widths Within the South Umpqua Watershed, Oregon. Water Resources Bulletin 30(6):993-1000.

Eastman, D. C. 1990. Rare and Endangered Plants of Oregon. Beautiful America Publishing Co. p. 114.

Environmental Protection Agency. 1986. Quality Criteria for Water. No. 440/5-86-001.

Environmental Protection Agency. 1998. National Recommended Water Quality Criteria. Published in the Federal Register v. 63. no. 237. December 10, 1998. pp. 68354-68364.

Federal Register. 1994. Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for the Conservancy Fairy Shrimp, Longhorn Fairy Shrimp, and The Vernal Pool Tadpole Shrimp, and Threatened Status for the Vernal Pool Fairy Shrimp. September 19, 1994.

Federal Register. 1996. Endangered and Threatened Wildlife and Plants; Final Designation of Critical Habitat for the Marbled Murrelet. May 24, 1996. 61(102):26256-26278.

Federal Register. 1999. Endangered and Threatened Wildlife and Plants; Final Rule to Remove the American Peregrine Falcon from the Federal List of Endangered and Threatened Wildlife, and to Remove the Similarity of Appearance Provision for Free-flying Peregrines in the Conterminous United States; Final Rule. August 25, 1999. 64(164)46542-46558.

Federal Register. 2000. Endangered and Threatened Wildlife and Plants; Endangered Status for "Erigeron decumbens" var. "decumbens" (Willamette Daisy) and Fender's Blue Butterfly ("Icaricia icarioides fenderi") and Threatened Status for "Lupinus sulphurous" ssp. "kincaidii" (Kincaid's Lupine). January 25, 2000. 65(16)3875-3890.

Filip, G. M. 1994. Forest Health Decline in Central Oregon: A 13-Year Case Study. Northwest Science 68:289-296.

Filip, Gregory M. and Schmitt, Craig L. 1990. Rx for Abies: Silvicultural Options for Diseased Firs in Oregon and Washington. USDA Forest Service, Pacific Northwest Research Station, Portland, Oregon. General Technical Report PNW-GTR-252.

Franklin, J. F. and C. T. Dyrness. 1984. Natural Vegetation of Oregon and Washington. Oregon State University Press, Corvallis, OR. 452 pp.

Fredriksen, R. L., D. G. Moore, and L. A. Norris. 1975. The Impact of Timber Harvest, Fertilization, and Herbicide Treatment on Streamwater Quality in Western Oregon and Washington. In Bernier, B. and C. Winget (eds.). Forest Soils and Forest Land Management - Proceedings of the Fourth North American Forest Soils Conference. Quebec, Canada. Laval University Press. pp. 283-313.

Furniss, M. J., T. D. Roelofs, and C. S. Yee. 1991. Road Construction and Maintenance. Pages 297-323 *in* William R. Meehan, editor. Influences of Forest and Rangeland Management on Salmonid Fisheries and Their Habitats. American Fisheries Society. Special Publication 19.

GIS. 1992-2000. Roseburg District Geographical Information System.

Goheen, Don. 1996. Southwest Oregon Forest Insect and Disease Center. J. Herbert Stone Nursery, Central Point, Oregon.

Graf, W. 1943. Natural History of the Roosevelt Elk. Oregon State College, Corvallis, OR. 222 pp. Ph.D. Dissertation.

Groot, C. and L. Margolis. 1991. Pacific Salmon Life Histories. UBC Press, Vancouver, B.C.

Harr, R.D. 1979. Effects of Timber Harvest on Stream Flow in the Rain-dominated Portion of the Pacific Northwest. In Proceedings of a Workshop on Scheduling Timber Harvest for Hydrologic Concerns. USDA Forest Service. Portland, OR. 45 pp.

Harr, R.D., Warren C. Harper, James T. Krygier, Frederic S. Hsieh. 1975. Changes in Storm Hydrographs After Road Building and Clear-cutting in the Oregon Coast Range. Water Resources Research. 11(3):436-444.

Haight, W. 1991. Status/Future of Management and Recovery of Oregon Peregrine Falcons. pp. 68-71. In: Rogue National Forest. 1991. J. E. Pagel. (ed.). Proceedings. Symposium on Peregrine Falcons in the Pacific Northwest. January 16-17. Ashland, OR.

Hem, J. D. 1985. Study and Interpretation of the Chemical Characteristics of Natural Water. U.S. Geological Survey Water-Supply Paper 2254. 263 pp.

Henny, C. J. 1991. Peregrine Falcons in Oregon and DDT in the Pacific Northwest. pp. 75-80. In: Rogue National Forest. 1991. J. E. Pagel. (ed.). Proceedings. Symposium on Peregrine Falcons in the Pacific Northwest. January 16-17. Ashland, OR.

Hickman, Gene. 1994. General Vegetation Section of Soils Report. Soil Conservation Service, Deschutes Business Ctr., Bend, Oregon.

Hinkle, Stephen R. 1999. Inorganic Chemistry of Water and Bed Sediment in Selected Tributaries of the South Umpqua River, Oregon, 1998. U.S. Geological Survey. Water-Resources Investigations Report. 99-4196.

Holaday, Steven. 1992. Summertime Water Temperature Trends in Steamboat Creek Basin, Umpqua National Forest. Civil Engineering, Oregon State University.

Holland, D. C. 1991. A Synopsis of the Ecology and Status of the Western Pond Turtle (Clemmys marmorata) in 1991. A report to the U.S. Fish and Wildlife Service. National Ecological Research Center. San Simeon, CA. 141 pp.

Holland, D. C. 1994. The Western Pond Turtle: Habitat and History. Report DOE/BP-62137-1. Bonneville Power Administration. Portland, OR. 302 pp.

Hubbard, L. E., T. A. Herrett, J. E. Poole, G. P. Ruppert, and M. L. Courts. 2000. Water Resources Data - Oregon - Water Year 1999. USGS Water-Data Report OR-99-1. Portland, Oregon. 335 pp.

Isaacs, Frank B. 1995. 1995 Midwinter Eagle Count Results for Oregon. Oregon Eagle Foundation, Inc. 3 pp.

Isaacs, F. B. and R. G. Anthony. 1995. Bald Eagle Nest Locations and History of Use in Oregon 1971 through 1994. Oregon Cooperative Wildlife Research Unit, Oregon State University, Corvallis. 16 pp.

Johnson, O. W., R. S. Waples, T. C. Wainwright, K. G. Neely, F. W. Waknitz, and L. T. Parker. 1994. Status Review for Oregon's Umpqua River Sea-run Cutthroat Trout. U.S. Dept. of Comm. NOAA Tech Memo. NMFS-NWFSC-15. 122 pp.

Johnson, S. L. and J. A. Jones. 2000. Stream Temperature Responses to Forest Harvest and Debris Flows in Western Cascades, Oregon. Can. J. Fish. Aqua. Sci. 57(Suppl. 2):30-39.

Jones, J. A. and G. E. Grant. 1996. Peak Flow Responses to Clear-cutting and Roads in Small and Large Basins, Western Cascades, Oregon. Water Resources Research 32-4: 959-974.

Kaye, T., K. Kuykendall, and W. Messinger. 1991. Aster vialis Inventory, Monitoring, and Pollination Biology. Cooperative Challenge Cost Share Project 90-1, prepared for the BLM Eugene and Roseburg Districts. On file at ONHP, ODA, and BLM Roseburg District.

Kuck, T. D. 2000. Regional Hydraulic Geometry Curves of the South Umpqua Area in Southwestern Oregon. Stream Systems Technology Center, Rocky Mountain Research Station, Fort Collins, Colorado. Stream Notes.

Lauman, J. E., K. E. Thompson, and J. D. Fortune, Jr. 1972. Fish and Wildlife Resources of the Umpqua Basin, Oregon, and Their Water Requirements. Oregon State Game Commission. Portland, Oregon. 127 pp.

MacDonald, L. H., A. W. Smart, and R. C. Wissmar. 1990. Monitoring Guidelines to Evaluate Effects of Forestry Activities on Streams in the Pacific Northwest and Alaska. Environmental Protection Agency. 166 pp.

Mantua, N. J., S. R. Hare, Y. Zhang, J. M. Wallace, and R. C. Francis. 1997. A Pacific Interdecadal Climate Oscillation With Impacts on Salmon Production. Bulletin of the American Meteorological Society. August, 1996.

Marshall, D. B. 1991. Sensitive Vertebrates of Oregon. First Ed. Oregon Department of Fish and Wildlife. Portland, OR.

McGraw, R. L. 1997. Timber Harvest Effects on Metamorphosed and Larval Long-toed Salamanders (Ambystoma macrodactylum). M.S. thesis. Univ. of Mont. 74 pp.

Meehan, W. R., editor. 1991. Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. Bethesda, Maryland: American Fisheries Society. Special Publication 19. 751 pp.

Moore, D. G. 1975. Impact of Forest Fertilization on Water Quality in the Douglas-fir Region -- A Summary of Monitoring Studies. In: Proc. 1974 National Convention: 209-219. Soc. of Amer. Foresters. New York City.

Morris, W. G. 1934. Lightning Storms and Fires on the National Forests of Oregon and Washington. USDA For. Serv., Pacific Northwest For. and Range Exp. Sta., Portland OR.

Nehlsen, W., J. E. Williams, and J. A. Lichatowich. 1991. Pacific Salmon at the Crossroads: Stocks at Risk From California, Oregon, Idaho and Washington. Fisheries 16(2):2-21.

Nehlsen, W. 1994. South Umpqua River Basin Case Study. The Pacific Rivers Council. 58 pp.

Norecol Environmental Consultants. 1988. Scientific Taking Permit Report. ODFW File: 1-117-02.01.

Norris, L. A. 1990. An Overview and Synthesis of Knowledge Concerning Natural and Prescribed Fire in Pacific Northwest forests. In Walstad, J. D. et al. (eds.) Natural and Prescribed Fire in Pacific Northwest Forests. Oregon State University Press, Corvallis, Or. 317 pp.

Onions, C. A. 1969. Sediment Transport in Streams in the Umpqua River Basin, Oregon. Open-File Report. U.S. Geological Survey. 45 pp.

Oregon Department of Environmental Quality. 1994. Oregon Administrative Rules, Chapter 340, Regulations Relating to: Water Quality Control.

Oregon Department of Environmental Quality. 1996. State-wide Water Quality Management Plan; Beneficial Uses, Policies, Standards, and Treatment Criteria for Oregon. Oregon Administrative Rules, Chapter 340, Division 41 – Dept. of Environmental Quality. Table 3 Exhibit-7.

Oregon Department of Environmental Quality. 1998. Listing Criteria for Oregon's 1998 303(d) List of Water Quality Limited Water Bodies.

Oregon Department of Environmental Quality. 2000. Removal Assessment Formosa Abandoned Mine Land Site Douglas County, Oregon. Available from the U.S. Bureau of Land Management, Roseburg District, Roseburg, Oregon.

Oregon Department of Fish and Wildlife. 1998. South Umpqua/Cow Creek Fall Chinook Aerial Survey Redd Counts. Oregon Department of Fish and Wildlife, Roseburg, Oregon.

Oregon Department of Fish and Wildlife. 1999. 1999 Cow Creek Rotary Trap. Oregon Department of Fish and Wildlife, Roseburg, Oregon.

Oregon Department of Fish and Wildlife. 2000. Cow Creek Rotary Trap Results. Oregon Department of Fish and Wildlife, Roseburg, Oregon.

Oregon Natural Heritage Program. 1998. Rare, Threatened, and Endangered Species of Oregon. Oregon Natural Heritage Program. Portland, Oregon. 92 pp.

Peterjohn, Bruce G., Hohn R. Sauer, and Chandler S. Robbins. 1995. Population Trends From the North American Breeding Bird Survey p. 4. In Ecology and Management of Neotropical Migratory Birds (Thomas E. Martin and Deborah M. Finch eds.). Oxford University Press, New York.

Reese, D.A. 1996. Comparative Demography and Habitat Use of Western Pond Turtles in Northern California: the Effects of Damming and Related Alterations. PhD Dissertation. University of California, Berkeley. 253 pp.

Reid, L. M. and T. Dunne. 1984. Sediment Production from Forest Road Surfaces. Water Resources Research 20:11, 1756-1761.

Reinhart, Herman Francis. 1962. The Golden Frontier: The Recollections of Herman Francis Reinhart, 1851-1869. Ed. Doyce B. Nunis. University of Texas Press. Austin, Texas.

Riddle, G. W. 1964. Early Days in Oregon: A History of the Riddle Valley. Myrtle Creek Mail. Myrtle Creek, Oregon.

Riddle, G. W. 1953. Early Days in Oregon: A History of the Riddle Valley. Printed for Riddle Parent Teachers Association. Riddle, Oregon.

Rinella, J. 1986. Analysis of Fixed-station Water Quality Data in the Umpqua River Basin, Oregon. Water Resources Investigation Report 85-4253. U.S. Geological Survey. Portland, Oregon. 96 pp.

Roper, B. B., D. L. Scarnecchia, and T. J. La Marr. 1994. Summer Distribution of and Habitat Use by Chinook Salmon and Steelhead Within a Major Basin of the South Umpqua River, Oregon. Transactions of the American Fisheries Society 123:298-308.

Rosgen, D. L. 1996. Applied River Morphology. Wildland Hydrology.

Roth, A. R. 1937. A Survey of the Waters of the South Umpqua Ranger District, Umpqua National Forest. USDA Forest Service. Portland, Oregon.

Roth, Lewis F., Robert D. Harvey, Jr., and John T. Kliejuna. 1987. Port-Orford-Cedar Root Disease. USDA Forest Service. Pacific Northwest Research Station. Portland, Oregon. General Technical Report R6FPM PR 010 91.

Sharp, B. 1990. Population Trends of Oregon's Neotropical Migrants. Oregon Birds 16(1):27-36. Spring.

Simon, D. C. 1998. Distributional Surveys of Umpqua chub Oregonichthys kalawatseti, 1987 and 1998. Final report submitted to U.S. Fish and Wildlife Service, Oregon State Office. Order no. 1448-13420-97-M216.

South Umpqua Planning Unit (SUPU). 1979. Unpublished.

Southwest Oregon Forest Insect and Disease Technical Center. 1995. Port-Orford-Cedar Root Disease in Southwest Oregon.

Stork, Pascal, Travis Kern, and Susan Bolton. 1997. Measurement of Differences in Snow Accumulation, Melt, and Micrometeorology Between Clearcut and Mature Forest Stands. Western Snow Conference. 65th Annual Meeting. Banff, Alberta, Canada. pp. 338-343.

Tanner, D. Q. and C. W. Anderson. 1996. Assessment of Water Quality, Nutrients, Algal Productivity, and Management Alternatives for Low-flow Conditions, South Umpqua River, Oregon, 1990-92. U.S. Geological Survey. Water-Resource Investigations Report. 96-4082.

Thomas, J. W., E. D. Forsman, J. B. Lint, et al. 1990. A Conservation Strategy for the Northern Spotted Owl: A Report of the Interagency Scientific Committee to Address the Conservation of the Northern Spotted Owl. Portland, OR. USDI, USDA, and NPS. 427 pp.

Thomas, R. B. and W. F. Megahan. 1998. Peak Flow Response to Clear-cutting and Roads in Small and Large Basins, Western Cascades, Oregon: A Second Opinion. Water Resources Research. Vol. 34, No. 12. pp. 3393-3403.

Thornbury, William D. 1965. Principles of Geomorphology. John Wiley and Sons.

USDA Forest Service. 1990. Standard and Guideline Procedures for Watershed Cumulative Effects and Water Quality. USDA Umpqua National Forest. 86 pp.

USDA Forest Service, USDC National Oceanic and Atmospheric Administration, USDC National Marine Fisheries Service, USDI Bureau of Land Management, USDI Fish and Wildlife Service, USDI National Park Service, and Environmental Protection Agency. 1993. Forest Ecosystem Management: An Ecological, Economic, and Social Assessment. Report of the Forest Ecosystem Management Assessment Team. (FEMAT)

USDA Forest Service and USDI Bureau of Land Management. 1994a. Final Supplemental Environmental Impact Statement, on Management of Habitat for Late-successional and Old-Growth Related Species Within the Range of the Northern Spotted Owl.

USDA Forest Service and USDI Bureau of Land Management. 1994b. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl. Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl.

USDA Forest Service and USDI Bureau of Land Management. 1995. Little River Watershed Analysis. USDA Forest Service, Umpqua National Forest, North Umpqua Ranger District and USDI Bureau of Land Management, Mt. Scott Resource Area.

USDA Forest Service and USDI Bureau of Land Management. 2001. Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and Other Mitigation Measures Standards and Guidelines in Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl.

USDA Natural Resources Conservation Service. 1999. Soil Biology Primer. PA-1637.

USDI Bureau of Land Management and USDA Forest Service. 1998. South Coast - Northern Klamath Late-Successional Reserve Assessment. Coos Bay, Roseburg, and Medford Bureau of Land Management Districts and Mapleton Ranger District, Siuslaw National Forest.

USDI Bureau of Land Management. 1986. Timber Production Capability Classification. Handbook 5251-1. Conducted by the Roseburg District, USDI, Bureau of Land Management. (TPCC - 1986).

USDI Bureau of Land Management. 1988. Monitoring Western Oregon Records Of Decision Document. Bureau of Land Management. H-1734-1-1988.

USDI Bureau of Land Management. 1992a. Draft Roseburg District Resource Management Plan and EIS. Roseburg, OR. 2 vols.

USDI Bureau of Land Management. 1994. Roseburg District Proposed Resource Management Plan/Environmental Impact Statement.

USDI Bureau of Land Management. 1994b. Port-Orford-Cedar Management Guidelines.

USDI Bureau of Land Management. 1995. Roseburg District Record of Decision and Resource Management Plan.

USDI Bureau of Land Management. 2000. Formosa Abandoned Mine Land Site Remedial Investigation. South River Field Office. Roseburg, Oregon.

USDI Fish and Wildlife Service. 1992b. Endangered and Threatened Wildlife and Plants; Determination of Critical Habitat for the Northern Spotted Owl. Federal Register (FR), 57(10): 1796-1838. January 15, 1992.

USDI Fish and Wildlife Service. 1992c. Determination of Threatened Status for the Washington, Oregon, and California Population of the Marbled Murrelet. Federal Register (FR), 57(191). October 1.

USDI Fish and Wildlife Service. 1986. Pacific Bald Eagle Recovery Plan (PBERP). Portland, OR. 163 pp.

USDI Fish and Wildlife Service. 1983. Revised Columbian White-tailed Deer Recovery Plan. U.S. Fish and Wildlife Service, Portland, OR. 75 pp.

Weatherbee, P. K. 1995. A Comparison of Observed and Predicted Snowpack Outflow During Rain-On-Snow, Umpqua National Forest. M.S. Thesis. University of Washington, Seattle, WA. 98 pp.

Wellman, R. E., J. M. Gordan, and R. L. Moffatt. 1993. Statistical Summaries of Streamflow Data in Oregon: Volume 2 – Annual Flow and High Flow, and Instantaneous Peak Flow. U.S. Geological Survey. Open-File Report 93-63. 318 pp.

Wemple, B. C. 1994. Hydrologic Integration of Forest Roads With Stream Networks in Two Basins, Western Cascades, Oregon. M.S. Thesis. Oregon State University, Corvallis, Oregon. 87 pp.

Wisdom, M. J., L. R. Bright, C. G. Carey, W. W. Hines, R. J. Pedersen, D. A. Smithey, J. W. Thomas, and G. W. Winter. 1986. A Model to Evaluate Elk Habitat in Western Oregon. Publication No. R6-F&WL-216-1986. USDA Forest Service, Pacific Northwest Region, Portland, OR. 36 pp.

Wyatt, B. 1959. Observations on the Movements and Reproduction of the Cascade Form of Cutthroat Trout. M.S. Thesis. Oregon State College, Corvallis, OR. 60 pp.

Appendix C
Fisheries

Table C-1. Summary Table of Current Conditions in the Lower Cow Creek WAU.

Drainage Name Subwatershed Name	Road Density	Stream Density	Percent BLM Administered Land	Stream Crossing Density	Percent Less Than 30 Years Old (BLM)	Percent HRP	Percent of Riparian Reserves at Least 80 Years Old
Catching Creek	4.15	6.83	47	1.61	6	98	73
Council Creek	5.47	2.10	38	2.10	43	90	45
Jerry Creek	3.15	1.17	7	1.17	49	100	42
Mitchell Creek	4.48	2.50	47	2.50	10	98	61
Nickle Mountain	6.60	4.12	8	3.31	0	99	100
Riddle	5.43	5.39	0	2.25	0	100	NA
Russell Creek	5.10	6.41	47	2.42	25	93	56
Shoestring	4.81	8.52	31	2.55	26	98	68
Riddle Subwatershed	4.66	6.20	29	2.09	21	97	61
Beatty Creek	1.75	5.95	24	0.38	1	98	96
Buck Creek	4.83	7.43	43	2.38	27	77	70
Doe Creek	5.79	8.52	25	3.04	42	88	35
Iron Mountain	4.32	5.91	51	1.21	21	72	71
Island Creek	5.39	6.80	50	2.32	35	88	40
Polan Creek	2.44	6.70	47	1.37	0	94	75
Rattlesnake Frontal	3.77	7.73	35	1.59	32	95	51
Salt Cow Creek	4.94	7.24	31	2.32	28	92	65
Lower Cow Creek Subwatershed	4.24	7.09	37	2.00	24	87	62
Cattle Creek	5.71	7.47	47	2.97	22	83	56
Little Dads Creek	5.20	8.38	58	2.38	39	93	54
Mile 15 Frontal	3.89	5.90	28	1.67	0	96	70
Table Creek	3.14	7.00	54	1.24	11	88	65
Middle Cow Creek Subwatershed	4.50	7.18	47	2.14	20	89	60

Drainage Name Subwatershed Name	Road Density	Stream Density	Percent BLM Administered Land	Stream Crossing Density	Percent Less Than 30 Years Old (BLM)	Percent HRP	Percent of Riparian Reserves at Least 80 Years Old
Darby Creek	4.10	7.72	52	2.29	17	64	81
Dutchman Creek	3.47	7.01	68	1.60	9	72	87
Lower Union	6.93	7.87	48	4.21	33	88	56
Middle Cow Frontal	4.41	8.25	50	2.71	25	86	64
Upper Cow Frontal	4.07	8.16	48	2.50	8	88	83
Upper Union	4.58	7.60	39	2.63	43	83	27
Upper Cow Creek Subwatershed	4.68	7.60	48	2.75	25	82	63
Audie Creek	6.17	9.27	46	3.84	40	81	39
Buck Martin	6.21	7.26	49	2.66	53	66	34
Cedar Gulch Creek	6.10	8.84	56	3.08	25	75	71
Hare Creek	6.08	9.43	46	3.68	24	85	66
Lower Middle Creek	6.92	8.07	47	3.50	33	78	47
Martin Middle	4.43	6.05	38	2.52	22	85	65
Smith Creek	5.97	7.57	33	3.17	13	76	87
Lower Middle Creek Subwatershed	5.89	7.90	45	3.23	32	79	56
Brush Middle	6.48	10.57	29	3.20	36	76	50
Gravel Creek	6.04	9.96	45	2.70	37	75	40
Panther Middle	4.97	6.93	45	1.47	35	64	51
Peavine Creek	4.90	6.81	59	3.26	21	85	78
South Fork Middle Creek	5.99	7.48	22	2.96	36	54	52
Upper Middle Creek	6.42	9.17	46	2.96	22	63	70
Upper Middle Creek Subwatershed	5.95	8.44	37	2.90	30	66	58
Lower Cow Creek WAU	4.89	7.28	39	2.49	25	85	60

NA = Does not apply, since there are no Riparian Reserves.

Table C-2. Habitat Bench Marks Related to Category Types

Pools	Bench Mark Weighing Scale 1-5	4-Excellent	3-Good	2-Fair	1-Poor	Row Totals
a) Pool Area %	2	$\geq$ 45	30-44	16-29	$\leq$ 15	
b) Residual Pool						
Small (1-3 ordered)	4	$\geq$ 0.55	0.35 - 0.54	0.15 - 0.34	0 - 0.14	
Large (4th order and greater)	4	$\geq$ 0.95	0.76 - 0.94	0.46 - 0.75	$\leq$ 0.45	
Riffles						
a) Width/Depth (wetted) (ODFW)	3	$\leq$ 10.4	10.5 - 20.4	20.5 - 29.4	$\geq$ 29.5	
b) Width/Depth (bank full) (USFS)	3	$\leq$ 10	11 - 15	16 - 19	$\geq$ 20	
c) Silt/Sand/Organics (% area) (ODFW)	2	$\leq$ 1	2 - 7	8 - 14	$\geq$ 15	
d) Embeddedness (% by unit) (USFS)	2	0	1 - 25	26 - 49	$\geq$ 50	
e) Gravel % (Riffles)	3	$\geq$ 80	30 - 79	16 - 29	$\leq$ 15	
f) Substrate dominant	3	Gravel	Cobble	Cobble	Bedrock	
subdominant (USFS)	2	Cobble	Large Boulder	Small Boulder	Anything	
Reach Average						
a) Riparian condition Species dom/subdom. (> 15 cm)	2	conifer/hdwd* Klam - hdwd*	conifer/hdwd* Klam - hdwd*	hdwd*/conifer	alder/anything	
Size (Conifers)	3	$\geq$ 36" Klam - $\geq$ 24"	24 - 35" Klam - 12 - 23"	7 - 23"	$\leq$ 6"	
b) Shade (%) (ODFW)						
Stream Width < 12 M	1	$\geq$ 80	71 - 79	61 - 70	$\leq$ 60	
Stream Width > 12 M	1	$\geq$ 70	61 - 69	51 - 60	$\leq$ 50	
LWD						
a) Pieces (lg/sm) 100 M Stream	3	$\geq$ 29.5	19.5 - 29.4	10.5 - 19.4	$\leq$ 10.4	
b) Vol/100 M Stream	2	$\geq$ 39.5	29.5 - 39.4	20.5 - 29.4	$\leq$ 10.4	
USFS - Pieces 50' or more long and 24" DBH per mile	5	$\geq$ 70	45 - 69	31 - 44	$\leq$ 30	
Temperatures	1	$\leq$ 55	56 - 60	61 - 69	$\geq$ 70	
Macroinvertebrates						
Totals for Category						

* Hardwood category does not include alder.
*Where USFS designations appear, either USFS or ODFW measurements may be used but not both.

HABITAT BENCHMARK RATING SYSTEM

100 - 82 EXCELLENT
81 - 63 GOOD
62 - 44 FAIR
43 - 25 POOR

Table C-3. ODFW Aquatic Habitat Inventory Data Table

Stream	Reach	% Pool Area	Residual Pool Depth	Riffle W/D Ratio	% Fines in Riffles	% Gravel in Riffles	Riparian Vegetation (dom/subdom)	Riparian Conifer Size	% Shade	LWD pieces per 100m	LWD vol per 100m	Aquatic Habitat Rating (AHR)
Ash (Mitchell) Cr	1	41.2	0.5	24.3	1	69	hdwd/con	small	79	0.1	0.3	Fair
	2	28.8	0.5	22.0	2	69	hdwd/con	small	97	0.6	0.5	Fair
	3	4.7	0.6	18.9	1	52	hdwd/con	small	89	1.7	6.8	Fair
	4	7.1	0.5	18.5	0	42	hdwd/con	medium	94	6.9	13.6	Fair
Beatty Cr	1	8.3	0.5	17.0	3	75	con/hdwd	medium	99	6.3	19.0	Fair
Buck (Cow Cr)	1	13.6	0.5	13.3	3	26	hdwd/con	medium	91	16.6	43.7	Fair
	2	33.2	0.5	15.7	3	45	con/hdwd	medium	79	5.6	5.8	Fair
Buck (Middle Cr)	1	24.8	0.3	20.6	8	30	con/hdwd	small	83	8.4	11.8	Fair
	2	20.8	0.3	18.8	8	24	con/hdwd	small	82	1.2	1.1	Fair
	3	1.9	0.8	25	0	100	con/hdwd	small	96	3.5	9.2	Fair
Catching Cr	1	18.3	0.4	21.8	1	52	hdwd/con	small	93	0.5	0.3	Fair
	2	32.2	0.4	26.7	1	53	hdwd/con	small	93	1.0	1.2	Fair
	3	16.0	0.3	28.3	2	37	con/hdwd	small	95	0.7	0.9	Fair
	4	30.0	0.4	19.4	3	23	con/hdwd	medium	99	2.1	8.0	Fair
Cattle Cr	1	14.7	0.4	21.8	1	47	hdwd/con	small	88	1.4	3.2	Fair
	2	15.8	0.5	16.8	0	33	hdwd/con	small	62	1.6	1.4	Fair
	3	13.7	0.7	17.9	1	39	hdwd/con	small	66	5.1	8.1	Fair
Cedar Gulch	1	21.8	0.2	10.9	5	16	hdwd/con	small	87	5.1	8.0	Fair
	2	40.0	0.3	6.1	68	10	con/hdwd	medium	61	5.1	7.3	Poor
Council Cr	1	23.0	0.3	15.4	0	50	hdwd/con	small	94	0.5	0.3	Fair
	2	--	--	--	--	--	--	--	--	--	--	--
	3	23.0	0.4	17.8	4	32	con/hdwd	small	95	3.2	10	Fair

Table C-3. ODFW Aquatic Habitat Inventory Data Table

Stream	Reach	% Pool Area	Residual Pool Depth	Riffle W/D Ratio	% Fines in Riffles	% Gravel in Riffles	Riparian Vegetation (dom/subdom)	Riparian Conifer Size	% Shade	LWD pieces per 100m	LWD vol per 100m	Aquatic Habitat Rating (AHR)
Darby Cr	1	22.4	0.6	13.1	0	58	hdwd/con	small	85	4.9	8.9	Fair
	2	15.8	0.5	15.0	0	55	hdwd/con	small	60	11.0	28.6	Fair
	3	14.9	0.6	14.0	0	59	con/hdwd	medium	90	19.0	50.8	Good
Doe Cr	1	12.8	0.5	16.7	3	42	hdwd/con	small	92	1.0	2.0	Fair
	2	26.1	0.5	20.9	1	58	con/hdwd	small	93	1.7	1.4	Fair
	3	17.4	0.4	15.9	1	63	con/hdwd	small	75	0.6	0.4	Fair
	4	15.4	0.4	14.0	1	57	con/hdwd	small	95	2.4	3.7	Fair
	5	8.5	0.4	10.0	0	52	con/hdwd	small	80	0.7	1.0	Fair
Iron Mtn Cr	1	20.9	0.5	16.2	0	29	hdwd/con	small	86	1.9	3.9	Fair
	2	24.3	0.6	15.0	3	56	hdwd/con	medium	91	2.4	6.2	Fair
	3	8.7	0.5	16.9	0	50	hdwd/con	medium	80	5.4	12.3	Fair
	4	12.1	0.6	11.3	0	62	con/hdwd	small	89	6.1	16.4	Fair
Little Dads Cr	1	20.6	0.6	23.8	5	59	con/hdwd	medium	97	7.4	32.6	Fair
	2	17.7	0.4	26.0	10	80	con/hdwd	medium	96	8.8	30.5	Fair
Live Oak Cr	1	48.9	0.6	16.5	17	63	con/hdwd	small	84	4.4	9.4	Fair
	2	77.1	0.5	33.5	35	28	con/hdwd	small	45	0.7	0.7	Poor
Martin Cr	1	6.0	0.4	27.0	9	30	con/hdwd	medium	90	3.0	8.5	Fair
	2	--	0.0	15.8	6	24	con/hdwd	medium	72	2.9	4.6	Poor
Middle Cr	1	22.7	0.8	21.5	9	24	hdwd/con	small	69	0.9	2.5	Fair
	2	12.3	0.7	23.0	5	20	con/hdwd	medium	67	1.5	4.1	Poor
	3	7.8	0.4	28.6	8	36	hdwd/con	small	88	1.7	2.7	Fair
	4	0.3	0.4	35.0	17	40	hdwd/con	small	75	3.5	12.7	Poor

Table C-3. ODFW Aquatic Habitat Inventory Data Table

Stream	Reach	% Pool Area	Residual Pool Depth	Riffle W/D Ratio	% Fines in Riffles	% Gravel in Riffles	Riparian Vegetation (dom/subdom)	Riparian Conifer Size	% Shade	LWD pieces per 100m	LWD vol per 100m	Aquatic Habitat Rating (AHR)
Peavine Cr	1	14.8	0.4	22.2	5	15	con/hdwd	small	69	1.0	2.0	Poor
	2	32.0	0.4	27.8	5	26	con/hdwd	small	70	2.5	2.1	Fair
	3	11.2	0.4	20.2	6	28	hdwd/con	small	98	2.6	9.7	Fair
Russell Cr	1	8.6	0.5	28.0	0	23	hdwd/con	small	82	1.5	1.2	Fair
	2	19.1	0.3	21.3	0	23	hdwd/con	small	99	3.4	7.6	Fair
Salt Cr	1	13.8	0.4	--	--	--	hdwd/con	small	96	9.6	32.2	--
	2	2.7	0.3	5.0	41	33	hdwd/con	medium	50	3.1	3.9	Fair
	3	1.0	0.2	--	--	--	hdwd/con	small	72	4.3	1.3	--
Shoestring Cr	1	0.9	0.4	--	--	--	hdwd/con	small	87	1.5	0.4	--
	2	--	0.0	--	--	--	con/hdwd	small	95	0.5	1.0	--
S. Fork Middle Cr	1	2.8	0.5	23.5	10	22	hdwd/con	small	74	1.5	2.6	Poor
	2	5.0	0.4	22.8	10	35	hdwd/con	small	90	2.6	4.7	Fair
	3	2.5	0.4	16.3	15	36	con/hdwd	small	97	2.5	3.5	Fair
	4	60.6	0.7	31.0	63	31	hdwd/con	small	82	5.7	15.5	Fair
	5	28.5	0.6	17.4	48	45	con/hdwd	small	70	4.2	10.6	Fair
Table Cr	1	31.7	0.5	22.0	0	20	con/hdwd	medium	92	2.1	7.4	Fair
	2	50.8	0.5	3.0	0	75	hdwd/con	medium	96	3.4	12.6	Good
	3	26.3	0.7	--	--	--	hdwd/con	medium	74	4.0	15.2	--
	4	38.4	0.5	16.0	10	70	con/hdwd	med/large	86	4.8	13.8	Fair
Union Cr	1	28.3	0.7	23.6	4	39	con/hdwd	small	74	3.8	14.7	Fair
	2	35.8	0.6	24.6	3	41	con/hdwd	small	82	4.6	14.5	Fair
	3	32.3	0.6	21.1	6	56	hdwd/con	small	85	6.8	23.2	Fair
	4	4.0	0.4	25.0	0	64	con/hdwd	small	96	4.0	10.2	Fair

-- = no data available

Table C-4. List of Fish Species Occurring in the Umpqua River Basin.

TYPE	COMMON NAME	SCIENTIFIC NAME
NATIVE ANADROMOUS	Sea-run Cutthroat trout Coho salmon Summer/Winter Steelhead trout Spring/Fall Chinook salmon Green Sturgeon White Sturgeon Pacific lamprey	Oncorhynchus clarki Oncorhynchus kisutch Oncorhynchus mykiss Oncorhynchus tshawytscha Acipenser medirostris Acipenser transmontanus Lampetra tridentata
NATIVE RESIDENT	Cutthroat trout Rainbow trout Oregon (Umpqua) chub Umpqua dace Longnose dace Umpqua squawfish Largescale sucker Redside shiner Speckled dace Brook lamprey Sculpin species	Oncorhynchus clarki Oncorhynchus mykiss Oregonichthys kalawatseti Rhinichthys evermanni Rhinichthys cataractae Ptychocheilus umpquae Catostomus macrocheilus Richardsonius balteatus Rhinichthys osculus Lampetra richardsoni Cottus spp.
NON-NATIVE	Brown trout Brook trout Lake trout Kokanee Largemouth bass Smallmouth bass Sunfishes Yellow perch White Crappie Black Crappie Black Bullhead Brown Bullhead Yellow Bullhead Peamouth Striped Bass Shad Mosquito fish Threespine stickleback Olympic mudminnow	Salmo trutta Salvelinus fontinalis Salvelinus namaycush Oncorhynchus nerka Micropterus salmoides Micropterus dolomieu Lepomis spp. Perca flavescens Pomoxis annularis Pomoxis nigromaculatus Ameiurus melas Ameiurus nebulosus Ameiurus natalis Mylocheilus caurinus Morone saxatilis Alosa sapidissima Gambusia affinis Gasterosteus aculeatus Novumbra hubbsi

Sources: BLM Roseburg District PRMP/EIS, Vol. II.
Dave Harris, personal communication, ODFW-Roseburg

Table C-5. Example of Biological Assessment Matrix of Factors and Indicators
Western Cascades Geology

FACTORS	INDICATORS	PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Water Quality	Maximum Temperature	2nd through 4th order basins: < 66 degrees Fahrenheit. 5th order or larger basins: < 69 degrees Fahrenheit.	2nd through 4th order basins: 66 - 69 degrees Fahrenheit. 5th order or larger basins: 66 - 74 degrees Fahrenheit.	2nd through 4th order basins: ≥ 70 degrees Fahrenheit. 5th order or larger basins: > 74 degrees Fahrenheit.
	Sediment and Turbidity	< 12% fines (< 0.85 mm) in gravel, relatively low turbidity.	12 - 17% fines (< 0.85 mm) in gravel, moderate turbidity.	> 17% fines (< 0.85 mm) in gravels, high turbidity.
Habitat Access	Physical Barriers	No man-made barriers in watershed that prevent upstream and downstream passage of age 1+ salmonids.	Some man-made barriers in watershed prevent upstream or downstream passage of age 1+ salmonids.	Most or all man-made barriers in watershed prevent upstream or downstream passage of age 1+ salmonids.
Habitat Elements	Large Woody Debris **	> 60 pieces/mile, > 24" in diameter, > 50' length. Little or no evidence of stream clean-out or management related debris flows.	30 - 60 pieces/mile, > 24" in diameter, > 50' length. Some evidence of stream clean-out and/or management related debris flows.	< 30 pieces/mile, > 24" in diameter, > 50' length. Evidence of stream clean-out and/or management related debris flows is widespread.
	Substrate	Dominant substrate is gravel or cobble, with very little embeddedness.	Gravel and cobble are subdominant substrates, with moderate amounts of embeddedness.	Bedrock, sand, silt, or small gravel substrates are dominant. Or gravel/cobble substrate with large amounts of embeddedness.
	Pool Characteristics ≥ 3rd order	> 30% pool habitat by area. Little or no reduction of pool volume by fine sediment or unsorted substrates (as per District roadless area stream surveys).	< 30% pool habitat by area. Moderate reduction of pool volumes by fine sediment or unsorted substrates.	< 30% pool habitat by area. Large reduction of pool volumes by fine sediment or unsorted substrates.
	Off-Channel Habitat	Active side channels relatively frequent and a result of structural influence (large wood, nick point, etc.).	Relatively few active side channels or evidence of abandoned side channels related to management activities.	Few or no active side channels and evidence of numerous abandoned side channels related to past management activities. Or side channels being formed due to aggraded channel.
	Refugia	Habitat refugia exist and are adequately buffered. Existing refugia are sufficient in size, number, and connectivity to maintain viable populations or sub-populations.	Habitat refugia exist but are not adequately buffered. Existing refugia are insufficient in size, number, and connectivity to maintain viable populations or sub-populations.	Adequate habitat refugia do not exist.

FACTORS	INDICATORS	PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Channel Condition and Dynamics	Width/Depth Ratio and Channel Type	W/D ratios and channel types are well within historic ranges and site potential in watershed. Rosgen Type / W/D Ratio A, E, G <12 B, C, F 12-30 D >40	W/D ratios and/or channel types in portions of watershed are outside historic ranges and/or site potentials.	W/D ratios and channel types throughout the watershed are well outside of historic ranges and/or site potentials.
	Streambank Condition	Relatively stable banks. Few or no areas of active erosion.	Moderately stable banks. Some active erosion occurring on outcurves and constrictions.	Highly unstable stream banks. Numerous areas of exposed soil and stream bank cutting.
	Floodplain Connectivity	Off-channel areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland functions, riparian vegetation, and succession.	Reduced linkage of wetland, floodplains, and riparian areas to main channel; overbank flows are reduced relative to historic frequency, as evidenced by moderate degradation of wetland and riparian vegetation function.	Severe reduction in hydrologic connectivity between off-channel, wetland, floodplain, and riparian areas; wetland extent drastically reduced and riparian vegetation function altered significantly.
Flow/Hydrology	Change in Peak/Base Flows	Timber harvest and roading history is such that little or no change to the natural flow regime has occurred.	Moderate amounts of timber harvest and roading have likely altered the flow regime to some extent.	Relatively high levels of timber harvest and roading have likely had a large effect on the flow regime.
	Drainage Network	Zero or minimum increase in drainage network density due to roads.	Moderate increases in drainage network due to roads.	Significant increases in drainage network density due to roads.
Watershed Conditions	Road Density and Location **	Road density < 2 miles/square mile, with no valley bottom roads.	Road density at 2 - 3 miles/square mile, with some valley bottom roads.	Road density > 3 miles/square mile, with many valley bottom roads.
	Disturbance History	< 5% ECA/decade (entire watershed) with no concentration of disturbance in unstable or potentially unstable areas, and/or Riparian Reserves; and for NWFP area (except AMAs), $\geq$15% retention of LSOG in watershed.	<5% ECA/decade (entire watershed) but disturbance concentrated in unstable or potentially unstable areas, and/or refugia, and/or Riparian Reserves; and for NWFP area (except for AMAs), $\geq$15% retention of LSOG in watershed.	>5% ECA/decade (entire watershed) and disturbance concentrated in unstable or potentially unstable areas, and/or refugia, and/or Riparian Reserves; does not meet NWFP standard for LSOG retention.
	Riparian Reserves **	Riparian Reserves are relatively intact, with >80% of these areas being in a late seral condition.	Riparian Reserves have been altered somewhat, with between 60-80% of these areas being found in a late seral condition.	Riparian Reserves have been substantially altered, with <60% of these areas being found in a late seral condition.
	Landslide Rates	Within 10-20% of historic, natural rates. Stream conditions not evidently altered due to management caused landslides.	Some subdrainages with >20% of landslides related to land management activities. Some stream conditions evidently altered by management related landslides.	Many subdrainages with >25% of landslides related to land management activities. Stream conditions obviously and/or dramatically altered by management related landslides.

** These values were obtained local investigations using roadless area stream surveys, historical aerial photographs, and studies of fire disturbance history.
Assumptions: The matrix would be filled out as the factors and indicators pertain to fish bearing portions of a stream system. In general, these streams would be 3rd order or larger in size. There are three levels of information that are used when determining health or function of each of the indicators: 1) Facts, 2) likelihoods based upon scientific literature and theory, and 3) professional judgements (which include local, site-specific knowledge).

Table C-6. Summary of 1984 BLM and 1988 Norecol Environmental Consultants Presence or Absence Electrofishing Data Collected in the Cow Creek Watershed Analysis Unit.

Stream Name	Surveyor	Site Name	Species	Number of Fish
Middle Creek	BLM	F2	Cutthroat Trout	1
			Sculpin	1
Middle Creek	BLM	M1	Coho Salmon	5
			Cutthroat Trout	87
			Sculpin	5
Middle Creek	Norelco	M1	Rainbow Trout	3
			Cutthroat Trout	1
			Coho Salmon	25
Middle Creek	BLM	M3	Coho Salmon	6
			Steelhead	7
			Sculpin	12
			Lamprey	3
Middle Creek	BLM	M5	Steelhead	14
			Dace	46
			Shiner	21
			Sculpin	24
Middle Creek	BLM	Martin Creek	Coho Salmon	15
			Steelhead	16
			Cutthroat Trout	5
			Sculpin	12
South Fork of Middle Creek	BLM	SF5	Coho Salmon	4
			Steelhead	14
			Cutthroat Trout	1
			Dace	1
			Sculpin	14
			Lamprey	2

Table C-6. Summary of 1984 BLM and 1988 Norecol Environmental Consultants Presence or Absence Electrofishing Data Collected in the Cow Creek Watershed Analysis Unit.

Stream Name	Surveyor	Site Name	Species	Number of Fish
South Fork of Middle Creek	BLM	SF4	Coho Salmon	2
			Steelhead	14
			Cutthroat Trout	2
			Dace	1
			Sculpin	27
			Lamprey	1
South Fork of Middle Creek	BLM	SF3	Coho Salmon	5
			Steelhead	88
			Sculpin	5
South Fork of Middle Creek	Norelco	SF1	Rainbow Trout	7
			Coho Salmon	13
			Dace	1
Russell Creek	Norelco	R1	Cutthroat Trout	8

Table C-7. Summary of 1993 ODFW Electrofishing Data Collected in the Cow Creek Watershed Analysis Unit.

Site	Species	Length (inches)	Number of Fish
Middle Creek above Brush Creek*	Coho Salmon	3	40
	Cutthroat Trout	4 to 9	6
	Lamprey	3 to 4	3
	Rainbow Trout	3 to 6	24
	Steelhead	2 to 6	70
	Trout Fry	2 to 3	2
	Dace	2	4

Table C-7. Summary of 1993 ODFW Electrofishing Data Collected in the Cow Creek Watershed Analysis Unit.

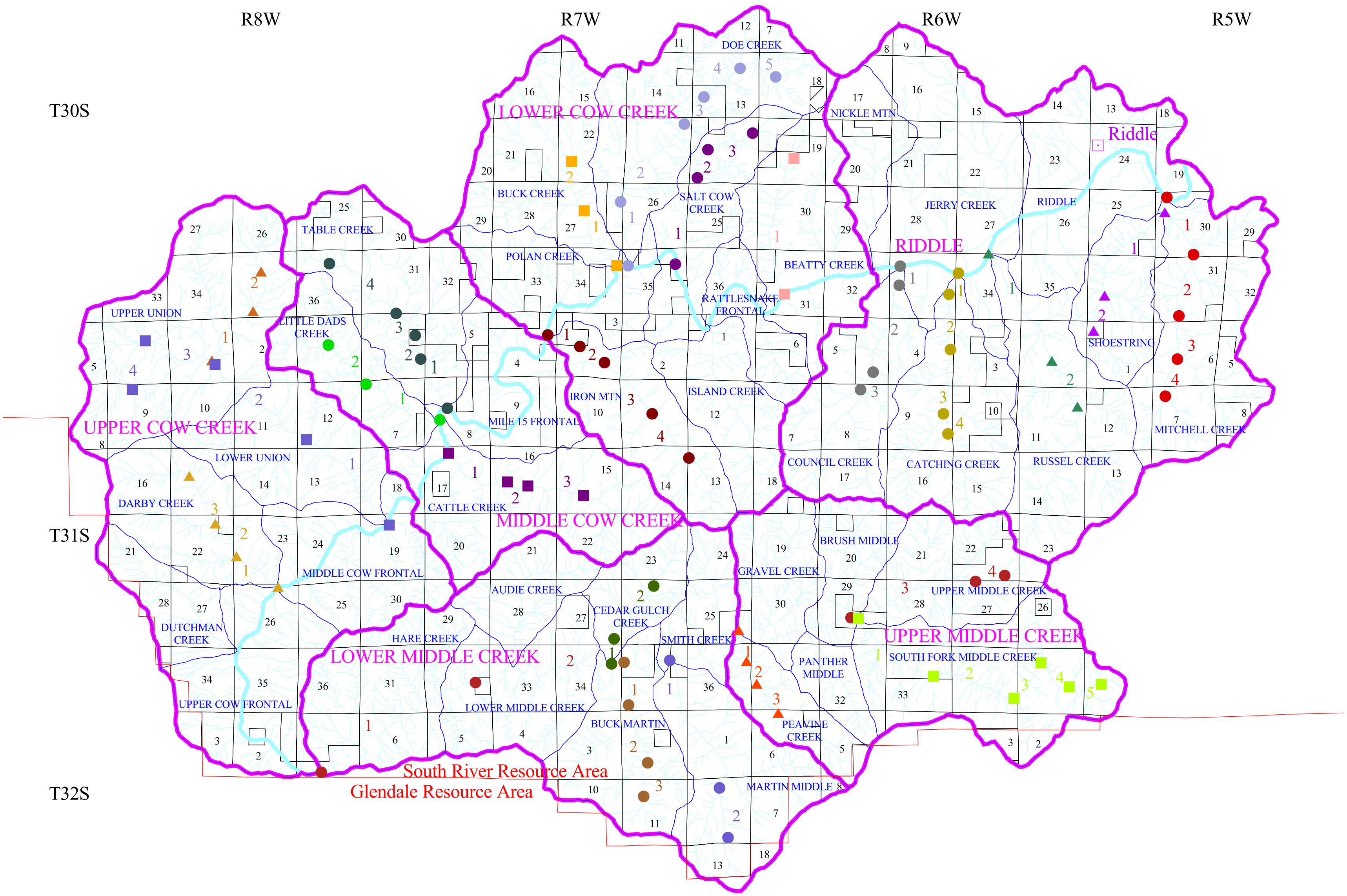
Site	Species	Length (inches)	Number of Fish
South Fork of Middle Creek	Coho Salmon	3 to 4	74
	Cutthroat Trout	3 to 6	16
	Rainbow Trout	3 to 6	19
	Steelhead	2 to 3	33
	Trout Fry	2	28
Martin Creek	Coho Salmon	2 to 4	73
	Cutthroat Trout	4 to 6	10
	Rainbow Trout	4 to 5	8
	Steelhead	2 to 4	55
	Trout Fry	2 to 3	10
Buck Creek	Coho Salmon	2 to 3	5
	Cutthroat Trout	3 to 6	3
	Steelhead	2	8
	Trout Fry	2	1
Cedar Gulch Creek	Coho Salmon	2 to 3	18
	Cutthroat Trout	4	1
	Rainbow Trout	3 to 5	2
	Steelhead	2 to 3	12
	Trout Fry	2	22
Peavine Creek	Coho Salmon	2 to 3	36
	Cutthroat Trout	3 to 5	7
	Speckled Dace	2	3
	Steelhead	2 to 3	9
	Trout Fry	2	7

* No fish were captured at the farthest point upstream sampled in Middle Creek. Acid mine drainage from the Formosa Mine may be affecting fish populations in Middle Creek.

Table C-8. Electrofishing Presence or Absence Data Collected From Middle Creek by the BLM in 1995 and 1996.

Site	Date	Species	Length (inches)	Comments
Peavine Creek	8-8-96	Cutthroat Trout	1 to 4	
Tributary #1 to Peavine Creek	8-8-96	Cutthroat Trout	1 to 4	
Smith Creek	8-8-96	Cutthroat Trout	1 to 3	
Martin Creek	6-6-95	Cutthroat Trout	3 to 6	
		Steelhead	Fry to 5	
	8-8-96	Cutthroat Trout	2 to 4	Young Fish are Using Gabion Structures
		Steelhead	2 to 5	
Tributary #1 to Martin Creek	8-8-96	Cutthroat Trout	2 to 4	
Middle Creek	9-13-95	Steelhead	3	
South Fork of Middle Creek	9-13-95	Steelhead	3 to 4.5	
		Sculpin	2	

Map C-1. Lower Cow Creek Watershed Analysis Unit Stream Reaches Surveyed by ODFW



Stream Reaches Surveyed
- Beatty Creek
- Buck Creek
- Buck Creek (Middle Creek)
- Catching Creek
- Cattle Creek
- Cedar Gulch Creek
- Council Creek
- Darby Creek
- Doe Creek
- Iron Mountain Creek
- Little Dads Creek
- Live Oak Creek
- Martin Creek
- Middle Creek
- Mitchell Creek
- Peavine Creek
- Russell Creek
- Salt Creek
- Shoestring Creek
- South Fork Middle Creek
- Table Creek
- Union Creek
- Resource Area Boundary
- Drainages
- Subwatersheds
- Cow Creek
- Section and Ownership Lines
- Streams

No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data was compiled from various sources. Spatial information may not meet National Map Accuracy Standards. This information may be updated without notification.

0 1 2 3 4 5 Miles

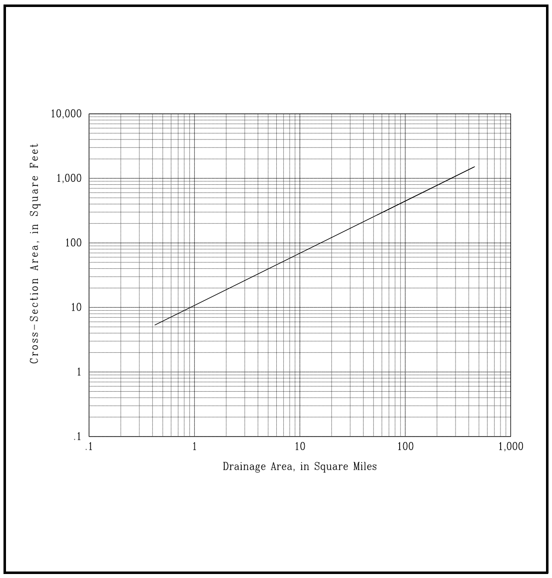
1:145000

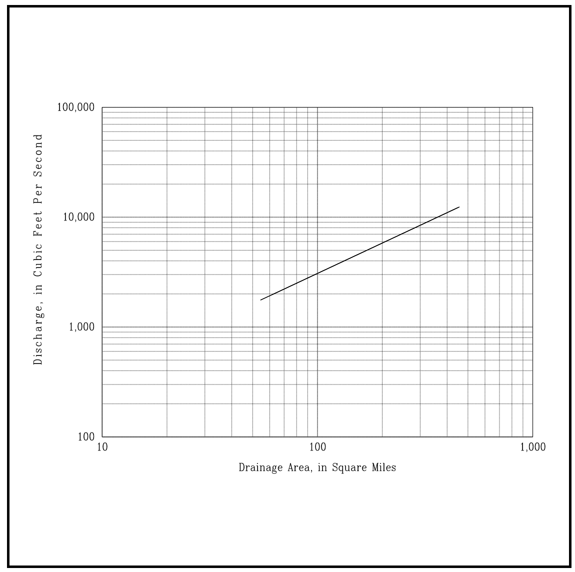
Appendix D

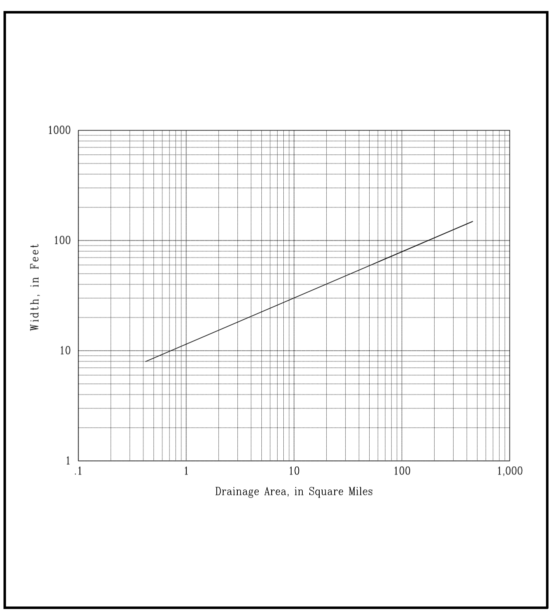
Hydrology

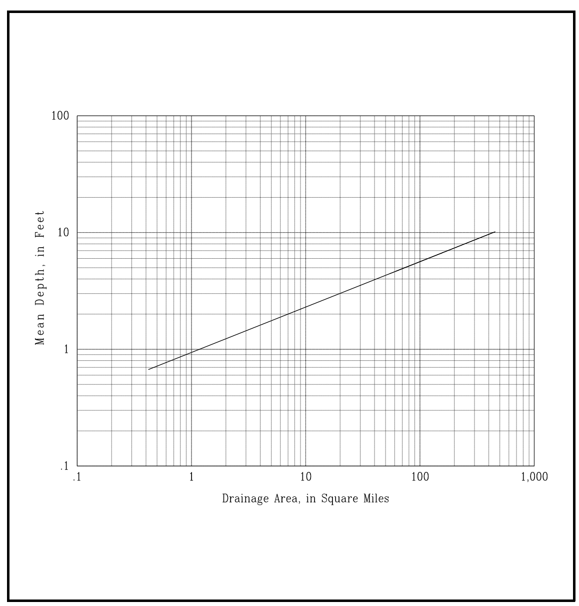
Development of regional curves using Rosgen's Level II classification can be used to predict bankfull streamflow, mean depth, width, and cross-sectional area of ungaged streams (Rosgen 1996). Graph D-1 shows regional curves developed by hydrologists in the Roseburg BLM District using the Level II classification (Kuck 2000). The classification system can be used to evaluate the processes of river mechanics and develop dimensionless ratios. The classification system can also be used to determine the feasibility of restoration projects, what structures needed to enhance and promote channel stability, and the size of culverts or bridges to install.

Graph D-1. Regional Curves for the South Umpqua River Basin Using Drainage Area to Estimate Bankfull Cross-sectional Area, Discharge, Mean Depth, and Width.









Appendix E
Wildlife

Appendix E

Spotted owl site ranking and general suitable habitat evaluation are the two topics to consider when planning management activities affecting northern spotted owl suitable habitat. Habitat evaluation would include the timing of habitat disturbance and spatial distribution of seral age classes. The following steps would be used to evaluate how a management activity affects northern spotted owl suitable habitat.

A. Spotted Owl Site Ranking

1. Use the information in Table 49. Values given in Table 49 were from owl survey data and suitable habitat inventory data.

2. Table 49 contains information on historic and current owl sites. The owl sites best representing the territory locations were selected. Usually the number of potential sites is lower than the total number of historic and current sites. The reason is that any one activity center can have more than one alternate location. Usually the area of these different alternate numbers overlap. Some have alternate numbers that are physically in a differed drainage, subwatershed, ownership, or section.

3. Criteria steps **a** through **m**, listed below, were used to group the selected owl sites to determine the rankings.

Criteria list:

a. Areas where owl sites are **not** present would be considered first.

b. If sites cannot be avoided, then sites that have more than 1,000 acres of suitable habitat in the provincial radius and more than 500 acres in the 0.7 mile radius with occupancy and history rankings of "3" would be **second**.

c. Sites with less than 1,000 acres of suitable habitat in the provincial radius and less than 500 acres in the 0.7 mile radius with occupancy and history rankings of "3" would be considered **third**.

d. Sites with an occupancy ranking of "2" and history ranking of "3" would be considered **fourth**.

e. Sites with an occupancy ranking of "3" and history ranking of "2" would be considered **fifth**.

f. Sites with more than 1,000 acres of suitable habitat in the provincial radius and more than 500 acres in the 0.7 mile radius with occupancy and history rankings of "2" would be considered **sixth**.

g. Sites with less than 1,000 acres of suitable habitat in the provincial radius and less than 500 acres in the 0.7 mile radius with occupancy and history rankings of "2" would be considered **seventh**.

h. Sites with more than 1,000 acres of suitable habitat in the provincial radius and more than 500 acres in the 0.7 mile radius with an occupancy ranking of "1" and a history value of "2" would be considered **eighth**.

i. Sites with more than 1,000 acres of suitable habitat in the provincial radius and more than 500 acres in the 0.7 mile radius with an occupancy ranking of "2" and a history ranking of "1" would be considered **ninth**.

j. Sites with more than 1,000 acres suitable habitat in the provincial radius and less than 500 acres in the 0.7 mile radius with an occupancy ranking of "1" and a history ranking of "2" would be considered **tenth**.

k. Sites with less than 1,000 acres of suitable habitat in the provincial radius and less than 500 acres in the 0.7 mile radius with an occupancy ranking of "1" and a history ranking of "2" would be considered **eleventh**.

l. Sites with less than 1,000 acres of suitable habitat in the provincial radius and less than 500 acres in the 0.7 mile radius with an occupancy ranking of "2" and a history ranking of "1" would be considered **twelfth**.

m. Sites with occupancy and history rankings of "1" would be considered **last**.

4. Projects meeting criteria **a**, which is removing or modifying suitable spotted owl habitat outside of known provincial territories would be considered first.

5. Owl territories meeting criteria **b** through **g** were grouped and given a ranking of **one**.

6. Owl territories meeting criteria **h** through **j** were grouped and given a ranking of **two**.

7. Owl territories meeting criteria **k** through **m** were grouped and given a ranking of **three**.

8. The following conditions apply to the individual rankings.

When it is not possible to avoid modifying or removing suitable habitat within a known territory, then sites with "go to" rank of "one" would be first, "two" would be second, and "three" would be last. The ranking in Table E-2 for any given owl site number has a different purpose based on Land Use Allocation (LSR or Matrix). For example, a site with a final rank of "1" in Matrix would be considered as a potential area where timber harvesting may occur first. Details of timing, location, and distance from core area would be determined by an ID Team and other staff evaluations. Sites with a rank of "1" in the LSR portion of the WAU would be considered first for habitat evaluation. Details of timing, location, distance from core area, objectives, and treatment would be determined by an ID Team or other staff evaluations.

B. Habitat Evaluation

The concept of habitat evaluation would be applied to the landscape while maintaining objectives for the various Land Use Allocations. Habitat evaluation would describe the timing, location, and spatial distribution of habitat removal or modification on Matrix lands in the WAU. Habitat evaluation may include topics like connectivity of mature and late-successional blocks to other similar blocks and their relationship to topography, the amount of suitable habitat present around spotted owl sites, where the suitable habitat is located, the connectivity of suitable habitat, and the status of dispersal habitat. The function and objectives of critical habitat would be considered in areas where Critical Habitat Units overlap Matrix lands.

In the LSR portion of the WAU, the habitat evaluation would consider current and future forest age classes, location, and connection to similar habitat within or between spotted owl territories across the landscape. This evaluation could locate LSR project areas and actions where manipulation of forest stands could aid reaching old-growth characteristics sooner than if left in the current condition.

Evaluation of the connectivity of suitable habitat would be conducted using aerial photographs of the WAU, seral age class maps, and ground inspections. This way the connection of late-successional blocks and the relationship to topography could be examined. Topography is important because knowing where connectivity is present or lacking and the relationship to riparian systems or uplands may make a difference on its success. Because of the checkerboard ownership, connectivity of the remaining older forest stands is very important. Even avian species capable of flight require connectivity of habitat for moving from one place to another. The ability to move within the forest from one place to another becomes more important to species that require or have dependency on the older age classes, have small territories, or move by crawling or walking across the ground.

The following is an example of steps to evaluate forest connectivity on the landscape. This example deals with owls but the process can be used for other species. This process would involve wildlife biologists, planning, and silviculture specialists.

1. Consider the ranking system. Keep in mind habitat acre thresholds of maintaining 500 acres within 0.7 miles, 1,335 acres within 1.3 miles, or 1,286 acres within 1.2 miles of a spotted owl site and LSR objectives. This data was presented in Table 49 in this watershed analysis.

2. Owl sites would be evaluated using the spatial arrangement of seral age classes within the provincial radii (1.2 or 1.3 miles) around an owl site. In the LSR, the purpose would be to locate areas where manipulation could increase the rate of stand development toward late-successional characteristics. On Matrix lands, the purpose may be to locate areas where manipulation may provide a functional forest corridor and coordinate the timing and spacing of timber harvesting units.

3. Within the WAU, the connectivity of suitable spotted owl habitat within an owl site to other late-successional habitat in the vicinity would be evaluated. Blocks of older age class stands (80 years

old and older) and how they are connected to other similar blocks would be analyzed. The following questions and comments would be reviewed and answered.

a. Does the provincial radii of owl sites contain forest stands suitable for harvest (Matrix) or manipulation (LSR/Matrix)? If the ranking table has been completed this information is already available.

b. Will manipulation of forest stands (LSR/Matrix) speed up attaining older age class characteristics to provide connectivity between owl sites and suitable spotted owl habitat?

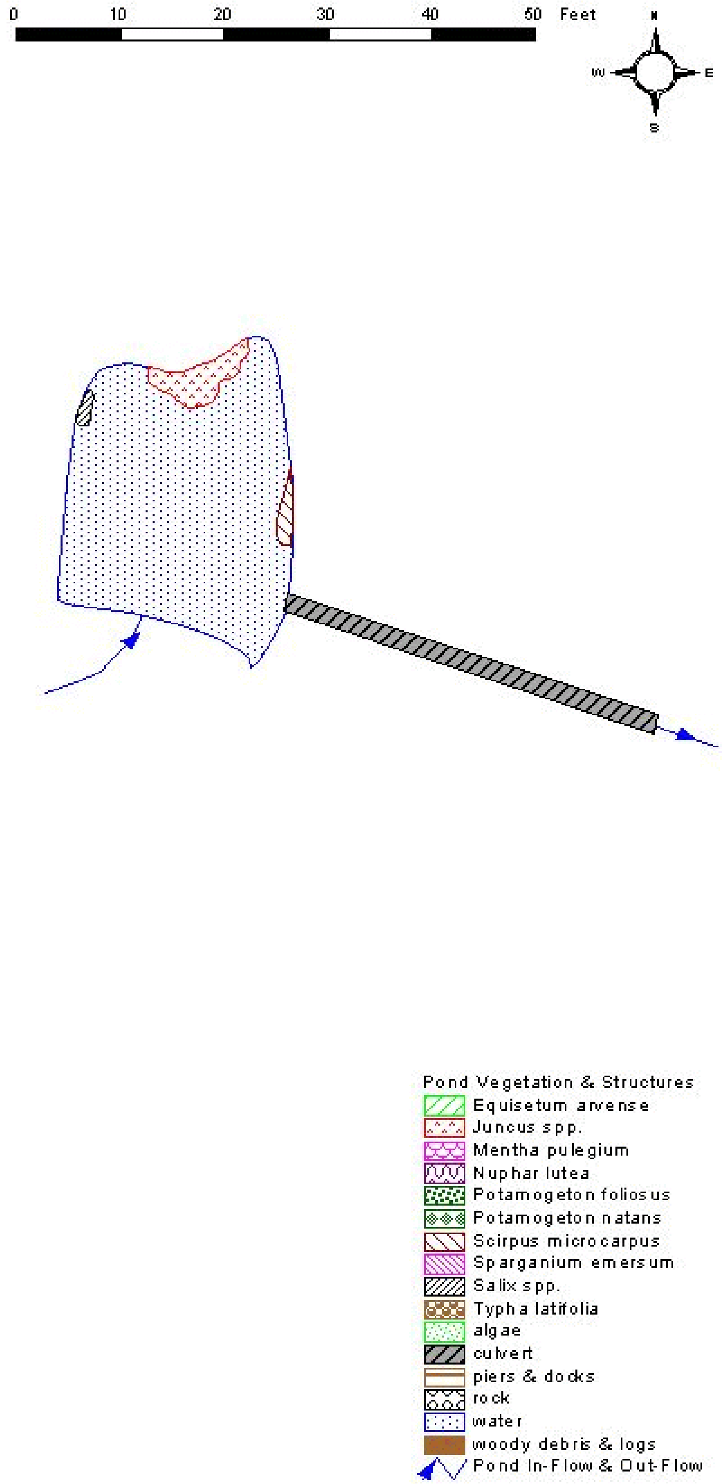
c. Will timber harvesting of stands reduce connectivity between suitable owl habitat and adjacent habitat?

d. Will manipulation of the stand increase or decrease connectivity between suitable owl habitat and adjacent habitat, between the LSRs and Matrix, or between Connectivity/Diversity Blocks?

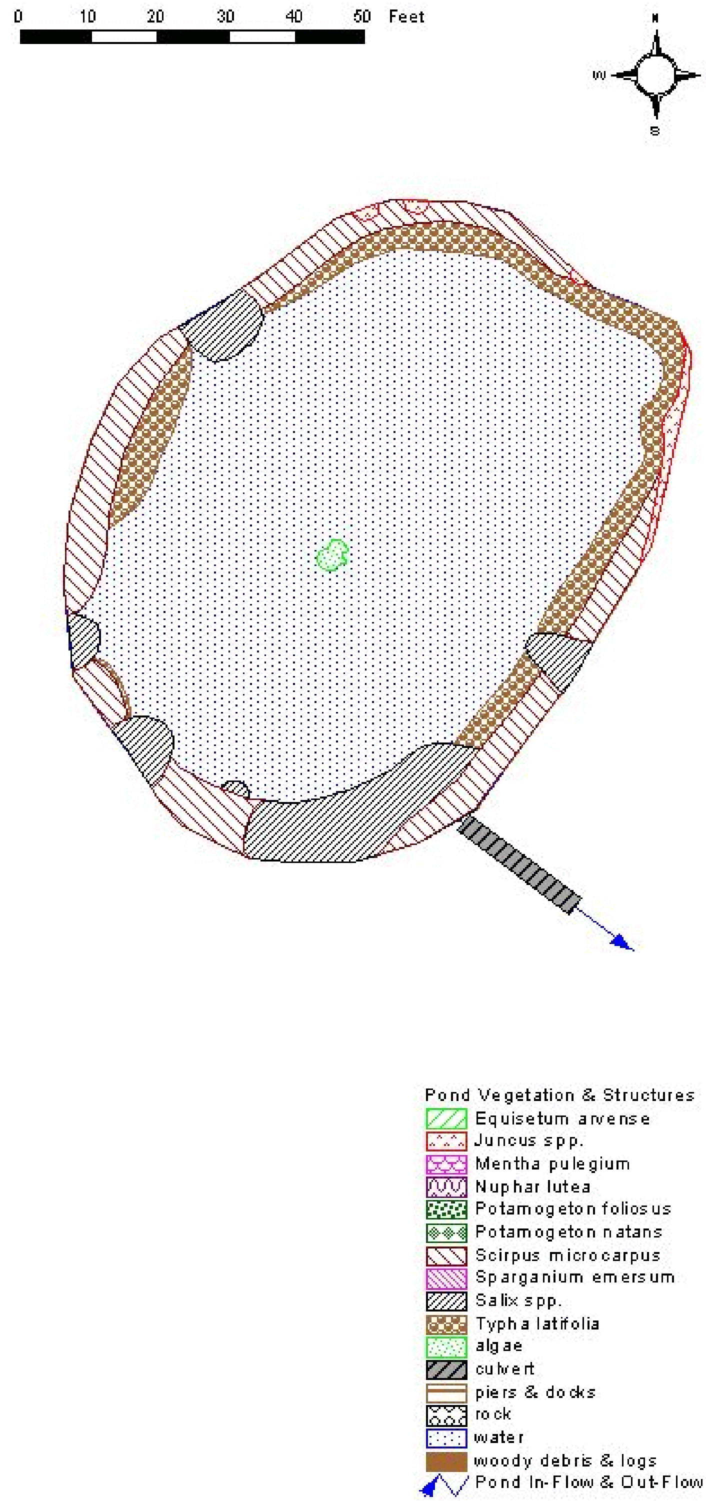
e. Where is connectivity needed? In the upland or in the riparian area of the drainage? Both? Is the Riparian Reserve connection adequate to meet objectives?

f. Evaluate and select forest stands to leave without manipulation and the advantages or disadvantages of such a choice (in Matrix or LSR). This could lead to long-term connection of older forest stands across the landscape.

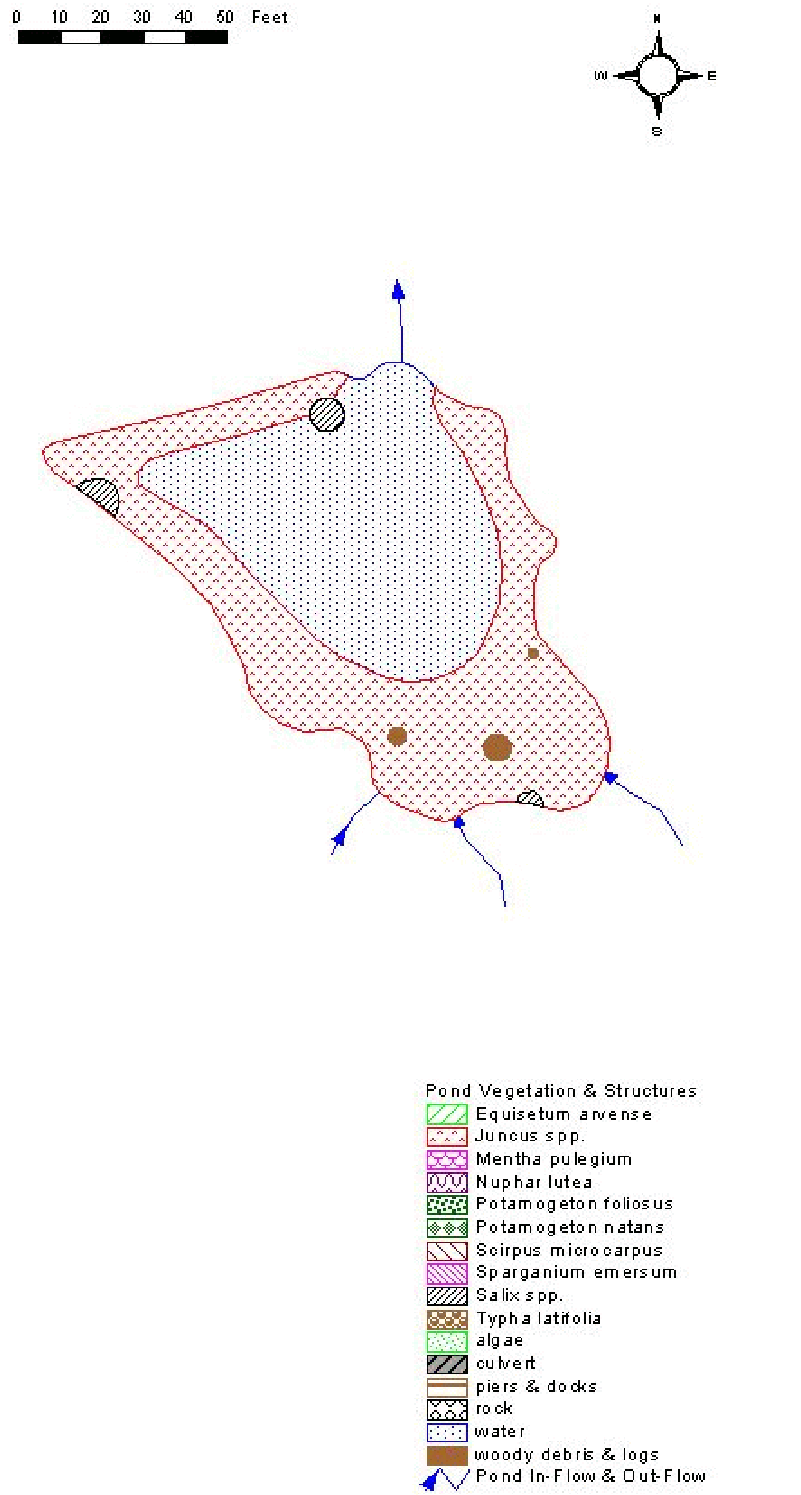
Pond Name: Buck Creek T30S-R04W-S36 **Survey Date:** June 28, 2000 **Surveyor:** Rex McGraw	
Pond Variable	0 *(n=3)*
Pond Morphology	
Surface Area	$50m^2$ ($543ft^2$)
Perimeter	29m (94ft)
SLD	1.14
Littoral Zone Depth	25cm (10in)
Water Chemistry	
Temperature	16ºC (61ºF)
pH	6.46
Conductivity	0.062mS/cm
Macro-Invertebrate Indices (Pond Averages)	
Familial Richness (S_f)	7
Shannon Diversity (H)	1.520
Equitability (J)	0.781
Simpson's Diversity (D)	0.745
Abundance	20.000
Hilsenhoff Biotic Index	4.142
Vertebrate Species Detected	
Roughskin Newt (*Taricha granulosa*)	



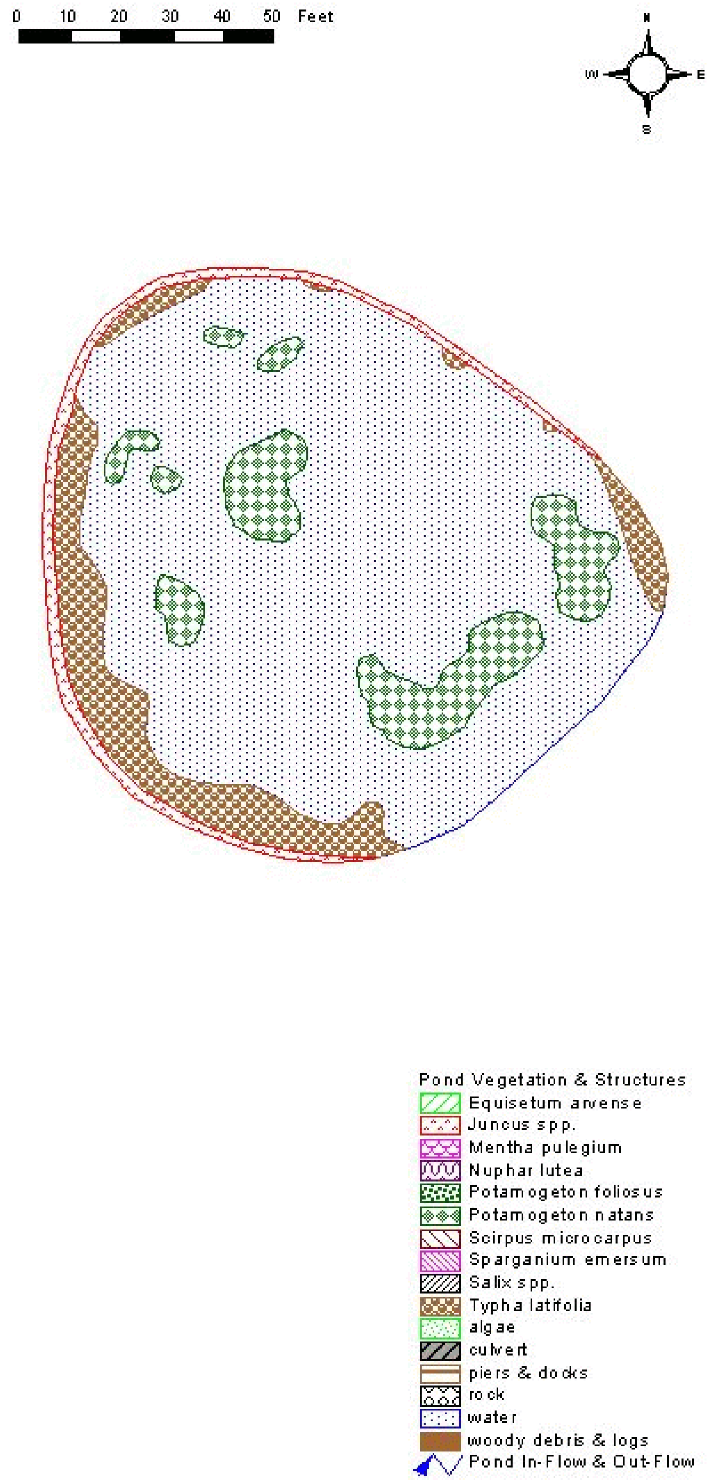
Pond Name: Dead Boomer T31S-R07W-S29 **Survey Date:** June 28, 2000 **Surveyor:** Rex McGraw	
Pond Variable	0 *(n=3)*
Pond Morphology	
Surface Area	583m^2 (6268ft^2)
Perimeter	88m (290ft)
SLD	1.03
Littoral Zone Depth	30cm (12in)
Water Chemistry	
Temperature	24ºC (75ºF)
pH	6.76
Conductivity	0.081mS/cm
Macro-Invertebrate Indices (Pond Averages)	
Familial Richness (S_f)	5
Shannon Diversity (H)	1.373
Equitability (J)	0.853
Simpson's Diversity (D)	0.699
Abundance	4.333
Hilsenhoff Biotic Index	7.574
Vertebrate Species Detected	
Bluegill (*Lepomis macrochirus*) Garter Snake (*Thamnophis* sp.) Roughskin Newt (*Taricha granulosa*)	



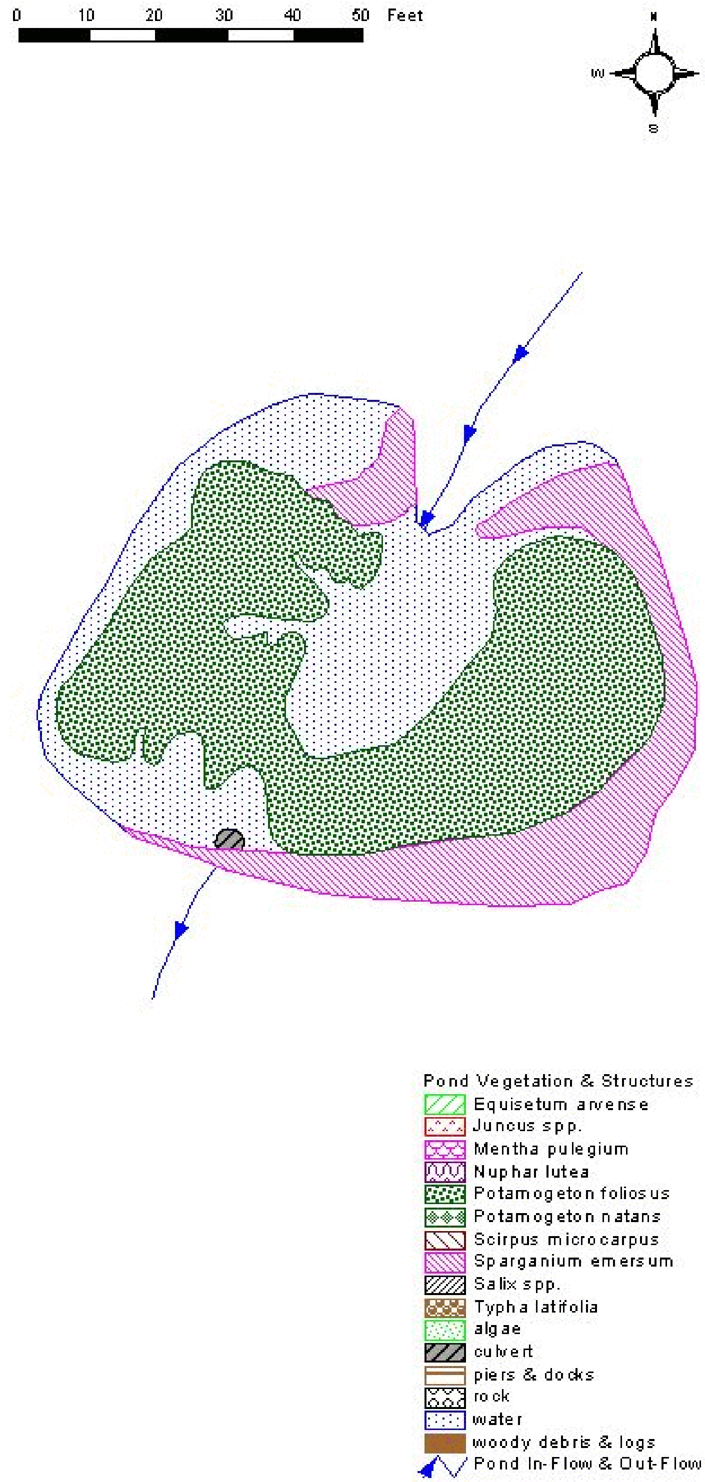
Pond Name: Dutchman T31S-R08W-S09 **Survey Date:** June 29, 2000 **Surveyor:** Rex McGraw	
Pond Variable	0 *(n=4)*
Pond Morphology	
Surface Area	779m^2 (8376ft^2)
Perimeter	123m (403ft)
SLD	1.24
Littoral Zone Depth	36cm (14in)
Water Chemistry	
Temperature	21ºC (70ºF)
pH	5.95
Conductivity	0.041mS/cm
Macro-Invertebrate Indices (Pond Averages)	
Familial Richness (S_f)	6
Shannon Diversity (H)	1.367
Equitability (J)	0.763
Simpson's Diversity (D)	0.671
Abundance	17.500
Hilsenhoff Biotic Index	7.471
Vertebrate Species Detected	
Garter Snake (*Thamnophis* sp.) Northwestern Salamander (*Ambystoma gracile*) Red-Legged Frog (*Rana aurora*) Roughskin Newt (*Taricha granulosa*)	



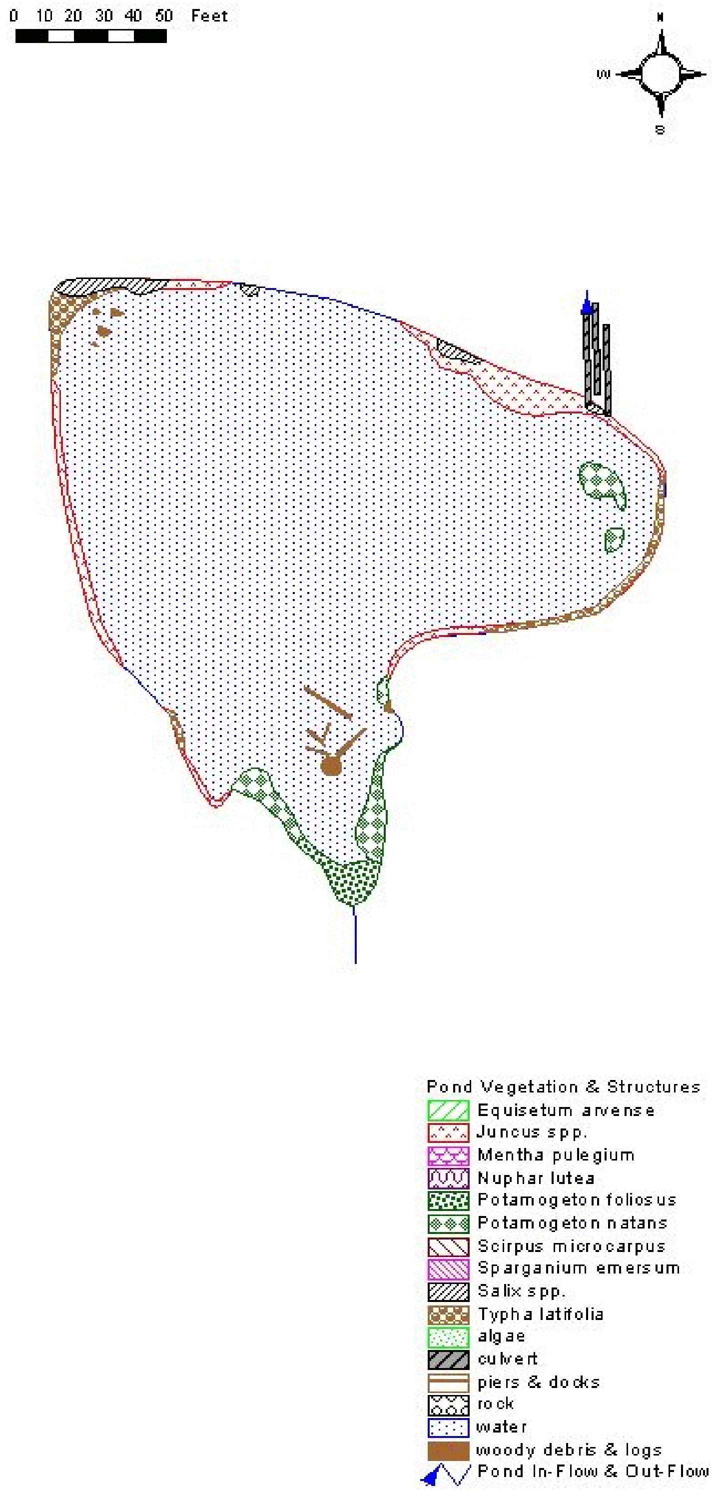
Pond Name: Hole-In-The-Wall T31S-R08W-S09 **Survey Date:** June 27, 2000 **Surveyor:** Rex McGraw	
Pond Variable	0 *(n=3)*
Pond Morphology	
Surface Area	984m^2 (10,584ft^2)
Perimeter	113m (372ft)
SLD	1.03
Littoral Zone Depth	36cm (14in)
Water Chemistry	
Temperature	27ºC (81ºF)
pH	7.42
Conductivity	0.077mS/cm
Macro-Invertebrate Indices (Pond Averages)	
Familial Richness (S_f)	10
Shannon Diversity (H)	1.224
Equitability (J)	0.531
Simpson's Diversity (D)	0.540
Abundance	30.000
Hilsenhoff Biotic Index	8.657
Vertebrate Species Detected	
Roughskin Newt (*Taricha granulosa*)	



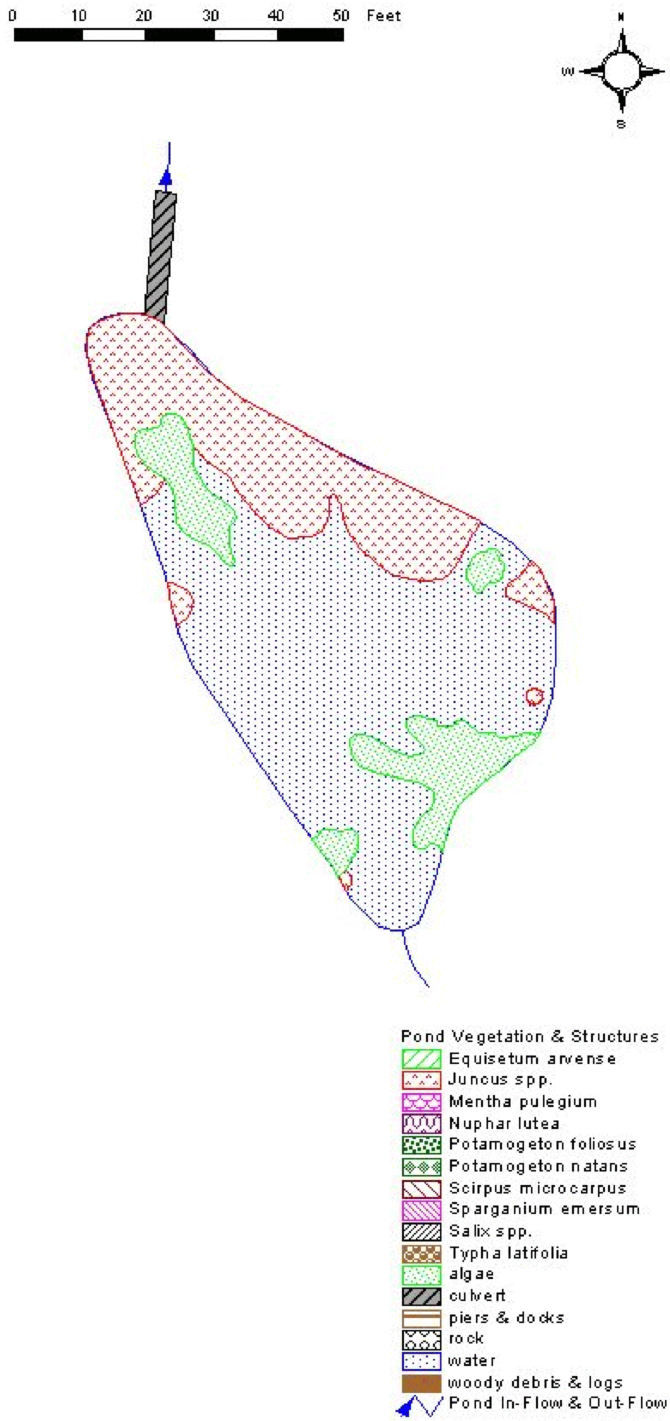
Pond Name: Manzanita Creek T30S-R08W-S27 **Survey Date:** September 15, 1999 **Surveyor:** Rex McGraw	
Pond Variable	0 *(n=3)*
Pond Morphology	
Surface Area	494m^2 (5307ft^2)
Perimeter	90m (294ft)
SLD	1.14
Littoral Zone Depth	29cm (11in)
Water Chemistry	
Temperature	21ºC (70ºF)
pH	7.68
Conductivity	0.085mS/cm
Macro-Invertebrate Indices (Pond Averages)	
Familial Richness (S_f)	7
Shannon Diversity (H)	1.237
Equitability (J)	0.635
Simpson's Diversity (D)	0.618
Abundance	7.886
Hilsenhoff Biotic Index	14.666
Vertebrate Species Detected	
Roughskin Newt (*Taricha granulosa*) Unknown Fish Species	



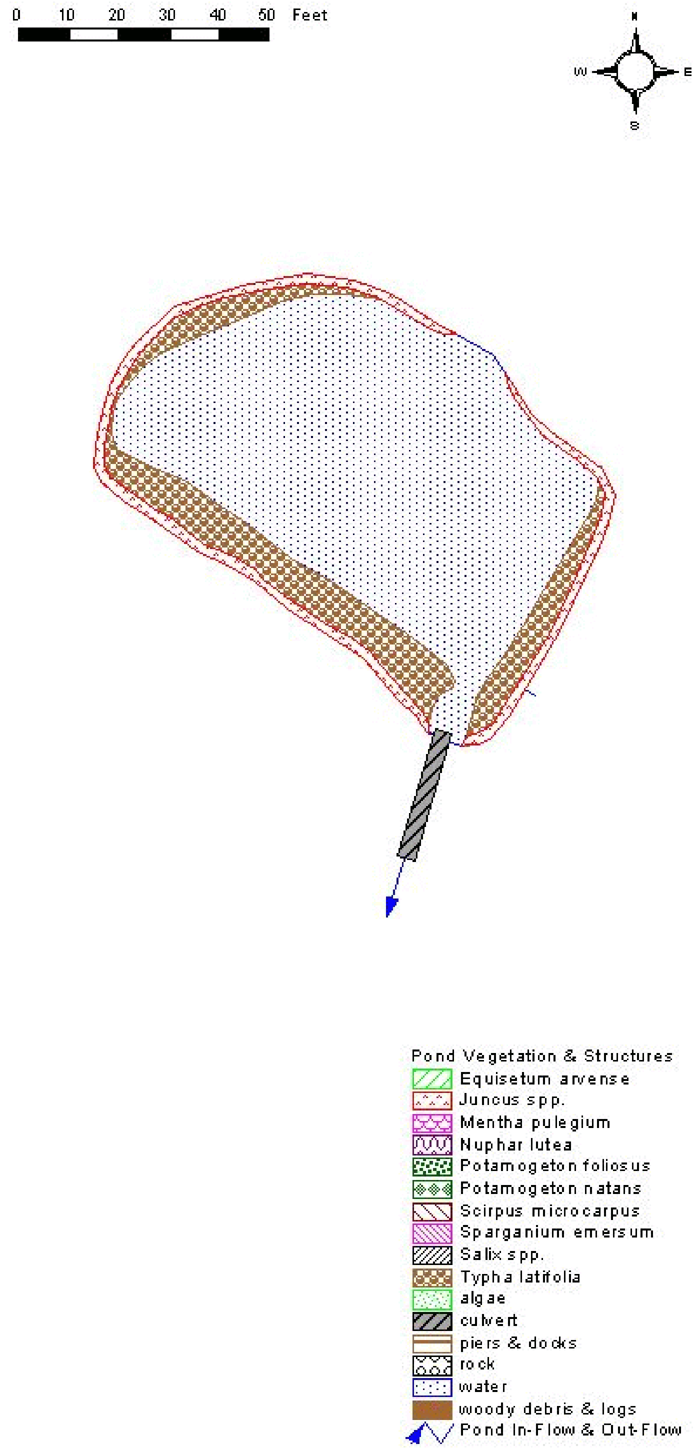
Pond Name: Michigan Springs T31S-R08W-S09 **Survey Date:** June 29, 2000 **Surveyor:** Rex McGraw	
Pond Variable	0 *(n=7)*
Pond Morphology	
Surface Area	2366m^2 (25,436ft^2)
Perimeter	213m (698ft)
SLD	1.23
Littoral Zone Depth	38cm (15in)
Water Chemistry	
Temperature	20ºC (68ºF)
pH	7.06
Conductivity	0.078mS/cm
Macro-Invertebrate Indices (Pond Averages)	
Familial Richness (S_f)	11
Shannon Diversity (H)	1.564
Equitability (J)	0.652
Simpson's Diversity (D)	0.712
Abundance	30.428
Hilsenhoff Biotic Index	6.169
Vertebrate Species Detected	
Pacific Giant Salamander (*Dicamptodon tenebrosus*) Roughskin Newt (*Taricha granulosa*) Trout (species uncertain)	



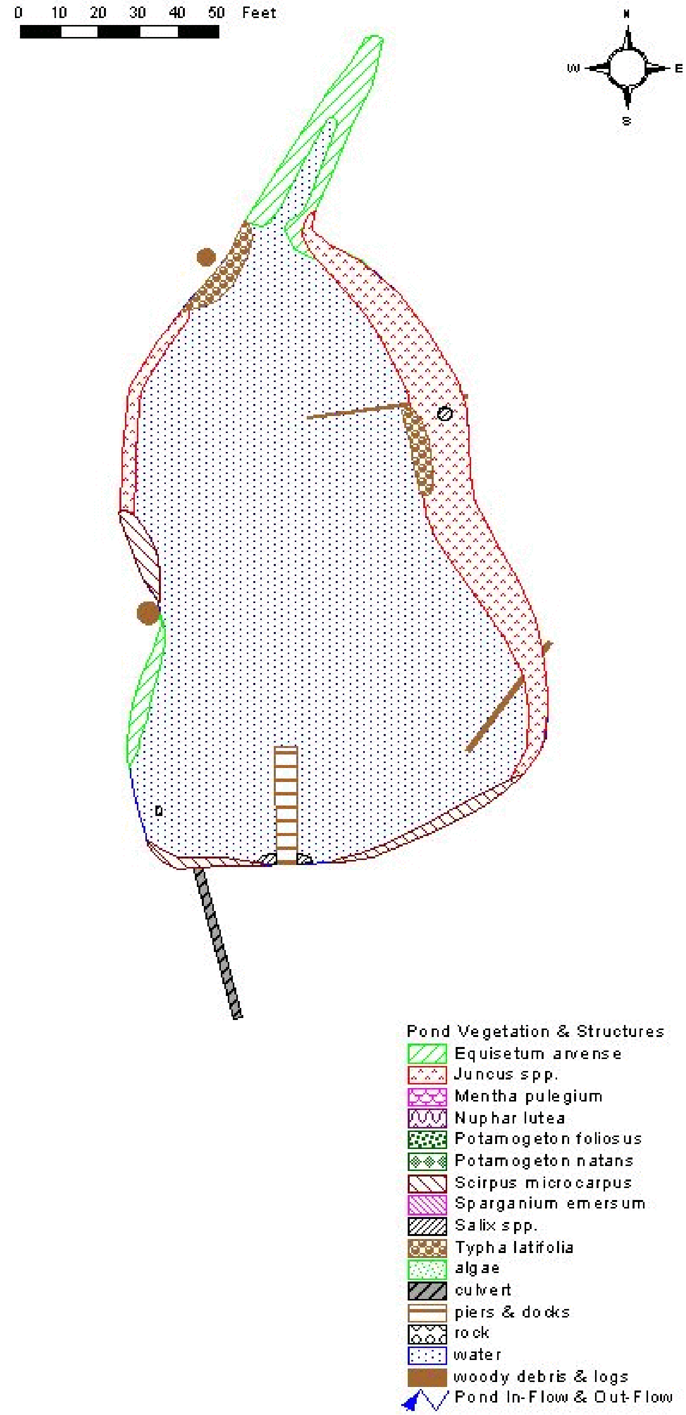
Pond Name: Ole Dads T31S-R07W-S07 **Survey Date:** June 28, 2000 **Surveyor:** Rex McGraw	
Pond Variable	0 *(n=3)*
Pond Morphology	
Surface Area	$309m^2$ ($3326ft^2$)
Perimeter	77m (252ft)
SLD	1.23
Littoral Zone Depth	20cm (8in)
Water Chemistry	
Temperature	22ºC (72ºF)
pH	6.59
Conductivity	0.046mS/cm
Macro-Invertebrate Indices (Pond Averages)	
Familial Richness (S_f)	9
Shannon Diversity (H)	1.386
Equitability (J)	0.630
Simpson's Diversity (D)	0.612
Abundance	19.000
Hilsenhoff Biotic Index	7.298
Vertebrate Species Detected	
Garter Snake (*Thamnophis* sp.) Roughskin Newt (*Taricha granulosa*)	



Pond Name: Panther Peavine T32S-R06W-S05 **Survey Date:** June 27, 2000 **Surveyor:** Rex McGraw	
Pond Variable	0 *(n=4)*
Pond Morphology	
Surface Area	547m^2 (5879ft^2)
Perimeter	91m (298ft)
SLD	1.10
Littoral Zone Depth	43cm (17in)
Water Chemistry	
Temperature	21ºC (70ºF)
pH	6.89
Conductivity	0.096mS/cm
Macro-Invertebrate Indices (Pond Averages)	
Familial Richness (S_f)	10
Shannon Diversity (H)	1.966
Equitability (J)	0.854
Simpson's Diversity (D)	0.827
Abundance	10.250
Hilsenhoff Biotic Index	6.525
Vertebrate Species Detected	
Pacific Treefrog (*Hyla regilla*) Roughskin Newt (*Taricha granulosa*)	



Pond Name: Pier No. 1 T31S-R08W-S11 **Survey Date:** July 7, 2000 **Surveyor:** Rex McGraw	
Pond Variable	0 *(n=5)*
Pond Morphology	
Surface Area	1298m^2 (13,954ft^2)
Perimeter	167m (549ft)
SLD	1.31
Littoral Zone Depth	30cm (12in)
Water Chemistry	
Temperature	18ºC (64ºF)
pH	6.92
Conductivity	0.070mS/cm
Macro-Invertebrate Indices (Pond Averages)	
Familial Richness (S_f)	16
Shannon Diversity (H)	2.352
Equitability (J)	0.848
Simpson's Diversity (D)	0.875
Abundance	9.333
Hilsenhoff Biotic Index	5.653
Vertebrate Species Detected	
Pacific Treefrog (*Hyla regilla*) Roughskin Newt (*Taricha granulosa*) Unknown Fish Species	



Pond Name: Risk-E T31S-R06W-S19 **Survey Date:** July 7, 2000 **Surveyor:** Rex McGraw	
Pond Variable	0 *(n=3)*
Pond Morphology	
Surface Area	253m^2 (2716ft^2)
Perimeter	62m (202ft)
SLD	1.09
Littoral Zone Depth	38cm (15in)
Water Chemistry	
Temperature	15ºC (52ºF)
pH	7.00
Conductivity	0.070mS/cm
Macro-Invertebrate Indices (Pond Averages)	
Familial Richness (S_f)	7
Shannon Diversity (H)	1.584
Equitability (J)	0.814
Simpson's Diversity (D)	0.755
Abundance	9.333
Hilsenhoff Biotic Index	6.857
Vertebrate Species Detected	
Garter Snake (*Thamnophis* sp.) Northwestern Salamander (*Ambystoma gracile*) Roughskin Newt (*Taricha granulosa*)	

Appendix F
Silviculture

Table F-1. Potential Pre-commercial Thinning Stands in the Lower Cow Creek Watershed Analysis Unit.

FOI	Township and Range	Section	Acres	FOI	Township and Range	Section	Acres
134289	32S-06W	03	24	42895	30S-08W	35	32
134870	32S-08W	03	11	42880	30S-08W	33	34
134869	32S-08W	03	26	42882	30S-08W	33	22
134383	32S-07W	09	19	42817	31S-08W	01	46
42946	30S-06W	07	34	42879	31S-08W	05	28
42255	30S-07W	15	12	42818	31S-08W	01	27
42943	30S-07W	13	39	42816	31S-08W	01	16
42256	30S-07W	15	12	13656	31S-06W	03	33
42944	30S-07W	13	50	13657	31S-06W	03	28
42945	30S-06W	19	68	42844	31S-06W	05	29
42672	30S-07W	21	9	42497	31S-08W	05	18
42858	30S-07W	21	10	41363	31S-08W	05	3
42857	30S-07W	21	31	13658	31S-06W	03	22
42260	30S-07W	25	8	42820	31S-08W	01	29
42899	30S-08W	25	28	42819	31S-08W	01	16
42261	30S-07W	27	30	42845	31S-06W	05	40
42262	30S-07W	27	10	42404	31S-07W	03	12
42826	30S-07W	30	7	42403	31S-07W	03	5
42893	30S-07W	30	29	42402	31S-07W	03	16
42897	30S-08W	25	31	13659	31S-06W	03	33
42896	30S-08W	25	16	42409	31S-07W	11	32
42336	30S-08W	35	12	42849	31S-06W	07	33
42894	30S-08W	35	28	42821	31S-07W	07	16

Table F-1. Potential Pre-commercial Thinning Stands in the Lower Cow Creek Watershed Analysis Unit.

FOI	Township and Range	Section	Acres	FOI	Township and Range	Section	Acres
42881	30S-08W	33	34	42887	31S-08W	11	8
42886	31S-08W	11	6	42810	31S-07W	13	19
42885	31S-08W	11	5	42416	31S-07W	15	18
41078	31S-06W	07	34	42417	31S-07W	15	29
42848	31S-06W	07	10	42852	31S-06W	17	25
13662	31S-06W	11	24	42418	31S-07W	15	18
42507	31S-08W	09	25	42851	31S-06W	17	39
42506	31S-08W	09	25	42809	31S-07W	13	21
42508	31S-08W	09	22	42850	31S-06W	17	25
42410	31S-07W	11	29	42419	31S-07W	15	24
42930	31S-08W	09	34	42808	31S-07W	13	35
14144	31S-08W	09	29	42421	31S-07W	15	29
42888	31S-08W	11	6	42420	31S-07W	15	31
42822	31S-07W	07	15	42522	31S-08W	15	17
42824	31S-07W	07	11	42779	31S-06W	18	34
41377	31S-08W	09	40	42804	31S-06W	19	7
42889	31S-08W	11	2	42525	31S-08W	21	142
42890	31S-08W	11	5	42855	31S-07W	23	38
42823	31S-07W	07	35	41441	31S-08W	23	30
42846	31S-06W	07	56	42532	31S-08W	23	19
41709	31S-07W	07	49	42452	31S-07W	23	8
42883	31S-08W	11	34	42439	31S-07W	19	13
13660	31S-06W	10	7	42451	31S-07W	23	6

Table F-1. Potential Pre-commercial Thinning Stands in the Lower Cow Creek Watershed Analysis Unit.

FOI	Township and Range	Section	Acres	FOI	Township and Range	Section	Acres
42884	31S-08W	11	56	42453	31S-07W	23	7
13663	31S-06W	11	17	42440	31S-07W	19	12
42847	31S-06W	07	34	42526	31S-08W	21	12
42811	31S-07W	13	18	42533	31S-08W	23	36
42454	31S-07W	23	8	42473	31S-07W	29	18
42853	31S-06W	19	45	42477	31S-07W	31	41
42436	31S-07W	19	14	42395	31S-06W	31	47
42527	31S-08W	21	6	42876	31S-06W	31	2
42528	31S-08W	21	5	42490	31S-07W	35	49
42455	31S-07W	23	8	42474	31S-07W	31	34
42438	31S-07W	19	26	42394	31S-06W	31	23
42529	31S-08W	21	44	41173	31S-06W	33	28
42450	31S-07W	23	28	42475	31S-07W	31	87
42437	31S-07W	19	23	42476	31S-07W	31	32
42456	31S-07W	23	14	42492	31S-07W	35	11
42931	31S-08W	21	4	42489	31S-07W	35	13
42531	31S-08W	21	4	42828	31S-06W	31	9
42467	31S-07W	27	10	42805	31S-06W	33	6
42469	31S-07W	29	30	42491	31S-07W	35	2
42470	31S-07W	29	21	42481	31S-07W	33	14
42471	31S-07W	29	13	42859	32S-06W	05	24
42472	31S-07W	29	42	41515	32S-07W	03	69
41147	31S-06W	29	7	42548	32S-07W	03	19

Table F-1. Potential Pre-commercial Thinning Stands in the Lower Cow Creek Watershed Analysis Unit.

FOI	Township and Range	Section	Acres	FOI	Township and Range	Section	Acres
42468	31S-07W	27	13	42814	32S-06W	03	37
42813	31S-06W	29	9	43009	32S-08W	01	62
41136	31S-06W	27	23	41492	32S-06W	03	16
43000	31S-06W	27	4	42863	32S-06W	05	29
41145	31S-06W	29	13	41518	32S-07W	03	52
42974	31S-06W	27	30	42918	32S-07W	03	2
42550	32S-07W	03	135	42861	32S-06W	05	36
42862	32S-06W	05	38	42543	32S-07W	01	26
42860	32S-06W	05	32	42566	32S-07W	11	33
42917	32S-07W	03	9	42567	32S-07W	11	12
42549	32S-07W	03	18	42927	32S-07W	11	25
41519	32S-07W	03	234	42564	32S-07W	11	12
42544	32S-07W	01	39	42563	32S-07W	11	19
43010	32S-08W	01	39	42565	32S-07W	11	13
41512	32S-07W	03	29	42928	32S-07W	11	14
42542	32S-07W	01	24	42568	32S-07W	11	11
42545	32S-07W	01	24	42929	32S-07W	11	4
42546	32S-07W	01	21				

Table F-2. Potential Pruning Stands in the Lower Cow Creek Watershed Analysis Unit.

FOI	Township and Range	Section	Acres	FOI	Township and Range	Section	Acres
131769	31S-08W	33	4	12552	31S-05W	18	2
130794	32S-08W	03	7	12722	31S-06W	13	52
40534	30S-06W	07	12	41094	31S-06W	17	20
11994	30S-05W	29	35	12722	31S-06W	13	111
12381	31S-05W	05	13	41094	31S-06W	17	6
12693	31S-06W	01	2	12735	31S-06W	15	27
12693	31S-06W	01	6	12735	31S-06W	15	10
12415	31S-05W	07	30	12735	31S-06W	15	10
12416	31S-05W	07	34	41100	31S-06W	19	98
12420	31S-05W	07	39	12760	31S-06W	23	28
10269	31S-06W	10	30	12762	31S-06W	23	22
13573	31S-05W	07	26	12762	31S-06W	23	7
12415	31S-05W	07	4	12758	31S-06W	23	30
12722	31S-06W	13	42	12757	31S-06W	23	13
12552	31S-05W	18	15	41144	31S-06W	29	11

Table F-3. Potential Matrix Commercial Thinning Stands in the Lower Cow Creek Watershed Analysis Unit.

FOI	Township and Range	Section	Acres	FOI	Township and Range	Section	Acres
131769	31S-08W	33	4	12552	31S-05W	18	2
130794	32S-08W	03	7	12722	31S-06W	13	52
40534	30S-06W	07	12	41094	31S-06W	17	20
11994	30S-05W	29	35	12722	31S-06W	13	111
12381	31S-05W	05	13	41094	31S-06W	17	6
12693	31S-06W	01	2	12735	31S-06W	15	27
12693	31S-06W	01	6	12735	31S-06W	15	10
12415	31S-05W	07	30	12735	31S-06W	15	10
12416	31S-05W	07	34	41100	31S-06W	19	98
12420	31S-05W	07	39	12760	31S-06W	23	28
10269	31S-06W	10	30	12762	31S-06W	23	22
13573	31S-05W	07	26	12762	31S-06W	23	7
12415	31S-05W	07	4	12758	31S-06W	23	30
12722	31S-06W	13	42	12757	31S-06W	23	13
12552	31S-05W	18	15	41144	31S-06W	29	11

Table F-4. Potential Connectivity Density Management Stands in the Lower Cow Creek Watershed Analysis Unit.

FOI	Township and Range	Section	Acres
130650	32S-06W	03	13
10068	31S-06W	09	17
12549	31S-05W	18	11
12547	31S-05W	18	18
12545	31S-05W	18	10
12737	31S-06W	15	6
10276	31S-06W	22	14
10285	31S-06W	22	3
12747	31S-06W	23	4
12747	31S-06W	23	8
41130	31S-06W	21	8
41130	31S-06W	21	4
41154	31S-06W	31	9
41164	31S-06W	31	17
41490	32S-06W	03	14
41486	32S-06W	01	14
130650	32S-06W	03	13

Table F-5. Potential LSR Density Management Stands in the Lower Cow Creek Watershed Analysis Unit.

FOI	Township and Range	Section	Acres	FOI	Township and Range	Section	Acres
40899	30S-08W	25	56	41213	31S-07W	11	17
40895	30S-08W	25	51	41392	31S-08W	11	9
40911	30S-08W	27	84	41203	31S-07W	07	27
40712	30S-07W	29	6	41392	31S-08W	11	20
40910	30S-08W	27	48	41213	31S-07W	11	10
40723	30S-07W	31	111	41213	31S-07W	11	3
40957	30S-08W	35	40	41213	31S-07W	11	17
40955	30S-08W	35	47	41221	31S-07W	13	12
40951	30S-08W	35	37	41221	31S-07W	13	31
40724	30S-07W	31	40	41418	31S-08W	15	14
40723	30S-07W	31	11	41221	31S-07W	13	2
41678	30S-07W	34	7	41407	31S-08W	13	14
40737	30S-07W	35	22	41277	31S-07W	23	30
40955	30S-08W	35	42	41277	31S-07W	23	23
40737	30S-07W	35	6	41285	31S-07W	25	9
40734	30S-07W	35	18	41302	31S-07W	29	60
40723	30S-07W	31	9	41285	31S-07W	25	67
40720	30S-07W	31	11	41286	31S-07W	25	20
40955	30S-08W	35	40	41302	31S-07W	29	1
40720	30S-07W	31	13	41341	31S-07W	35	8
41181	31S-07W	01	3	41341	31S-07W	35	19
41181	31S-07W	01	19	41341	31S-07W	35	33
42401	31S-07W	01	50	42491	31S-07W	35	2
42842	31S-08W	05	15	41502	32S-07W	01	131
41503	32S-07W	01	18	41502	32S-07W	01	16

Appendix G

Roads

Table G-1. Roads in the Lower Cow Creek WAU to Consider Decommissioning.

Road Number	Miles	Surface Type	Subwatershed
30-6-7.05A	0.24	Rock	Lower Cow Creek
30-7-13.00C	0.26	Rock	Lower Cow Creek
30-7-15.02A	0.10	Rock	Lower Cow Creek
30-7-21.02A	0.23	Rock	Lower Cow Creek
30-7-22.03B	0.40	Rock	Lower Cow Creek
30-7-29.01B	0.10	Rock	Lower Cow Creek
31-7-1.02A	0.42	Rock	Lower Cow Creek
31-7-13.01A	0.10	Rock	Lower Cow Creek
30-8-25.02A	0.51	Natural	Middle Cow Creek
30-8-25.05A	0.40	Rock	Middle Cow Creek
30-8-35.01E	0.21	Rock	Middle Cow Creek
31-7-10.02B	0.27	Rock	Middle Cow Creek
31-7-15.00A	0.32	Rock	Middle Cow Creek
31-7-29.02A	0.35	Rock	Middle Cow Creek
31-8-1.00A	0.30	Rock	Middle Cow Creek
31-8-1.01A	0.11	Natural	Middle Cow Creek
30-8-32.01A	0.34	Rock	Upper Cow Creek
30-8-35.04A	0.10	Rock	Upper Cow Creek
30-8-35.04B	0.30	Rock	Upper Cow Creek
31-7-29.02A	0.35	Rock	Upper Cow Creek
31-8-4.00B	0.14	Rock	Upper Cow Creek
31-8-5.04A	0.19	Rock	Upper Cow Creek
31-8-9.04A	0.10	Rock	Upper Cow Creek
31-8-9.05A	0.15	Rock	Upper Cow Creek

Table G-1. Roads in the Lower Cow Creek WAU to Consider Decommissioning.

Road Number	Miles	Surface Type	Subwatershed
31-8-9.06A	0.10	Rock	Upper Cow Creek
31-8-10.01A	0.69	Rock	Upper Cow Creek
31-8-11.02A	0.58	Rock	Upper Cow Creek
31-8-11.07A	0.20	Rock	Upper Cow Creek
31-8-14.00C	0.10	Rock	Upper Cow Creek
31-7-21.02A	0.04	Rock	Lower Middle Creek
31-7-23.01A	0.22	Rock	Lower Middle Creek
31-7-24.02A	0.59	Natural	Lower Middle Creek
31-7-25.04A	0.24	Rock	Lower Middle Creek
31-7-25.05A	0.13	Rock	Lower Middle Creek
31-7-27.01A	0.49	Rock	Lower Middle Creek
31-7-27.02A	0.11	Rock	Lower Middle Creek
31-7-27.04A	0.22	Rock	Lower Middle Creek
31-7-28.01B	0.03	Natural	Lower Middle Creek
31-7-29.02A	0.35	Rock	Lower Middle Creek
31-7-29.03A	0.43	Rock	Lower Middle Creek
31-7-29.04A	0.55	Rock	Lower Middle Creek
31-7-31.01A	0.38	Rock	Lower Middle Creek
31-7-31.02A	0.35	Rock	Lower Middle Creek
31-7-31.04A	0.37	Rock	Lower Middle Creek
31-7-33.02D	0.08	Rock	Lower Middle Creek
31-7-33.03C	0.10	Natural	Lower Middle Creek
31-7-33.05A	0.11	Rock	Lower Middle Creek
31-7-33.06A	0.44	Rock	Lower Middle Creek

Table G-1. Roads in the Lower Cow Creek WAU to Consider Decommissioning.

Road Number	Miles	Surface Type	Subwatershed
31-7-34.03A	0.74	Rock	Lower Middle Creek
31-7-35.03A	0.16	Rock	Lower Middle Creek
32-6-6.03A	0.25	Rock	Lower Middle Creek
32-7-1.04A	0.15	Rock	Lower Middle Creek
32-7-3.02A	0.19	Rock	Lower Middle Creek
32-7-3.05A	0.10	Rock	Lower Middle Creek
32-7-4.00B	0.50	Natural	Lower Middle Creek
32-7-4.01A	0.11	Rock	Lower Middle Creek
32-7-5.01A	0.14	Rock	Lower Middle Creek
32-7-10.00B	0.05	Rock	Lower Middle Creek
32-8-1.04A	0.23	Rock	Lower Middle Creek
31-6-17.04C	0.31	Rock	Upper Middle Creek
31-6-19.01A	0.28	Rock	Upper Middle Creek
31-6-19.02A	0.30	Rock	Upper Middle Creek
31-6-19.03A	0.50	Rock	Upper Middle Creek
31-6-27.02A	0.15	Rock	Upper Middle Creek
31-6-32.00A	0.04	Rock	Upper Middle Creek
31-6-32.00B	0.21	Rock	Upper Middle Creek
31-7-24.02A	0.59	Natural	Upper Middle Creek
31-6-3.02A	0.41	Rock	Riddle
31-6-7.05A	0.30	Rock	Riddle
31-6-11.01A	0.28	Rock	Riddle
31-6-15.00A	0.39	Rock	Riddle
Total	19.27		

Table G-2. Roads in the Lower Cow Creek WAU to Consider Either Decommissioning or Improving.

Road Number	Miles	Surface Type	Subwatershed
30-6-7.02A	0.20	Natural	Lower Cow Creek
30-8-35.03A	0.50	Rock	Upper Cow Creek
31-8-4.00A2	0.62	Rock	Upper Cow Creek
31-7-27.03A	0.50	Rock	Lower Middle Creek
32-7-1.01A	0.90	Rock	Lower Middle Creek
31-6-18.00B	0.90	Natural	Upper Middle Creek
31-6-19.00A	0.76	Natural	Upper Middle Creek
31-6-21.00A	0.30	Natural	Upper Middle Creek
31-6-7.01A	0.45	Rock	Riddle
31-6-7.06A	0.40	Rock	Riddle
31-6-13.00A	0.66	Natural	Riddle
Total	6.19		

Table G-3. Roads in the Lower Cow Creek WAU to Consider Improving.

Road Number	Miles	Surface Type	Subwatershed
30-6-18.00A	0.89	Rock	Lower Cow Creek
30-6-32.00B	8.00	Bituminous	Lower Cow Creek
30-7-13.00B	0.94	Rock	Lower Cow Creek
30-7-23.00C	1.85	Rock	Lower Cow Creek
30-7-25.00B	0.16	Natural	Lower Cow Creek
30-7-27.01A	0.73	Rock	Lower Cow Creek
30-7-36.00B1	0.10	Natural	Lower Cow Creek
30-7-36.00B2	0.30	Natural	Lower Cow Creek
30-7-36.00B3	0.10	Natural	Lower Cow Creek
31-6-5.00D	3.46	Rock	Lower Cow Creek
31-7-10.01C	0.39	Rock	Lower Cow Creek
30-6-32.00B	8.00	Bituminous	Middle Cow Creek
30-7-30.01B	0.40	Rock	Middle Cow Creek
30-8-25.01B	0.70	Rock	Middle Cow Creek
31-7-16.00A	1.88	Rock	Middle Cow Creek
31-7-17.03B	0.85	Rock	Middle Cow Creek
31-8-11.04C	1.77	Rock	Middle Cow Creek
31-8-12.02C	2.13	Rock	Middle Cow Creek
30-6-32.00B	8.00	Bituminous	Upper Cow Creek
30-6-32.00C	5.80	Bituminous	Upper Cow Creek
30-8-26.01A1	1.13	Rock	Upper Cow Creek
30-8-27.01A	0.30	Natural	Upper Cow Creek
30-8-35.00A3	0.35	Natural	Upper Cow Creek
31-8-3.00B	1.30	Rock	Upper Cow Creek

Table G-3. Roads in the Lower Cow Creek WAU to Consider Improving.

Road Number	Miles	Surface Type	Subwatershed
31-8-3.01A	1.10	Natural	Upper Cow Creek
31-8-3.01C	0.30	Natural	Upper Cow Creek
31-8-5.02A2	2.48	Rock	Upper Cow Creek
31-8-8.01B	0.20	Rock	Upper Cow Creek
31-8-13.01A	1.00	Natural	Upper Cow Creek
31-8-15.01A	0.70	Rock	Upper Cow Creek
31-7-24.01B	1.78	Rock	Lower Middle Creek
31-7-25.01C	1.86	Natural	Lower Middle Creek
31-7-26.01B	1.20	Rock	Lower Middle Creek
31-7-29.00A	0.20	Rock	Lower Middle Creek
31-7-29.00B	0.40	Rock	Lower Middle Creek
31-7-33.01B	1.09	Rock	Lower Middle Creek
32-7-1.00C	1.63	Rock	Lower Middle Creek
32-7-3.00A	1.51	Rock	Lower Middle Creek
32-7-3.04A	0.70	Rock	Lower Middle Creek
32-7-5.00A	1.40	Rock	Lower Middle Creek
32-7-11.02A	0.52	Natural	Lower Middle Creek
30-6-35.01D	1.25	Natural	Upper Middle Creek
30-6-35.01F	0.50	Natural	Upper Middle Creek
31-6-13.01A	2.09	Rock	Upper Middle Creek
31-6-21.02A	2.22	Rock	Upper Middle Creek
31-6-26.01B	0.30	Natural	Upper Middle Creek
31-6-28.00C	0.45	Natural	Upper Middle Creek
31-6-29.02A	0.20	Natural	Upper Middle Creek

Table G-3. Roads in the Lower Cow Creek WAU to Consider Improving.

Road Number	Miles	Surface Type	Subwatershed
31-6-33.03A	1.15	Rock	Upper Middle Creek
32-6-5.01A	0.60	Rock	Upper Middle Creek
30-6-35.01C	0.59	Rock	Riddle
30-6-35.01D	1.25	Natural	Riddle
30-6-35.01F	0.50	Natural	Riddle
31-6-3.00A	2.20	Rock	Riddle
31-6-5.02A	0.60	Rock	Riddle
31-6-7.00D	0.20	Rock	Riddle
31-6-10.00A	1.42	Natural	Riddle
31-6-12.01A1	1.53	Natural	Riddle
31-6-12.01A2	1.30	Rock	Riddle
31-6-13.01A	2.09	Rock	Riddle
31-6-17.03A	0.74	Natural	Riddle
Total	88.78		

Table G-4. Roads in the Lower Cow Creek WAU Not Needing Treatment at This Time.

Road Number	Miles	Surface Type	Subwatershed
30-6-7.00A	0.42	Rock	Lower Cow Creek
30-6-7.03A	0.37	Rock	Lower Cow Creek
30-6-32.00A	5.20	Bituminous	Lower Cow Creek
30-7-13.01A	0.65	Rock	Lower Cow Creek
30-7-13.01B	0.70	Rock	Lower Cow Creek
30-7-13.02A	0.27	Rock	Lower Cow Creek
30-7-13.04A	0.44	Rock	Lower Cow Creek
30-7-13.04B	0.12		Lower Cow Creek
30-7-15.00A	0.57	Rock	Lower Cow Creek
30-7-15.01A	0.23	Rock	Lower Cow Creek
30-7-21.03A	0.30	Rock	Lower Cow Creek
30-7-21.05A	0.30	Rock	Lower Cow Creek
30-7-21.05B	0.30	Rock	Lower Cow Creek
30-7-22.03A	1.82	Rock	Lower Cow Creek
30-7-22.04A	0.54	Rock	Lower Cow Creek
30-7-23.00B	0.10	Rock	Lower Cow Creek
30-7-23.01B	1.03	Rock	Lower Cow Creek
30-7-23.01C	1.10	Rock	Lower Cow Creek
30-7-23.01D	0.86	Rock	Lower Cow Creek
30-7-24.01A	0.40	Rock	Lower Cow Creek
30-7-24.01B	0.30	Rock	Lower Cow Creek
30-7-24.02A	0.45	Rock	Lower Cow Creek
30-7-25.00A	0.73	Rock	Lower Cow Creek
30-7-29.00A	0.37	Rock	Lower Cow Creek

Table G-4. Roads in the Lower Cow Creek WAU Not Needing Treatment at This Time.

Road Number	Miles	Surface Type	Subwatershed
30-7-36.00B4	0.20	Rock	Lower Cow Creek
30-7-36.00B5	0.20	Rock	Lower Cow Creek
31-6-5.00B	0.24	Rock	Lower Cow Creek
31-6-5.00C	0.35	Rock	Lower Cow Creek
31-6-5.00E	1.32	Rock	Lower Cow Creek
31-6-7.02A	1.02	Rock	Lower Cow Creek
31-6-7.04A	0.54	Rock	Lower Cow Creek
31-7-10.03A	2.39	Rock	Lower Cow Creek
31-7-13.00A	1.44	Rock	Lower Cow Creek
31-7-14.00A	1.40	Rock	Lower Cow Creek
30-8-25.03A	0.75	Rock	Middle Cow Creek
30-8-26.01A2	0.35	Rock	Middle Cow Creek
30-8-35.02A	0.63	Rock	Middle Cow Creek
30-8-36.01A	0.32	Rock	Middle Cow Creek
31-7-14.00A	1.40	Rock	Middle Cow Creek
31-7-17.00A	3.10	Rock	Middle Cow Creek
31-7-17.00B	1.90	Rock	Middle Cow Creek
31-7-20.04A	0.71	Rock	Middle Cow Creek
31-7-22.00A	1.20	Rock	Middle Cow Creek
31-8-11.03E	0.96	Rock	Middle Cow Creek
31-8-11.04B	0.46	Rock	Middle Cow Creek
31-8-12.03B	0.53	Rock	Middle Cow Creek
31-8-12.03C	0.09	Rock	Middle Cow Creek
31-8-12.04A	0.47	Rock	Middle Cow Creek

Table G-4. Roads in the Lower Cow Creek WAU Not Needing Treatment at This Time.

Road Number	Miles	Surface Type	Subwatershed
29-8-29.02G	1.40	Bituminous	Upper Cow Creek
29-8-29.02I1	0.50	Bituminous	Upper Cow Creek
29-8-29.02I2	0.70	Rock	Upper Cow Creek
29-8-29.02K	0.10	Rock	Upper Cow Creek
30-6-32.00D	0.30	Bituminous	Upper Cow Creek
30-8-26.01A2	0.35	Rock	Upper Cow Creek
30-8-27.00A	0.62	Rock	Upper Cow Creek
30-8-35.00A1	0.40	Rock	Upper Cow Creek
30-8-35.00A2	0.50	Rock	Upper Cow Creek
31-7-19.00A	2.70	BST	Upper Cow Creek
31-7-19.00B	1.50	BST	Upper Cow Creek
31-7-19.00C	3.50	Rock	Upper Cow Creek
31-7-19.00D	0.80	Rock	Upper Cow Creek
31-7-19.00E	7.50	Rock	Upper Cow Creek
31-7-20.04A	0.71	Rock	Upper Cow Creek
31-7-20.05A	1.05	Rock	Upper Cow Creek
31-7-30.01B	1.25	Rock	Upper Cow Creek
31-7-30.02B	0.51	Rock	Upper Cow Creek
31-7-30.03B	0.31	Rock	Upper Cow Creek
31-8-3.00C	1.40	Rock	Upper Cow Creek
31-8-4.00A1	0.19	Rock	Upper Cow Creek
31-8-5.00A	0.10	Rock	Upper Cow Creek
31-8-9.00A	1.90	Rock	Upper Cow Creek
31-8-9.00B	0.10	Rock	Upper Cow Creek

Table G-4. Roads in the Lower Cow Creek WAU Not Needing Treatment at This Time.

Road Number	Miles	Surface Type	Subwatershed
31-8-9.01A	0.45	Rock	Upper Cow Creek
31-8-9.01B	0.75	Rock	Upper Cow Creek
31-8-9.02A	0.50	Rock	Upper Cow Creek
31-8-11.00A	0.53	Rock	Upper Cow Creek
31-8-11.00B	1.08	Rock	Upper Cow Creek
31-8-11.00C	0.66	Rock	Upper Cow Creek
31-8-11.01A	0.50	Rock	Upper Cow Creek
31-8-11.01C	0.09	Rock	Upper Cow Creek
31-8-11.03E	0.96	Rock	Upper Cow Creek
31-8-11.04A	0.59	Rock	Upper Cow Creek
31-8-11.04B	0.46	Rock	Upper Cow Creek
31-8-11.05A	0.97	Rock	Upper Cow Creek
31-8-11.08A	0.50	Rock	Upper Cow Creek
31-8-12.04A	0.47	Rock	Upper Cow Creek
31-8-13.00A	0.44	Rock	Upper Cow Creek
31-8-13.03A	1.95	Rock	Upper Cow Creek
31-8-14.00A	0.10	Rock	Upper Cow Creek
31-8-15.00A	0.85	Rock	Upper Cow Creek
31-8-15.01B	1.20	Rock	Upper Cow Creek
31-8-16.00B	2.10	Rock	Upper Cow Creek
31-8-21.00A	0.70	Rock	Upper Cow Creek
31-8-23.00A	0.61	Rock	Upper Cow Creek
31-8-26.01B	0.10	Rock	Upper Cow Creek
31-8-36.00A	0.80	Rock	Upper Cow Creek

Table G-4. Roads in the Lower Cow Creek WAU Not Needing Treatment at This Time.

Road Number	Miles	Surface Type	Subwatershed
32-8-1.00A	6.00	Bituminous	Upper Cow Creek
32-8-3.05A	0.70	Rock	Upper Cow Creek
31-7-17.00B	1.90	Rock	Lower Middle Creek
31-7-17.00C	1.49	Rock	Lower Middle Creek
31-7-21.00A	1.10	Rock	Lower Middle Creek
31-7-21.01A	0.80	Rock	Lower Middle Creek
31-7-22.00A	1.20	Rock	Lower Middle Creek
31-7-25.02A	0.91	Rock	Lower Middle Creek
31-7-25.03A	0.50	Rock	Lower Middle Creek
31-7-25.03B	0.84	Rock	Lower Middle Creek
31-7-26.00B	0.74	Rock	Lower Middle Creek
31-7-26.00C2	0.45	Rock	Lower Middle Creek
31-7-27.00B	0.02	Rock	Lower Middle Creek
31-7-31.00A	1.29	Rock	Lower Middle Creek
31-7-31.03A	1.84	Rock	Lower Middle Creek
31-7-33.01A	0.60	Rock	Lower Middle Creek
31-7-33.02A	1.40	Rock	Lower Middle Creek
31-7-33.02B	0.50	Rock	Lower Middle Creek
31-7-33.02C	1.00	Rock	Lower Middle Creek
31-7-33.03A	0.36	Rock	Lower Middle Creek
31-7-35.00B	0.26	Rock	Lower Middle Creek
31-7-35.00D	1.06	Rock	Lower Middle Creek
31-7-35.01A	0.40	Rock	Lower Middle Creek
31-7-35.01D	0.60	Rock	Lower Middle Creek

Table G-4. Roads in the Lower Cow Creek WAU Not Needing Treatment at This Time.

Road Number	Miles	Surface Type	Subwatershed
31-8-36.00A	0.80	Rock	Lower Middle Creek
32-7-1.00B	1.61	Rock	Lower Middle Creek
32-7-1.00D	0.89	Rock	Lower Middle Creek
32-7-1.03A	1.56	Rock	Lower Middle Creek
32-7-2.01B	0.78	Rock	Lower Middle Creek
32-7-3.01A	0.82	Rock	Lower Middle Creek
32-7-3.03A	0.60	Rock	Lower Middle Creek
32-7-3.03B	0.20	Rock	Lower Middle Creek
32-7-4.02B	0.20	Rock	Lower Middle Creek
32-7-6.00A	4.10	Rock	Lower Middle Creek
32-7-6.00B	0.50	Rock	Lower Middle Creek
32-7-10.01A	0.70	Rock	Lower Middle Creek
32-7-11.00A	0.42	Rock	Lower Middle Creek
32-7-11.03A	0.40	Rock	Lower Middle Creek
32-7-12.02A	0.37	Rock	Lower Middle Creek
32-7-12.02B	0.88	Rock	Lower Middle Creek
32-8-1.00A	6.00	Bituminous	Lower Middle Creek
30-6-35.00F	0.23	Rock	Upper Middle Creek
30-6-35.01G	0.20	Natural	Upper Middle Creek
30-6-35.01K	0.19	Rock	Upper Middle Creek
31-6-17.00A	0.90	Rock	Upper Middle Creek
31-6-17.01A	2.10	Rock	Upper Middle Creek
31-6-17.01B	2.90	Rock	Upper Middle Creek
31-6-17.04A	0.30	Rock	Upper Middle Creek

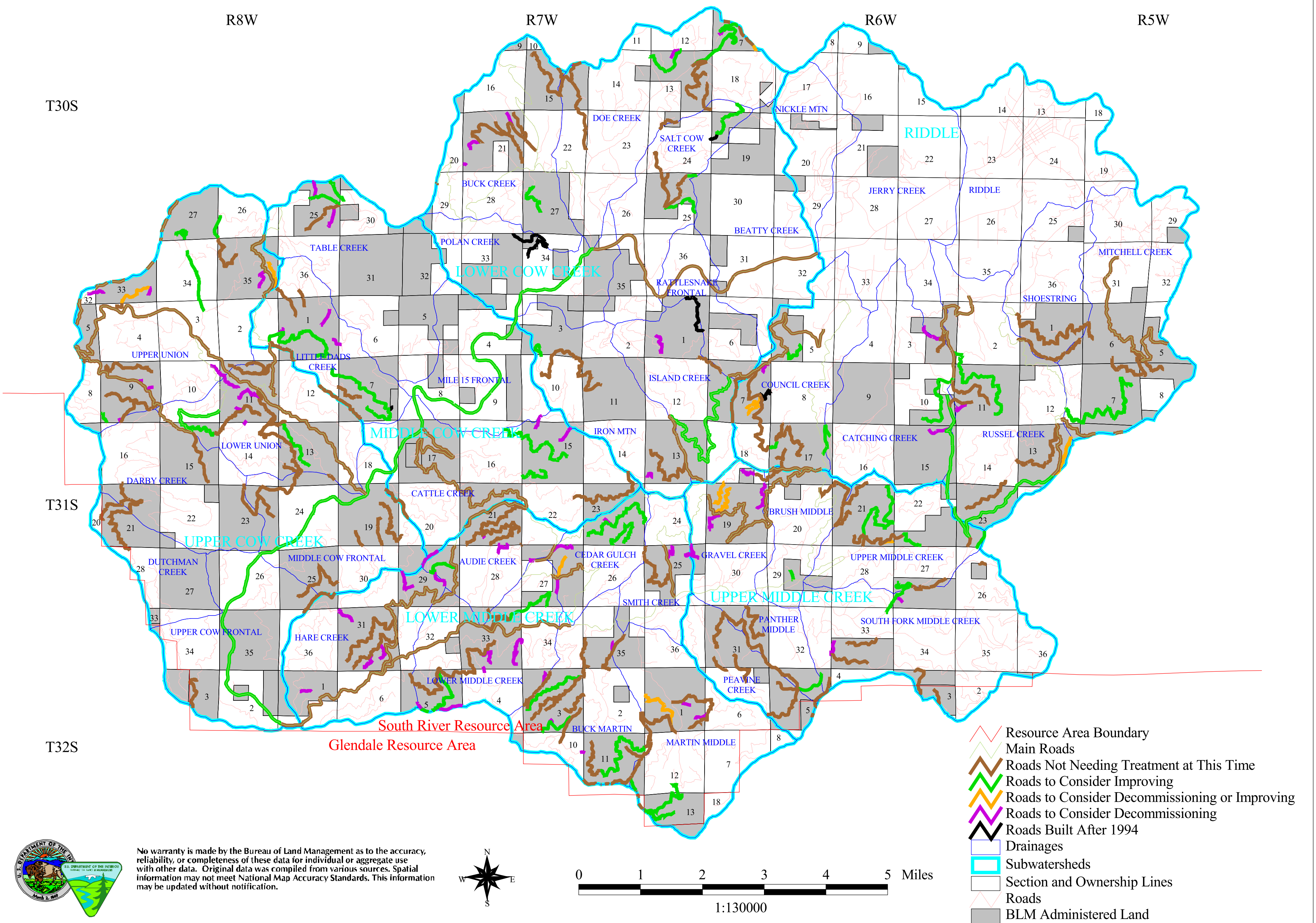
Table G-4. Roads in the Lower Cow Creek WAU Not Needing Treatment at This Time.

Road Number	Miles	Surface Type	Subwatershed
31-6-17.04B	0.30	Rock	Upper Middle Creek
31-6-20.00A	1.67	Rock	Upper Middle Creek
31-6-21.01A	0.86	Rock	Upper Middle Creek
31-6-21.03A	0.39	Rock	Upper Middle Creek
31-6-27.00A	0.17	Rock	Upper Middle Creek
31-6-27.01A	0.17	Rock	Upper Middle Creek
31-6-28.00B	1.27	Rock	Upper Middle Creek
31-6-29.03B	0.76	Rock	Upper Middle Creek
31-6-31.00A	2.98	Rock	Upper Middle Creek
31-6-31.00B	0.57	Rock	Upper Middle Creek
31-6-31.00C	0.40	Rock	Upper Middle Creek
31-6-33.00B	0.62	Rock	Upper Middle Creek
31-7-36.01B	1.00	Rock	Upper Middle Creek
32-6-3.01C	0.40	Rock	Upper Middle Creek
32-6-3.02B	0.69	Rock	Upper Middle Creek
32-6-5.00A	0.70	Rock	Upper Middle Creek
32-6-5.00B	0.18	Rock	Upper Middle Creek
32-6-5.02A	0.40	Rock	Upper Middle Creek
32-6-6.01A	0.71	Rock	Upper Middle Creek
32-6-6.02A	0.34	Rock	Upper Middle Creek
30-5-31.00A1	0.72	Bituminous	Riddle
30-5-31.00A2	1.38	Rock	Riddle
30-5-31.00B	1.65	Rock	Riddle
30-6-35.00C	1.06	Rock	Riddle
30-6-35.01A	2.34	Rock	Riddle

Table G-4. Roads in the Lower Cow Creek WAU Not Needing Treatment at This Time.

Road Number	Miles	Surface Type	Subwatershed
31-5-5.00A	0.46	Rock	Riddle
31-5-6.00A	0.56	Rock	Riddle
31-5-6.00B	0.82	Rock	Riddle
31-6-2.00A	2.75	Rock	Riddle
31-6-2.01A	1.41	Rock	Riddle
31-6-3.01A	0.41	Rock	Riddle
31-6-5.00A	2.92	Rock	Riddle
31-6-5.00B	0.24	Rock	Riddle
31-6-7.00A	0.75	Rock	Riddle
31-6-7.00B	0.66	Rock	Riddle
31-6-7.00C	0.85	Rock	Riddle
31-6-7.00E	0.37	Rock	Riddle
31-6-7.00F	0.30	Rock	Riddle
31-6-7.02A	1.02	Rock	Riddle
31-6-10.01A	1.09	Rock	Riddle
31-6-10.02A	0.54	Rock	Riddle
31-6-12.02B	1.50	Rock	Riddle
31-6-12.02D	0.94	Rock	Riddle
31-6-12.03B	1.18	Rock	Riddle
31-6-17.00A	0.90	Rock	Riddle
31-6-17.01A	2.10	Rock	Riddle
31-6-17.02A	0.34	Rock	Riddle
31-6-17.05A	0.30	Rock	Riddle
31-6-17.06A	0.20	Rock	Riddle
Total	183.24		

Map G-1. Lower Cow Creek Watershed Analysis Unit
Potential Road Treatment Opportunities



Appendix H

Aquatic Conservation Strategy and Riparian Reserves

Appendix H
Aquatic Conservation Strategy and Riparian Reserves

The four components of the Aquatic Conservation Strategy are Riparian Reserves, Key Watersheds, Watershed Analysis, and Watershed Restoration. The Aquatic Conservation Strategy (ACS) was developed to restore and maintain the ecological health of watersheds and aquatic ecosystems on public lands. The Aquatic Conservation Strategy seeks to prevent further degradation and restore habitat over broad landscapes as opposed to individual projects or small watersheds.

Aquatic Conservation Strategy objectives can be associated or linked with the National Marine Fisheries Service (NMFS) Matrix of Pathways and Indicators. The factors and indicators may relate to one or more of the nine ACS objectives. Including the NMFS factors and indicators in an ACS objective consistency discussion may provide a common link and logic track between the ACS objectives and the effects determination of a proposed project on Federally-listed fish species (i.e. Oregon Coast coho salmon).

When determining whether activities retard or prevent attainment of Aquatic Conservation Strategy objectives, the scale of analysis typically would be BLM analytical watersheds (Fifth Field Watershed) or similar units (USDI 1995). The time period would be defined as decades to possibly more than a century (USDA and USDI 1994b and USDI 1995).

ACS Objective 1. Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted.

Pathways/Indicators Used in BA Effects Matrix:

Habitat Elements/Off-Channel Habitat
Habitat Elements/Refugia
Channel Condition/Dynamics/Floodplain Connectivity
Watershed Conditions/Road Density and Location
Watershed Conditions/Disturbance History
Watershed Conditions/Riparian Reserves

ACS Objective 2. Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.

Pathways/Indicators Used in BA Effects Matrix:

Water Quality/Temperature
Water Quality/Chemical Contamination/Nutrients
Habitat Access/Physical Barriers
Habitat Elements/Off-channel Habitat
Habitat Elements/Refugia
Channel Condition/Dynamics/Floodplain Connectivity
Flow/Hydrology/Increase in Drainage Network
Watershed Conditions/Riparian Reserves

ACS Objective 3. Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.

Pathways/Indicators Used in BA Effects Matrix:

Habitat Elements/Substrate
Habitat Elements/Large Woody Debris
Habitat Elements/Pool Frequency
Habitat Elements/Pool Quality
Habitat Elements/Off-channel Habitat
Channel Condition/Dynamics/Width/Depth Ratio
Channel Condition/Streambank Condition
Channel Condition/Dynamics/Floodplain Connectivity
Watershed Conditions/Road Density and Location
Watershed Conditions/Riparian Reserves

ACS Objective 4. Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.

Pathways/Indicators Used in BA Effects Matrix:

Water Quality/Temperature
Water Quality/Sediment/Turbidity
Water Quality/Chemical Contamination/Nutrients
Watershed Conditions/Riparian Reserves

ACS Objective 5. Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.

Pathways/Indicators Used in BA Effects Matrix:

Water Quality/Sediment/Turbidity
Habitat Elements/Substrate
Habitat Elements/Pool Quality
Flow/Hydrology/Change in Peak/Base Flow
Flow/Hydrology/Increase in Drainage Network
Watershed Conditions/Road Density and Location
Watershed Conditions/Disturbance History
Watershed Conditions/Riparian Reserves

ACS Objective 6. Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.

Pathways/Indicators Used in BA Effects Matrix:

Water Quality/Sediment/Turbidity
Habitat Access/Physical Barriers
Habitat Elements/Large Woody Debris
Habitat Elements/Pool Quality
Habitat Elements/Off-channel Habitat
Channel Condition/Dynamics/Floodplain Connectivity
Flow/Hydrology/Change in Peak/Base Flow
Flow/Hydrology/Increase in Drainage Network

ACS Objective 7. Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.

Pathways/Indicators Used in BA Effects Matrix:

Channel Condition/Dynamics/Floodplain Connectivity
Flow/Hydrology/Change in Peak/Base Flow
Flow/Hydrology/Increase in Drainage Network

ACS Objective 8. Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.

Pathways/Indicators Used in BA Effects Matrix:

Water Quality/Temperature
Water Quality/Sediment/Turbidity
Water Quality/Chemical Contamination/Nutrients
Habitat Elements/Substrate
Habitat Elements/Large Woody Debris
Habitat Elements/Pool Frequency
Habitat Elements/Off-Channel Habitat
Channel Condition/Dynamics/Width/Depth Ratio
Channel Condition/Streambank Condition
Channel Condition/Dynamics/Floodplain Connectivity
Watershed Conditions/Riparian Reserves

ACS Objective 9. Maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species.

Pathways/Indicators Used in BA Effects Matrix:

Water Quality/Temperature
Water Quality/Sediment/Turbidity
Water Quality/Chemical Contamination/Nutrients
Habitat Access/Physical Barriers
Habitat Elements/Substrate
Habitat Elements/Large Woody Debris
Habitat Elements/Pool Frequency
Habitat Elements/Pool Quality
Habitat Elements/Off-channel Habitat
Habitat Elements/Refugia
Channel Condition/Dynamics/Width/Depth Ratio
Channel Condition/Streambank Condition
Channel Condition/Dynamics/Floodplain Connectivity
Watershed Conditions/Riparian Reserves

Riparian Reserves are associated in the NMFS Matrix of Pathways and Indicators with seven of the nine Aquatic Conservation Strategy objectives. Riparian Reserves generally parallel the stream network, but include other areas necessary for maintaining hydrologic, geomorphic, and ecological processes that directly affect streams, stream processes, and fish habitats. Riparian Reserves are expected to provide benefits including:

- maintaining streambank integrity (ACS objectives 3, 8, and 9)
- maintaining and recruiting large woody debris and other vegetative debris to provide aquatic habitat and filter suspended sediments. The trapped sediments would absorb and store water. This water would be available during summer months to supplement low summer flows. (ACS objectives 3, 5, 6, and 8)
- the large woody debris would help regulate streamflows by dissipating energy, thus moderating peak streamflows and protecting the morphology of stream channels (ACS objectives 3, 8, and 9)
- providing a nutrient source and water for aquatic and terrestrial species (ACS objectives 2, 4, 8, and 9)
- maintaining shade and riparian climate (ACS objectives 2, 4, 8, and 9)
- providing sediment filtration from upslope activities (ACS objectives 5, 6, 8, and 9)
- enhancing habitat for species dependent on the transition zone between upslope and riparian areas (ACS objectives 1, 2, 4, 8, and 9)
- improving travel and dispersal corridors for terrestrial animals and plants and providing greater connectivity within the watershed (ACS objectives 1, 2, 3, 6, and 8)
- maintaining surface and ground water systems as exchange areas for water, sediment, and nutrients (ACS objectives 2, 4, 6, and 8)
- providing for the creation and maintenance of pool habitat, both for frequency and quality (ACS objectives 3, 6, 8, and 9)
- providing lateral, longitudinal, and drainage network connections, which include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia (ACS objectives 1, 2, 6, 7, 8, and 9).

Appendix I
Timber Harvesting

Appendix I
Timber Harvesting

A long range timber harvesting plan was initiated for the South River Resource Area. The timber harvesting planning went through a rigorous process to determine suitable timber harvesting locations. This process continues to be refined.

The first step in the selection process of potential harvest areas was to identify all available and suitable stands. Information from GIS was used to identify Matrix lands greater than 80 years old and not located in reserved areas, such as Riparian Reserves, LSRs, TPCC Nonsuitable Woodland areas, owl core areas, or other administratively withdrawn areas. The remaining available stands were identified as being potential harvest areas. Birthdates (Dk) in the Forest Operation Inventory (FOI) were used to determine which stands were greater than 80 years old.

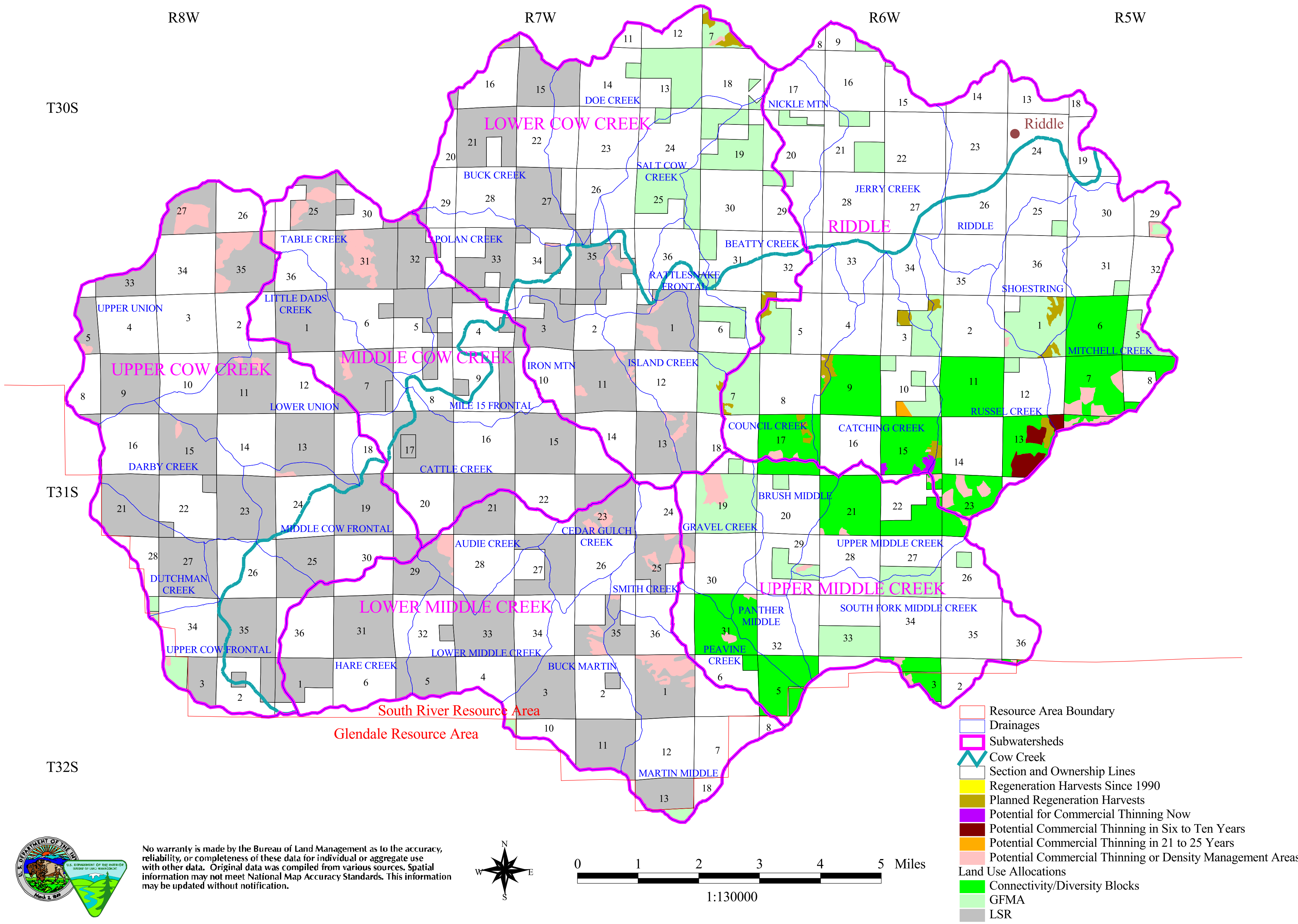
Interpretation of aerial photographs and GIS themes were used to identify suitable harvest areas and define logical unit boundaries. Unit boundaries were established within subwatershed (sixth field watershed) boundaries. Small areas (generally less than two acres) were not mapped as harvestable unless they could be harvested from an existing road. Some stands greater than 80 years old did not appear (as determined by aerial photograph interpretation) to have enough merchantable trees to make a viable unit after retention tree requirements were met. Those areas were not identified for harvesting at this time.

The identified harvest units were digitized into a GIS theme. The digitized harvest units were used to develop a timber sale plan through the year 2024 by attempting to balance timber harvesting equally across all watersheds in the South River Resource Area over time. The timber sale plan assumed timber harvesting would occur in each subwatershed at a level proportional to the number of acres currently available for timber harvesting, with one-third of the available acres in GFMA planned to be harvested in each of the first three decades. Timber harvesting of approximately 1,200 acres per decade was planned within Connectivity/Diversity Blocks in the resource area while maintaining 25 to 30 percent of each Connectivity/Diversity Block in late-successional forests.

Another step was to rank each subwatershed's relative importance to the terrestrial wildlife, hydrology, and fisheries resources. The goals were to identify subwatersheds or areas within a subwatershed where delaying timber harvesting would benefit a resource and what subwatersheds would be impacted the least by timber harvests. In general, subwatersheds with the least amount of BLM-administered land and the fewest available acres for timber harvesting were identified as the places to plan timber harvests first.

The latest step was to evaluate all available timber harvesting units previously identified where harvesting could occur with acceptable impacts to the wildlife, hydrology, and fisheries resources. Potential priority timber harvesting units were areas that did not have obvious conflicts with wildlife, fisheries, or hydrology and were considered to be physically harvestable (see Map I-1). Changes to unit size and shape would be anticipated after extensive field review. Other areas having some concern from wildlife, fisheries, or hydrology, generally, would be considered for timber harvesting after the priority areas. Although, occasions may occur where a lower priority area for timber harvesting may be harvested before a higher priority area, such as if including a lower priority unit in a sale would allow decommissioning of a road to facilitate the recovery of a larger area.

Map I-1. Lower Cow Creek Watershed Analysis Unit
Potential BLM Harvest Areas



No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data was compiled from various sources. Spatial information may not meet National Map Accuracy Standards. This information may be updated without notification.

Appendix J

Soils

Characteristics of Soil Parent Material in the Lower Cow Creek WAU.

Soil characteristics are divided into two groups, surface and subsoil layers. The surface soil layer includes the soil from the surface to a depth of 12 inches. The subsoil layer includes the soil from a depth of 12 inches to bedrock or to a depth of 60 inches. The layers are non-disturbed soil weighted averages by layer depth and percent of soil type component. Soil depth and drainage are averaged using both soil layers.

Table J-1. Weighted Average Soil Characteristics by Parent Material.

Geologic Parent Material	% of WAU	Acres	Depth (Inches)	Drainage (Code)	% Clay Surface Layer	% Clay Subsoil Layer	K Factor Surface Layer	K Factor Subsoil Layer	Available Water Capacity Surface Layer (cm/cm)	Available Water Capacity Subsoil Layer (cm/cm)
Water	0.43	438								
Clayey Alluvium	0.21	211	62.07	5.74	40.10	45.96	0.31	0.33	0.17	0.16
Mixed Alluvium	3.14	3,220	61.07	3.31	21.71	25.54	0.26	0.24	0.15	0.14
Conglomerate	2.25	2,302	27.44	3.01	14.80	17.94	0.11	0.11	0.10	0.09
Granodiorite	0.22	230	58.00	3.33	21.93	33.95	0.21	0.25	0.15	0.16
Metamorphic Rock	46.01	47,134	37.30	2.86	24.26	27.28	0.18	0.16	0.11	0.10
Pits	0.93	953								
Sandstone and Siltstone	11.49	11,772	42.65	3.37	30.46	39.68	0.26	0.28	0.18	0.17
Sandstone, Siltstone, and Metamorphic Rock	28.57	29,270	45.64	3.05	28.11	32.84	0.25	0.27	0.14	0.14
Serpentine	6.17	6,323	27.92	3.14	40.61	44.71	0.16	0.15	0.09	0.08
Volcanic rock	0.58	595	48.24	3.00	20.35	25.46	0.08	0.10	0.08	0.09

Table J-1 (continued). Weighted Average Soil Characteristics by Parent Material.

Geologic Parent Material	% of WAU	Acres	Bulk Density Surface Layer (g/cm^3)	Bulk Density Subsoil Layer (g/cm^3)	% Organic Matter Surface Layer	% Organic Matter Subsoil Layer	pH Surface Layer	pH Subsoil Layer	CEC Surface Layer (meq/100g)	CEC Subsoil Layer (meq/100g)	Permeability Surface Layer (um/s)	Permeability Subsoil Layer (um/s)
Water	0.43	438										
Clayey Alluvium	0.21	211	1.27	1.27	3.83	2.07	5.98	5.97	26.79	26.75	4.87	1.95
Mixed Alluvium	3.14	3,220	1.36	1.37	2.56	0.97	6.12	6.13	17.70	16.65	12.84	28.20
Conglomerate	2.25	2,302	1.42	1.43	1.03	0.39	6.07	5.68	8.28	8.21	26.37	26.17
Granodiorite	0.22	230	1.30	1.40	3.25	0.98	5.81	5.94	16.10	18.30	14.29	5.71
Metamorphic Rock	46.01	47,134	1.33	1.36	2.15	1.12	6.02	5.92	13.19	12.68	16.91	15.76
Pits	0.93	953										
Sandstone and Siltstone	11.49	11,772	1.32	1.34	2.68	1.62	5.68	5.50	15.93	17.88	8.03	5.19
Sandstone, Siltstone, and Metamorphic Rock	28.57	29,270	1.37	1.36	2.30	1.37	5.69	5.52	15.97	16.88	6.99	4.52
Serpentine	6.17	6,323	1.32	1.33	4.49	1.84	6.69	6.73	16.90	16.43	2.36	1.54
Volcanic Rock	0.58	595	1.33	1.32	3.40	1.49	5.61	5.40	16.12	17.76	16.76	16.76

The Natural Resources Conservation Service - National Soil Survey Handbook Part 618 - Soil Properties and Qualities section 430-VI-NSSH (1996) was the source for most of the following information.

Depth: Depths are from the soil surface to weathered (soft) or unweathered (hard) bedrock in inches.

Table J-2. Depth Codes and Description of What the Codes Mean.

Code	Description	Depth to Bedrock (inches)
RO	Rock Outcrop	0 - 4
SHV	Very Shallow	4 - 10
SH	Shallow	10 - 20
MD	Moderately Deep	20 - 40
DP	Deep	40 - 60
DPV	Very Deep	> 60

Drainage: An estimate of the natural drainage class or the prevailing wetness conditions of a soil.

Table J-3. Drainage Class Codes and Description of What the Codes Mean.

Code	Drainage Class	Depth to Water Table (inches)	Permeability	Description
1	Excessively Drained	> 60	Very Rapid	Water moves through the soil very rapidly. Internal free water is very rare or greater than 60 inches deep. Soils are commonly coarse-textured, have very high saturated hydraulic conductivity. Textures include very coarse, coarse, and medium sands, and loamy and medium sands with rock fragments.
2	Some What Excessively Drained	> 60	Moderately Rapid to Rapid	Water moves through the soil rapidly. Internal free water is very rare or greater than 60 inches deep. Soils are commonly moderately coarse and coarse textured with high saturated hydraulic conductivity. Textures include medium, fine, and loamy fine sand.
3	Well Drained	40 - 60	Moderate to Slow	Water moves through the soil readily but not rapidly. Internal free water is 40 to 60 inches deep. Wetness does not inhibit root growth for significant periods during most growing seasons. Soils commonly have very fine sandy loam, fine sandy loam, silt loam, silty clay loam, clay loam, sandy clay, or silty clay textures.
4	Moderately Well Drained	20 - 40	Moderate to Slow	Water moves through the soil somewhat slowly. Internal free water is 20 to 40 inches and may be transitory or common. Soil is wet within the rooting depth for only a short time during the growing season. The soil has a moderately low or very low saturated hydraulic conductivity class.
5	Somewhat Poorly Drained	10 - 20	Moderate to Slow	Water moves through the soil slowly. Internal free water is ten to 20 inches and transitory to permanent. Mesophytic plant growth is restricted, unless the soil is artificially drained. The soil has a moderately low to very low saturated hydraulic conductivity class.
6	Poorly Drained	0 - 10	Moderate to Slow	Water moves through the soil so slowly it is wet at or near the surface periodically during the growing seasons. Internal free water is zero to ten inches and common or persistent. Most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously wet beyond eight inches in depth. The soil has a low or very low saturated hydraulic conductivity class.
7	Very Poorly Drained	above surface to 6	Rapid to Slow	Water is at or near the soil surface during much of the growing season. Internal free water is zero to ten inches and is persistent or permanent. Most mesophytic crops cannot be grown unless the soil is artificially drained. Ponds occur frequently.

Clay: Measured as soil grain size < than .002 mm in diameter percent by weight.

Table J-4. Percent of Clay by General Soil Type.

Clay Percent	General Soil Type
0 - 10	Sandy
10 - 35	Loamy
> 35	Clayey

K Factor: The soil erodibility factor quantifies the susceptibility of a soil to detachment by water from the whole soil layer including coarse fragments (gravels, cobbles and stones). It is a quantitative value experimentally determined by applying a series of simulated rainstorms on freshly tilled plots. Soil erodibility factors can be estimated using a nomograph, which incorporates the relationships between five soil properties (1) percent silt plus very fine sand, (2) percent sand greater than 0.10 mm in diameter, (3) organic matter content, (4) structure, and (5) permeability. Rock fragment content is adjusted separately from the nomograph. The K factor value is lower when the rock fragment content is higher. Soils with more organic matter content have lower K factor values. Soils with high silt or very fine sand content would have higher K factor values. Soils with small size particles and low structural aggregate stability have higher K factor values. Soils with low infiltration (water movement) into the soil have higher K factor values. Soils with low water storage capacity have higher K factor values. The K factor values obtained experimentally range from 0.02 to 0.69.

Table J-5. The K Factor Groups and Erodibility.

K Factor Groups	Erodibility
0.02 - 0.20	Low
0.21 - 0.31	Moderate
0.32 - 0.69	High

Available Water Capacity: Available Water Capacity is the volume of water available to plants if the soil, including fragments, was at field capacity. It is commonly considered to be the amount of water held in the soil between field capacity and the wilting point, with corrections for salinity, fragments, and rooting depth. Available water capacity classes are used as subjective ratings reflecting the sum of available water capacity in inches to some arbitrary depth. Class limits vary according to climate zone and the crops commonly grown in an area. Available Water Capacity is an important soil property used for developing water budgets, predicting droughtiness, designing drainage systems, protecting water resources, and predicting yields.

Bulk Density: Bulk Density is the oven-dried weight of soil material less than 2 mm in diameter per unit volume of soil at a water tension of 1/10 bar or 1/3 bar. Bulk density influences plant growth and engineering applications. It is used to convert measurements from a weight basis to a volume basis. Bulk density is an indicator of how well plant roots are able to extend into the soil. Bulk density is used to calculate porosity.

Table J-6. Particle Size Classes in Relation to Bulk Density and Root Growth.

Family Particle Size Class	Restriction - Initiation (grams per cm^3)	Root Limiting (grams per cm^3)
Sandy (Sandy)	1.69	> 1.85
Coarse Loamy (Loamy)	1.63	> 1.80
Fine Loamy (Loamy)	1.60	> 1.78
Coarse Silty (Loamy)	1.60	> 1.79
Fine Silty (Loamy)	1.54	> 1.65
Clayey (35 - 45% Clay)	1.49	> 1.58
Clayey (> 45 % Clay)	1.39	> 1.47

Organic Matter: Organic matter is the percent by weight of decomposed plant and animal residue, expressed as a weight percentage of soil material less than 2 mm in diameter. Organic matter influences the physical and chemical properties of soils in a greater proportion than the quantity of organic matter present (Brady 1974). It encourages granulation and good tilth, increases porosity, lowers bulk density, promotes water infiltration, reduces plasticity and cohesion, and increases the available water capacity. It has a high cation adsorption capacity and is important for pesticide binding. It furnishes energy to soil microorganisms. Organic matter releases nitrogen, phosphorous, and sulfur as it decomposes.

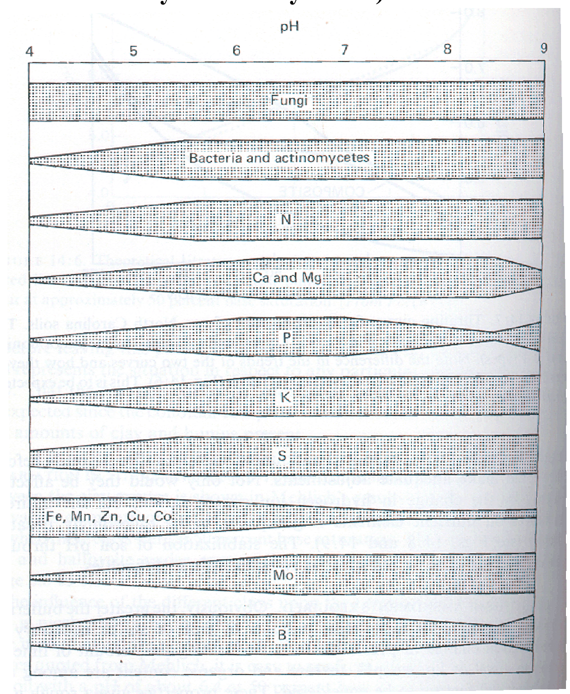
pH: Soil pH is a numerical expression of the relative acidity or alkalinity of a soil.

Figure J-1 shows the relationship in mineral soils between pH, microorganism activity, and the availability of plant nutrients. The wide portions of the bands indicate the pH when microbial activity and nutrient availability are the highest. Generally, pH ranging from six to seven promote plant nutrient availability. If soil pH is optimum for phosphorus, other plant nutrients, if present in adequate amounts, would be available. Acidic soils (with a low pH) have less calcium, magnesium, and molybdenum and more aluminum, iron, and boron available. Acidic soils also have less nitrogen and phosphorus available and possibly more organic toxins. Calcium, magnesium, nitrogen and molybdenum are more abundant and aluminum is not toxic with alkaline soils (soils with a high pH). Soils with a pH above 7.9 may have an inadequate availability of iron, manganese, copper, zinc, phosphorus, and boron. Highly alkaline or acidic soils can be very corrosive to steel. Acidic soils, with a pH less than 5.5, are likely to be highly corrosive to concrete. Alkaline soils, with a pH greater than 8.5, are susceptible to dispersion and piping may be a problem. Piping is when water flows along root channels or through animal burrows.

Table J-7. Descriptions of pH Range of Values.

pH Values	Class Descriptor
1.8 - 3.4	Ultra acid
3.5 - 4.4	Extremely acid
4.5 - 5.0	Very strongly acid
5.1 - 5.5	Strongly acid
5.6 - 6.0	Moderately acid
6.1 - 6.5	Slightly acid
6.6 - 7.3	Neutral
7.4 - 7.8	Slightly alkaline
7.9 - 8.4	Moderately alkaline
8.5 - 9.0	Strongly alkaline
9.1 - 11.0	Very strongly alkaline

Figure J-1. Relationship in Mineral Soils Between pH, Microorganism Activity, and Plant Nutrient Availability (From Nature and Properties of Soils. 8th edition. Nyle C. Brady. 1974).



Cation Exchange Capacity: Cation Exchange Capacity (CEC) is expressed as meq/100 g of soil. Cation Exchange Capacity is a measure of the ability of a soil to retain cations, which may be plant nutrients. Soil particles are composed of silicate and aluminosilicate clay. These particles are negatively charged colloids. A cation is a positively charged ion, for example H+, Ca++, Mg++, K+, NH4+, and Na+ are all cations. Cations are bound ionically to the surface of the negatively charged colloid particles. Cation Exchange Capacity increases as the clay and organic matter contents increase. Soils with a low Cation Exchange Capacity hold fewer cations and may require more frequent applications of fertilizer and amendments than soils having a high CEC.

Table J-8. Cation Exchange Capacity Values Associated with Soil Types.

Soil Type	Typical CEC Values (meq/100g of soil)
Sand	2 - 4
Loam	7 - 16
Clay	4 - 60
Organic	50 - 300

Permeability: Permeability enables water or air to move through the soil. Values are measured in micrometers per second or inches per hour. Permeability is used in soil interpretations to determine the suitability of irrigation, drainage system, septic tank absorption fields, terraces, and other conservation practices. Permeability is affected by pore size and shape distribution. Texture, organic matter content, mineralogy, structure, matted or absence of roots, pore size, and density are used to estimate permeability.

Table J-9. Relationship of Class Values to Permeability Classes.

Permeability Class	Class Values (inches per hour)	Class Values (um per second)
Very rapid	20 - 100	141 - 705
Rapid	6 - 20	42 - 141
Moderately rapid	2 - 6	14 - 42
Moderate	0.6 - 2	4 - 14
Moderately slow	0.2 - 0.6	1.4 - 4
Slow	0.06 - 0.2	0.42 - 1.4
Very slow	0.0015 - 0.06	0.01 - 0.42
Impermeable	0.00 - 0.0015	0.00 - 0.01

Saturated Hydraulic Conductivity: Saturated hydraulic conductivity (Ksat) is the preferred parameter for measuring a soils ability to transmit water. It is defined as the reciprocal, or inverse, of the resistance of the soil matrix to water flow measured in microns (micrometers) per second. Saturated hydraulic conductivity is affected by texture or other observable properties.

Table J-10. Saturated Hydraulic Conductivity Classes.

Saturated Hydraulic Conductivity Class	Class Values (um per second)	Class Values (inches per hour)
Very High	$\geq$ 100	$\geq$ 14.17
High	10-100	1.417-14.17
Moderately High	1-10	0.141-1.417
Moderately Low	0.1-1	0.014-0.141
Low	0.01-0.1	0.001-0.014
Very Low	<0.01	< 0.001

Appendix K

Water Quality Restoration Plan

Water Quality Restoration Plan
Appendix to the Lower Cow Creek Watershed Analysis
Lower Cow Creek Watershed

Bureau of Land Management
Roseburg District Office

December 2003

Watershed at a Glance	
Watershed	Lower Cow Creek: 102,447 acres Federally-Administered Land: 39,944 acres (39 percent)
Stream Miles*	Total: 1,165 Perennial: 248 Federally-Administered Land: 526 total 99 perennial Private Ownership: 639 total 149 perennial
Watershed Identifier	1710030209 (Hydrologic Unit Code)
303(d) Listed Parameters	Temperature, Habitat Modification, pH, and Toxics
Beneficial Uses	Industrial, Mining, Public and Domestic Water Supply, Irrigation, Livestock Watering, Water Contact Recreation, and Cold Water Biota (Salmonids Spawning and Rearing, Resident Fish and Aquatic Life)
Known Impacts	Wastewater Discharge, Agriculture, Timber Harvesting, Roads, Mining, and Water Withdrawals

*Data are from BLM GIS. Perennial streams are estimated to be at least third order streams.

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Statement of Purpose

This water quality restoration plan is being prepared to meet the requirements of Section 303(d) of the 1972 Federal Clean Water Act.

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Water Quality Restoration Plan Element Location

A Table of Contents for location of the Oregon Department of Environmental Quality (ODEQ) elements within the Lower Cow Creek Watershed Water Quality Restoration Plan (WQRP) is provided below:

Chapter 1 - Project Overview

Introduction

The area covered by this plan includes all Federally-administered land (see Table 1) in the Lower Cow Creek Watershed managed by the Bureau of Land Management (BLM) following the Standards and Guidelines in the Northwest Forest Plan (NWFP) (USDA and USDI 1994). Private land within the area of this Water Quality Restoration Plan (WQRP) includes urban, agricultural, and forested lands. The private forested land is managed following the Oregon Forest Practices Act (OFPA). A subsequent Water Quality Management Plan (WQMP) will be written by the Oregon Department of Environmental Quality (ODEQ) to cover the private lands in the Lower Cow Creek Watershed. The Lower Cow Creek Watershed WQRP is intended to be adaptive in management implementation and includes the protocols described in the Forest Service and Bureau of Land Management Protocol for Addressing Clean Water Act Section 303(d) Listed Waters (USDA et al. 1999). It allows for future changes in response to new information. Information generated during development of the WQMP may indicate this WQRP for Federally-administered land needs to be revised.

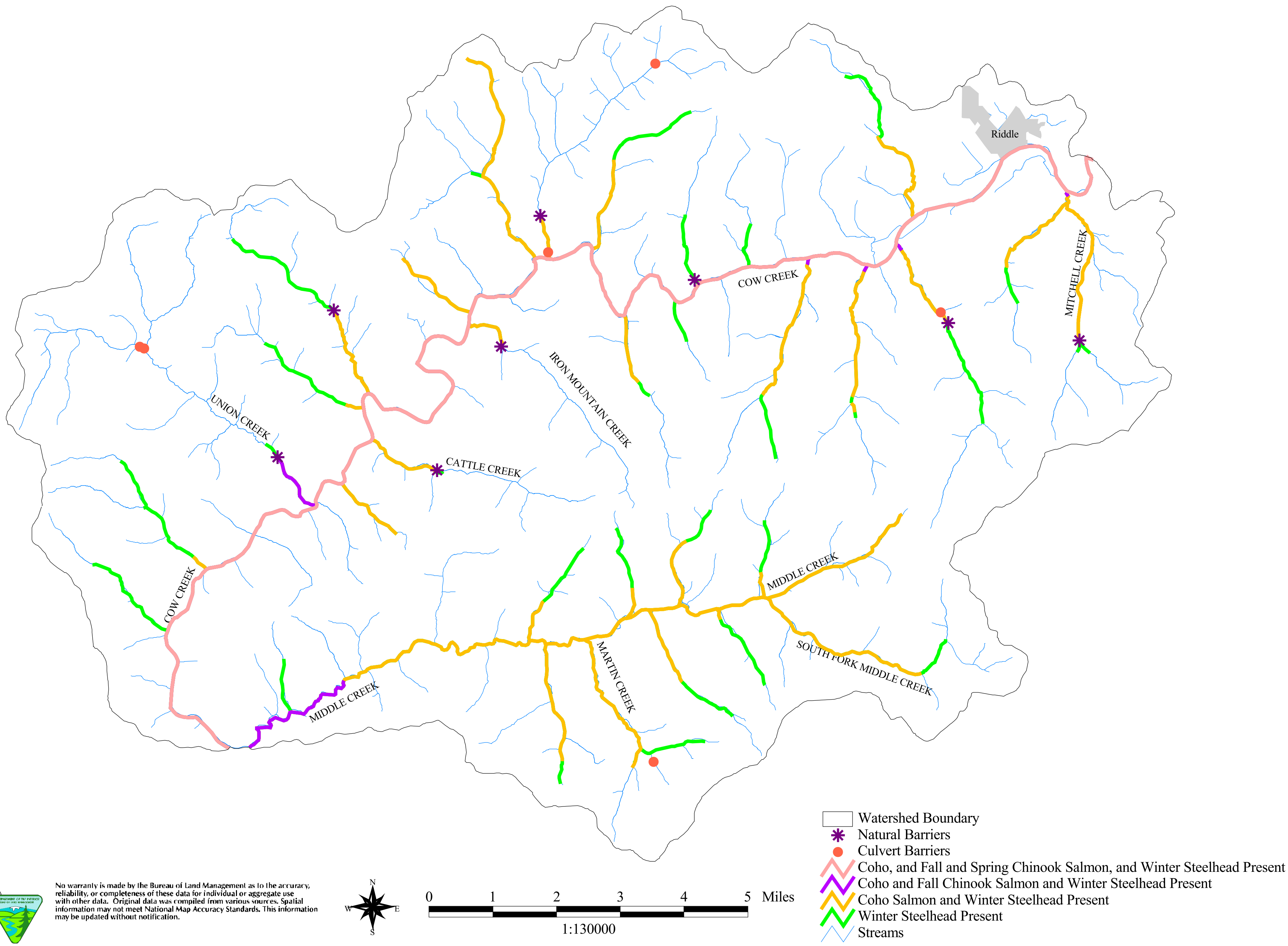
Table 1. Watershed Ownership in the Lower Cow Creek Watershed.

Ownership	Acres
Total	102,447
Federal	39,944
Private	62,503

Lower Cow Creek is a high value salmonid fish watershed in the Southern Oregon Coastal Basin. Despite habitat modification, spawning coho salmon, fall and spring chinook salmon, and winter steelhead return to Cow Creek every year. Anadromous and resident fish distributions are shown on Figure 1.

The Lower Cow Creek Watershed covers approximately 102,447 acres (160 square miles) in southwestern Oregon and is a major tributary to the South Umpqua River. Some of the land along Cow Creek is flat and used for agricultural purposes. In the agricultural areas some tributaries of Cow Creek have been straightened or had their flow patterns altered. The native vegetation in the agricultural areas has been replaced with low growing vegetation, generally grasses. Riparian areas may have some deciduous trees (hardwoods) along the stream banks. The higher elevations of the watershed are a combination of Federally-administered and private forested land. Timber harvesting and road construction have probably affected channel complexity, water quality, and hydraulic processes in the watershed.

Figure 1. Lower Cow Creek Watershed Anadromous and Resident Fish Distribution



No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data was compiled from various sources. Spatial information may not meet National Map Accuracy Standards. This information may be updated without notification.

Location

The management area for this WQRP is the Lower Cow Creek Watershed (see Figure 2), one of thirteen Fifth Field watersheds comprising the South Umpqua Subbasin. The South Umpqua Subbasin drains about 1,800 square miles. The Lower Cow Creek Watershed covers about nine percent of the South Umpqua Subbasin and about 32 percent of the entire Cow Creek drainage area. Cow Creek is divided into four Fifth Field watersheds; Lower Cow Creek, West Fork Cow Creek, Middle Cow Creek, and Upper Cow Creek. Cow Creek flows out of the Cascade Mountains until it meets the South Umpqua River near Riddle, Oregon. The South Umpqua River meets the North Umpqua River near Roseburg, Oregon where they join to form the Umpqua River. Most of the Federally-administered land in the Lower Cow Creek Watershed is managed by the Roseburg BLM District. However, the Medford BLM District manages a small amount of land in the southern portion of the watershed. For analytical purposes, the area was divided into six subwatersheds and 39 drainages (see Figure 3).

Ownership and Land Use Allocations

Lands administered by the BLM are managed according to the Land Use Allocations established by the Records of Decision for the Roseburg and Medford District Resource Management Plans (RMP) (USDI 1995) 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 ROD) (USDA and USDI 1994). Mapped Land Use Allocations within the WQRP area include Late-Successional Reserve (LSR), Connectivity/Diversity Blocks, and General Forest Management Areas (GFMA). The analysis area contains a Tier 1 Key Watershed (as defined in the SEIS ROD), which includes all of Middle Creek. Riparian Reserves are superimposed upon the Land Use Allocations. Acreage by Land Use Allocation are presented in Table 2 and shown on Figure 4.

Figure 2. Vicinity Map Lower Cow Creek Watershed

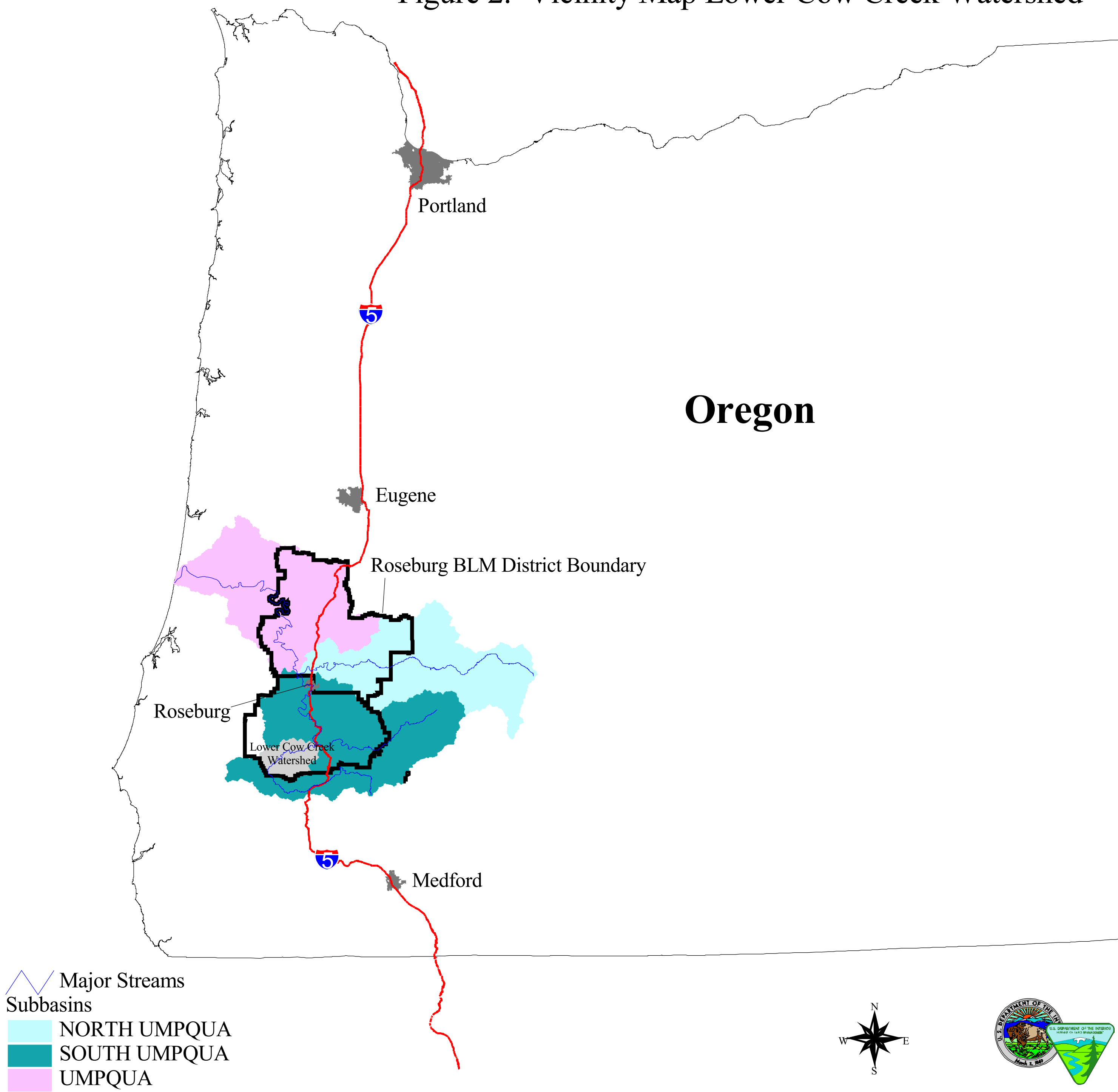


Figure 3. Lower Cow Creek Watershed Subwatersheds and Drainages

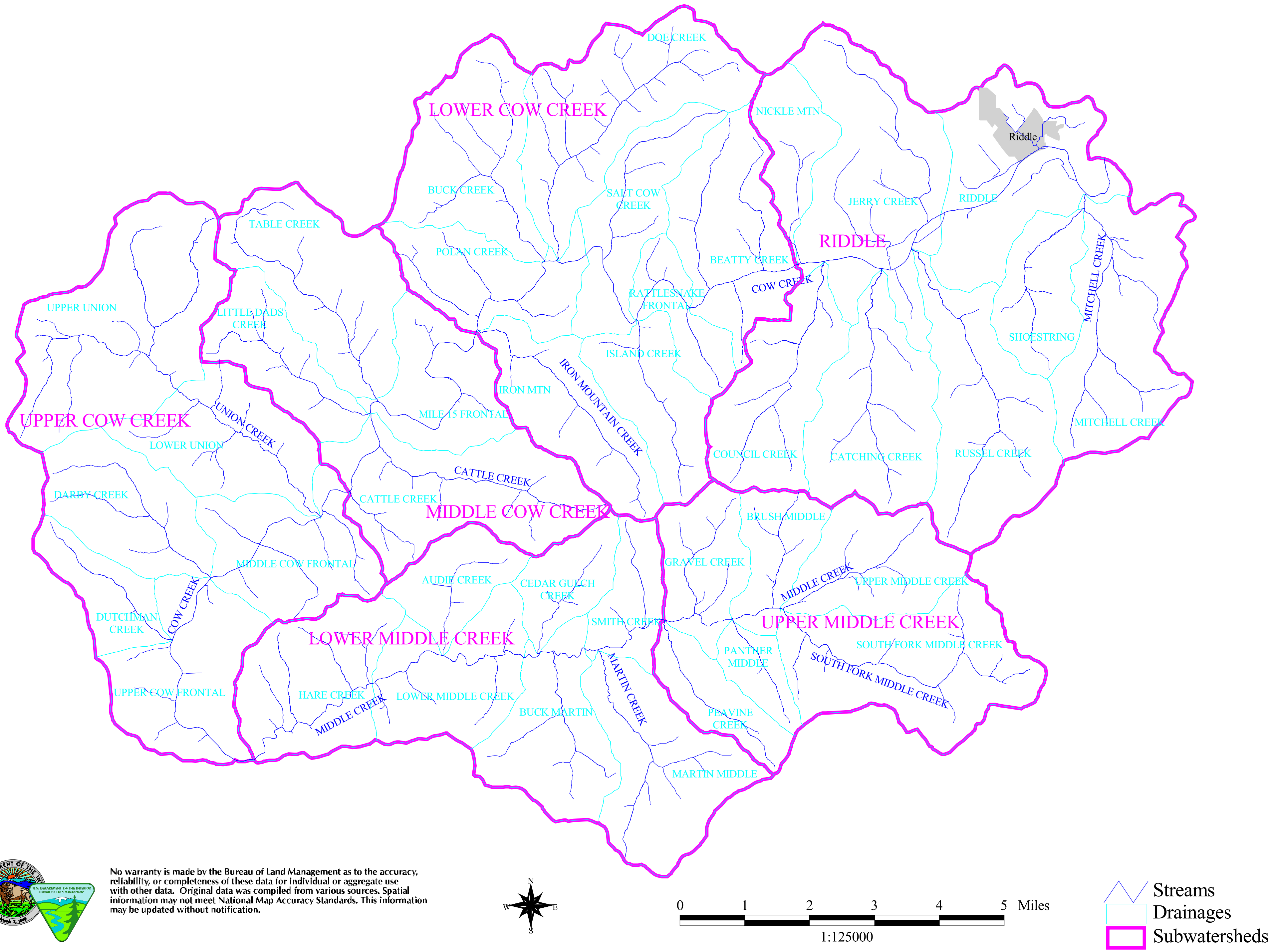


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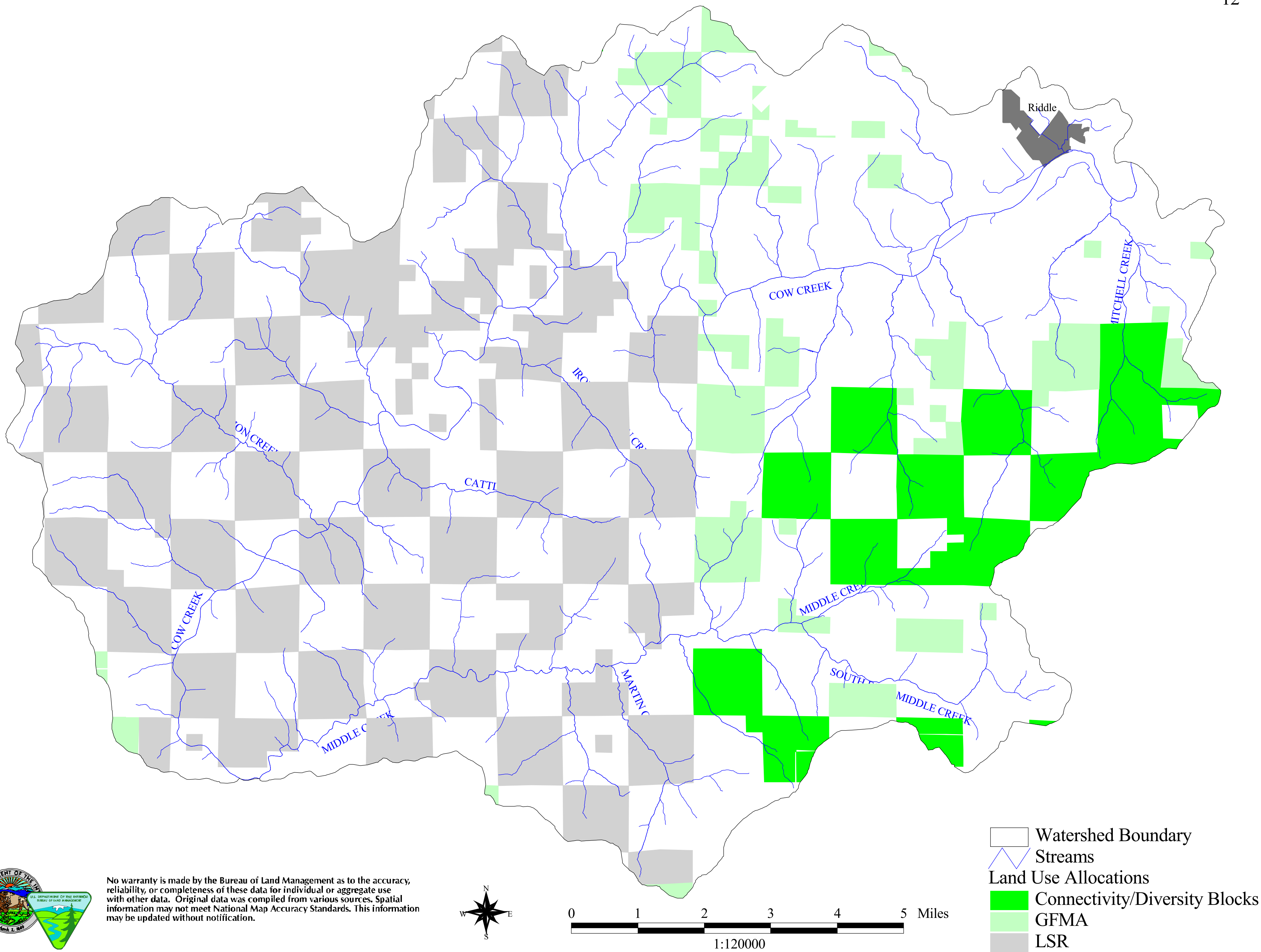
Table 2. Acres and Percentage of Federally Managed Lands by Land Use Allocation.

Land Use Allocation	Acres in Roseburg District	Acres in Medford District	Total Acres of Federally Managed Lands	Percent of Federally Managed Lands	Percent of Watershed Analysis Unit
Late-Successional Reserve	25,742	0	25,742	64	25
Riparian Reserves (Outside of LSR)	5,799	74	5,873	15	6
Other Reserved Areas (Owl Core Areas and TPCC Withdrawn Areas)	1,349	2	1,351	3	1
Connectivity/Diversity Blocks	3,680	157	3,837	10	4
General Forest Management Area (GFMA)	2,963	162	3,125	8	3
Total	39,533	395	39,928	100	39

Figure 4. Lower Cow Creek Watershed Land Use Allocations



Late-Successional Reserve (LSR)

This Land Use Allocation is defined on page 7 of the SEIS ROD. Management for the LSR is also described in the South Coast-Northern Klamath Late-Successional Reserve Assessment (USDI and USDA 1998).

Matrix

The Matrix Land Use Allocation includes Federally-administered land outside of designated reserves. The Roseburg and Medford BLM District RMPs divided Matrix into General Forest Management Areas (GFMA) and Connectivity/Diversity Blocks (CONN).

General Forest Management Areas (GFMA)

General Forest Management Areas would be managed on a regeneration harvest cycle of 80 to 110 years. Six to eight green trees per acre would be retained within regeneration harvest units.

Connectivity/Diversity Blocks (CONN)

Connectivity/Diversity Blocks would be managed on a 150 year area control rotation. Twelve to 18 green trees per acre would be retained within regeneration harvest units. Twenty-five to 30 percent of each Connectivity/Diversity Block would be maintained in late-successional forests at any point in time.

Current Conditions

The drainage density in the Lower Cow Creek Watershed is 7.28 miles per square mile. First and second order streams consist of approximately 917 miles, which is about 79 percent of the stream miles in the watershed (see Table 3). These are generally steep headwater channels draining small areas. Many first and second order streams are intermittent in the late summer. The remaining 21 percent of stream miles are third order or larger streams, which usually flow all year.

Longitudinal profiles of streams are useful to compare morphology between stream reaches and from one stream to another. Lower Cow Creek and the lower section of Middle Creek have average gradients of less than one percent. These are low-energy depositional streams. In contrast, tributary streams have steeper channel gradients. Tributary streams usually start below steeply sloped headwalls. These high-energy, erosional streams can transport large amounts of water and sediment. However, all streams contain low gradient reaches, which may provide valuable aquatic habitat.

Table 3. Miles of Streams by Stream Order and Drainage.

Drainage Name **Subwatershed Name**	Miles of Stream by Stream Order							
	1	2	3	4	5	6	7	Total
Catching Creek	21.9	6.1	3.4	1.7	2.4	0.0	0.0	35
Council Creek	17.6	6.3	4.0	2.6	0.0	0.0	0.0	30
Jerry Creek	19.3	7.4	6.5	3.3	0.4	0.0	3.2	40
Mitchell Creek	21.4	9.1	3.6	2.0	2.7	0.0	0.0	39
Nickle Mountain	3.9	2.2	1.1	1.3	0.0	0.0	0.0	8
Riddle	14.1	6.7	5.3	1.0	0.0	0.1	4.2	31
Russell Creek	22.3	8.4	3.5	1.3	3.4	0.0	0.0	39
Shoestring	12.8	5.7	2.3	1.9	0.0	0.0	0.0	23
Riddle Subwatershed	133.2	51.9	29.6	15.1	9.0	0.1	7.5	246
Beatty Creek	15.0	6.3	4.5	1.3	0.0	0.0	1.9	29
Buck Creek	21.4	8.2	3.6	2.6	1.7	0.0	0.0	37
Doe Creek	31.9	10.3	6.1	2.4	3.9	0.0	0.0	55
Iron Mountain	12.6	5.2	2.9	3.2	0.0	0.0	0.0	24
Island Creek	12.3	5.3	1.4	2.5	0.0	0.0	0.0	22
Polan Creek	13.0	5.1	3.4	0.0	0.0	0.0	2.6	24
Rattlesnake Frontal	8.4	2.9	1.7	0.0	0.0	0.0	1.4	14
Salt Cow Creek	14.2	5.6	2.9	1.5	0.0	0.0	1.7	26
Lower Cow Creek Subwatershed	128.8	48.9	26.5	13.5	5.6	0.0	7.6	231
Cattle Creek	26.7	8.9	4.7	3.7	0.0	0.0	1.4	45
Little Dads Creek	14.8	5.4	3.3	2.2	0.0	0.0	0.0	26
Mile 15 Frontal	10.8	4.0	1.2	0.3	0.0	0.0	4.1	20
Table Creek	21.3	9.2	3.9	3.7	0.0	0.0	0.0	38
Middle Cow Creek Subwatershed	73.6	27.4	13.0	9.9	0.0	0.0	5.6	129
Darby Creek	19.9	6.1	3.6	1.4	0.0	0.0	0.0	31
Dutchman Creek	8.9	3.0	1.7	0.8	0.0	0.0	0.0	14
Lower Union	21.1	6.0	3.2	0.5	3.4	0.0	0.0	34
Middle Cow Frontal	22.5	5.6	3.8	0.9	0.0	0.0	3.0	36
Upper Cow Frontal	21.2	10.8	2.8	0.0	0.0	0.0	4.1	39
Upper Union	35.2	14.9	6.2	4.7	1.3	0.0	0.0	62
Upper Cow Creek Subwatershed	128.6	46.4	21.4	8.3	4.7	0.0	7.0	216

Table 3. Miles of Streams by Stream Order and Drainage.

Drainage Name **Subwatershed Name**	Miles of Stream by Stream Order							
	1	2	3	4	5	6	7	Total
Audie Creek	13.6	4.5	1.7	1.1	0.0	0.0	0.0	21
Buck Martin	17.3	5.9	3.0	1.9	0.0	1.2	0.0	29
Cedar Gulch Creek	10.0	4.0	1.5	1.4	0.0	0.0	0.0	17
Hare Creek	27.0	8.3	5.0	0.6	0.0	2.9	0.0	44
Lower Middle Creek	20.6	5.9	2.9	0.4	0.0	3.0	0.0	33
Martin Middle	17.6	6.8	3.0	1.5	2.1	0.0	0.0	31
Smith Creek	8.7	2.1	2.1	0.0	1.4	0.3	0.0	15
Lower Middle Creek Subwatershed	114.7	37.4	19.3	6.9	3.5	7.3	0.0	189
Brush Middle	14.1	4.7	1.7	1.2	0.8	0.0	0.0	23
Gravel Creek	17.3	4.1	2.4	1.6	1.2	0.0	0.0	27
Panther Middle	5.0	1.5	0.8	0.8	0.0	0.0	0.0	8
Peavine Creek	9.0	2.1	0.4	2.3	0.0	0.0	0.0	14
South Fork Middle Creek	29.3	10.8	3.9	1.0	3.6	0.0	0.0	49
Upper Middle Creek	20.1	8.0	3.3	1.6	0.1	0.0	0.0	33
Upper Middle Creek Subwatershed	94.7	31.3	12.7	8.5	5.7	0.0	0.0	153
Lower Cow Creek WAU	674	243	123	62	29	7	28	1,165
Drainage Density	4.2	1.5	0.8	0.4	0.2	0.1	0.1	7.3

Listing Status

Beneficial water use within the watershed includes industrial, mining, public, and domestic water supply, irrigation, livestock watering, water contact recreation, and cold water biota (salmonids spawning and rearing, resident fish and aquatic life). Table 4 shows the parameters the ODEQ (1998) used to place the streams on the 1998 303(d) water quality limited list.

Table 4. Water Quality Limited 1998 303(d) Listings in the Lower Cow Creek Watershed.

Name and Description	Parameter	Listing Criteria	Miles	Season	Beneficial Uses Affected
Cow Creek Mouth to Riddle	Toxics	Chlorine	1.85	June through April	Resident Fish and Aquatic Life, Drinking Water
Cow Creek Mouth to West Fork Cow Creek	Habitat Modification	--	24.41	--	Resident Fish and Aquatic Life, Salmonid Spawning and Rearing
Cow Creek Mouth to West Fork Cow Creek	pH	pH Greater Than 8.5	24.41	Summer	Resident Fish and Aquatic Life, Water Contact Recreation
Cow Creek Mouth to West Fork Cow Creek	Temperature	Rearing 17.8°C (64° F)	24.41	Summer	Resident Fish and Aquatic Life, Salmonid Spawning and Rearing
Cattle Creek Mouth to Headwaters	Temperature	Rearing 17.8°C (64° F)	3.23	Summer	Resident Fish and Aquatic Life, Salmonid Spawning and Rearing
Iron Mountain Creek Mouth to Headwaters	Temperature	Rearing 17.8°C (64° F)	3.84	Summer	Resident Fish and Aquatic Life, Salmonid Spawning and Rearing
Martin Creek Mouth to Headwaters	Temperature	Rearing 17.8°C (64° F)	3.3	Summer	Resident Fish and Aquatic Life, Salmonid Spawning and Rearing
Middle Creek Mouth to Headwaters	Temperature	Rearing 17.8°C (64° F)	12.78	Summer	Resident Fish and Aquatic Life, Salmonid Spawning and Rearing
Middle Creek Mouth to Headwaters	Habitat Modification	--	12.78	--	Resident Fish and Aquatic Life, Salmonid Spawning and Rearing
Middle Creek, South Fork Mouth to Headwaters	Temperature	Rearing 17.8°C (64° F)	10.76	Summer	Resident Fish and Aquatic Life, Salmonid Spawning and Rearing

-- = No Data.

Cow Creek water temperatures exceeded the ODEQ standard between June and September. The water quality limited status for temperature on Cow Creek is located mainly along privately owned land, since there is very little Federally-administered land along Cow Creek in this watershed. Water temperature standards were also exceeded on Cattle Creek, Iron Mountain Creek, Martin Creek, the South Fork of Middle Creek, and Middle Creek (see Table 5). Data collected by the BLM showed Union Creek and Mitchell Creek also exceeded the water temperature standard. However, they are not on the water quality limited list for temperature, at this time. The purpose of this WQRP is to present information if Federally-administered lands are providing the coolest water possible downstream and how the BLM will address water temperature problems. The intention is to show what extent water is being warmed and what factors are contributing to the warming on Federally-administered land.

Table 5. Water Temperature Data Collected by the Roseburg BLM District in the Lower Cow Creek Watershed.

Stream Name	Years Data Were Collected	Range of Seven-Day Maximum Temperatures (EC)	Average of Seven-Day Maximum Temperatures (EC)	Maximum Number of Days Temperature Exceeded 17.8 EC (Year)	Low Flow at Site for 1999/2000 (cfs)	Drainage Area Above Site (Acres)
Cattle Creek	1997 to 2000	18.6 - 20.6	19.5	45 (1997)	0.55/0.34	2,755
Dutchman Creek	1999	16.4	16.4	0	---	683
Iron Mountain	1997 to 1999	17.9 - 19.6	18.6	31 (1998)	0.30/---	2,587
Martin Creek	1998 to 2000	18.9 - 20.4	19.7	38 (1998)	0.48/0.41	3,276
Martin Creek (Upper Site)	2000	16.9	16.9	0	---/0.30	1,109
Middle Creek	1994, 1995, 1997 to 2000	19.4 - 21.5	20.5	54 (1997)	0.44/0.38	2,302
Mitchell Creek	1999, 2000	19.1 - 20.1	19.6	42 (2000)	0.35/0.39	1,986
South Fork of Middle Creek	1994, 1995, 1997 to 2000	19.8 - 23.5	21.0	66 (1994)	2.08/1.82	4,117
Union Creek	1997 to 2000	19.6 - 21.5	20.6	65 (1997)	1.36/1.47	8,012

Seasonal Variation in Temperature and Flow

Stream temperature and flow vary seasonally and annually. Water temperatures are cool during the winter months but can exceed the state standard during the summer when streamflows are lowest and solar radiation and air temperatures are the highest. Normally stream temperatures increase in July and August when flows are receding but are not at their lowest flow level. However, maximum temperatures may occur earlier in the summer on streams with little shade (Johnson and Jones 2000). Water temperature data collected by BLM personnel in the Lower Cow Creek Watershed were found to be highest during July and August when streamflows were at their lowest level (see Table 6).

Table 6. Summer Stream Temperature Data Summarized by Year Collected by the Roseburg BLM District in the Lower Cow Creek Watershed.

Stream Name	Date	Maximum Temperature (EC)	Date	Minimum Temperature (EC)	ªT	Seven-Day Averages			Days Greater Than 17.8 EC
						Maximum	Minimum	ªT (EC)	
Cattle Creek	8/6/97	20.3	5/21/97	9.9	5.0	19.3	15.3	4.0	45
Cattle Creek	7/28/98	21.7	6/17/98	10.2	5.3	20.6	17.0	3.6	39
Cattle Creek	8/28/99	19.6	9/28/99	6.9	5.5	18.6	15.9	2.8	33
Cattle Creek	8/8/00	20.2	10/24/00	5.9	5.9	19.4	15.8	3.6	29
Dutchman Creek	8/28/99	16.8	9/28/99	8.8	2.2	16.4	15.2	1.2	0
Iron Mountain Creek	8/6/97	19.0	5/26/97	10.1	4.0	18.2	16.3	1.8	14
Iron Mountain Creek	7/28/98	20.6	6/17/98	10.4	4.1	19.6	16.5	3.1	31
Iron Mountain Creek	8/28/99	18.3	10/3/99	9.3	4.4	17.9	16.1	1.8	7
Martin Creek	7/28/98	21.7	6/17/98	9.0	5.1	20.4	16.7	3.7	38
Martin Creek	8/10/99	20.1	10/3/99	6.9	5.9	18.9	15.6	3.3	37
Martin Creek	7/31/00	20.5	4/29/00	5.9	5.9	19.8	15.5	4.3	32
Martin Creek (Upper Site)	8/8/00	17.7	4/29/00	5.7	4.2	16.9	14.0	2.9	0
Middle Creek	7/20/94	22.6	10/13/94	4.9	8.1	21.5	15.5	6.0	40
Middle Creek	7/27/95	22.0	6/12/95	8.1	7.5	20.6	15.4	5.2	41
Middle Creek	8/6/97	20.6	5/21/97	8.3	9.5	19.7	13.8	5.9	54
Middle Creek	7/27/98	22.6	6/17/98	8.6	7.2	21.4	15.2	6.2	49
Middle Creek	8/10/99	20.4	9/28/99	5.0	8.7	19.4	11.9	7.5	46
Middle Creek	7/31/00	21.1	4/29/00	5.7	7.5	20.3	14.6	5.7	48
Mitchell Creek	8/28/99	20.0	9/28/99	9.0	5.0	19.1	16.1	3.0	36
Mitchell Creek	8/8/00	20.8	5/11/00	7.3	5.0	20.1	16.2	4.0	42
South Fork Middle Creek	7/20/94	24.9	10/13/94	4.3	10.2	23.5	15.2	8.3	66
South Fork Middle Creek	7/27/95	22.0	6/12/95	7.8	8.5	20.8	13.1	7.7	52
South Fork Middle Creek	8/6/97	21.9	5/21/97	8.1	8.4	20.9	13.1	7.8	63
South Fork Middle Creek	7/27/98	21.9	6/17/98	8.1	7.0	20.6	14.5	6.2	41
South Fork Middle Creek	8/28/99	20.9	9/28/99	5.5	8.1	19.8	12.5	7.3	47
South Fork Middle Creek	8/8/00	21.6	4/29/00	5.4	7.8	20.7	13.9	6.8	53
Union Creek	8/6/97	21.4	5/25/97	9.9	6.2	20.5	15.8	4.6	65
Union Creek	7/27/98	22.8	6/17/98	10.2	5.9	21.5	16.4	5.1	53
Union Creek	8/10/99	20.4	9/28/99	7.6	6.6	19.6	15.6	4.0	47
Union Creek	7/31/00	21.5	10/24/00	6.4	6.0	20.8	15.8	5.1	54

Definitions:
ªT = Highest value of daily difference between the maximum and the minimum temperature for the season.
Seven-Day Maximum = Average value of daily maximum temperatures for the highest seven consecutive days.
Seven-Day Minimum = Average value of daily minimum temperatures for the same seven days.
Seven-Day ªT = Average of the daily difference between the maximum and the minimum temperatures for the same seven days.

Minimum Flows

Streamflow normally decreases until September or October. The two-year recurrence interval, seven-day low flow for Cow Creek near Riddle is 27 cfs (0.059 cfs per square mile), 8.8 cfs (0.113 cfs per square mile) for Cow Creek near Azalea, and 7.4 cfs (0.085 cfs per square mile) for the West Fork of Cow Creek near Glendale (Wellman et al. 1993). The minimum discharge recorded between 1954 and 1987 on Cow Creek near Riddle was 7.4 cfs from August 17 to 19, 1977. The minimum discharge for Cow Creek near Azalea between 1932 and 1985 was 1.1 cfs on August 12, 1981. The minimum discharge recorded between 1955 and 1987 on the West Fork of Cow Creek near Glendale was 3.7 cfs on August 17 and 19, 1977. Galesville Reservoir has increased summer flows in Cow Creek since 1985. Flows generally reflect annual precipitation levels with higher low flows in wetter years and lower summer flows in drier years. Some variation in low flow from year to year is typical of streams in the Lower Cow Creek Watershed.

Summer streamflows are produced by the release of subsurface water. This is primarily dependent upon soil type, soil depth, and porosity. Generally, the soils and geology in the watershed do not allow subsurface water retention during the summer.

Timeline for Implementation

The problems leading to water quality limitations and 303(d) listing have accumulated over many decades. Natural recovery and restorative management actions to address these problems will occur over an extended period of time. The first priority is to correct the causes of the problems to avoid additional degradation. This has largely been accomplished through the use of Best Management Practices (BMPs). The second priority is to address the symptoms of the problems. This is accomplished through restorative management actions. Implementation will be continued until the restoration goals, objectives, and management actions described in this WQRP are achieved. The Aquatic Conservation Strategy contained in the NWFP describes restoration timeframes. The ACS seeks to prevent further degradation and restore habitat over broad landscapes as opposed to individual projects or small watersheds. Because it is based on natural disturbance processes, it may take decades, possibly more than a century to achieve objectives.

The South River Resource Area has completed an aquatic restoration assessment. This assessment discusses the restoration needs and ways to address those needs. In addition, the resource area has initiated a programmatic environmental assessment for implementing restoration projects within the next five to ten years.

Responsible Parties

Participants in this plan for Federally-administered lands include the BLM and ODEQ. The BLM is the lead agency in this plan, since the BLM manages a large percentage of land in the Lower Cow Creek Watershed. Federal land managers agreed the Federal agency managing the most land within a watershed would be the lead agency for completing a WQRP.

A summary Water Quality Management Plan (including information from this WQRP) for Cow Creek will be developed by ODEQ with assistance from the Oregon Department of Forestry (ODF) and the Oregon Department of Agriculture. The Oregon Water Resources Department (OWRD) may be a participant in the implementation and monitoring components of the Water Quality Management Plan (WQMP). The WQMP will address private forest, agricultural, and non-resource lands.

The ODF is the Designated Management Agency (DMA) regulating water quality on non-Federal forest lands. The Oregon Board of Forestry in consultation and with the participation and support of ODEQ has adopted water protection rules in the form of Best Management Practices (BMP) for forest operations. These rules are implemented and enforced by ODF and monitored to assure their effectiveness. The ODF and ODEQ will jointly demonstrate how the Oregon Forest Practices Act (OFPA), forest protection rules (including the rule amendment process), and BMPs adequately protect water quality.

Reasonable Assurance of Implementation

The BLM is responsible for creating and implementing public land management plans for lands under their jurisdiction. The plans are required to comply with the Clean Water Act and state environmental protection programs. These plans fully address water quality and provide the foundation for long term restorative processes that are passive in nature. These plans also protect overall water quality through Best Management Practices (BMPs) that guide land management activities including restoration and rehabilitation.

The BLM works cooperatively with other interested parties in the watershed. This includes watershed councils, other government agencies, and private entities. The problems affecting water quality are widespread. Activities need to be coordinated with other parties to accomplish watershed restoration.

Public Involvement

The SEIS ROD for the NWFP (USDA and USDI 1994) was signed in April 1994, following extensive public review. Watershed analysis is a required component (in certain situations, such as in Key Watersheds) of the Aquatic Conservation Strategy (ACS) under the NWFP. This WQRP is a procedural step that focuses on water quality using elements of the NWFP. It tiers to and appends the Lower Cow Creek Watershed Analysis (USDI 2001). The watershed analysis describes the current conditions in the watershed in order to develop the appropriate context upon which this WQRP can base conclusions regarding BLM's ability to meet water quality standards on Federally-administered lands.

The ODEQ procedure for public input offers a 30-day public comment period prior to submission of a WQMP to the Environmental Protection Agency (EPA). The ODEQ will provide appropriate public notice requesting comments on the information contained in the WQMP and state the document is pending submission to EPA. The public notice would provide the public an opportunity to submit written or oral comments. If submitted comments indicate significant public interest, written requests from ten or more people are received, or an organization representing at least ten people requests a public hearing, then a public hearing would be held.

Chapter 2 - Condition Assessment/Problem Description

Parameter 1. Stream Temperature

Introduction/Listing Validation

For stream temperature, the affected beneficial uses are resident fish and aquatic life and salmonid fish spawning and rearing. Salmonid fish species require specific water temperatures at various stages of their fresh water life (ODEQ 1998b).

The Oregon water quality standard [OAR 340-41 – (basin) (2) (b)] that applies to the Umpqua Basin is:

> Standards applicable to all basins (adopted as of 1/11/96, effective 7/1/96):
> Seven (7) day moving average of daily maximum shall not exceed the following values unless specifically allowed under a Department-approved basin surface water temperature management plan:
>
> 17.8° C (64° F) Rearing (June 1 to September 14)
> 12.8° C (55° F) during times and in waters that support salmon spawning, egg incubation, and fry emergence from the egg and from the gravels (September 15 to May 31).

A stream is listed as water quality limited if there is documentation that the moving seven-day average daily maximum temperature exceeds the appropriate standard. This represents the warmest seven-day period (usually occurring from late July to early September) and is calculated by a moving average of the daily maximum temperatures. The time period of interest for rearing is June 1 through September 14. Streams on the water quality limited list for temperature in the Lower Cow Creek Watershed include Cow Creek, Cattle Creek, Iron Mountain Creek, Martin Creek, Middle Creek, and the South Fork of Middle Creek (see Figure 5). Data collected by the BLM in 2000 show the upper portion of Martin Creek did not exceed the water quality limited standard for temperature. However, Mitchell Creek and Union Creek did exceed the water quality limited standard for temperature (see Tables 4 and 5).

The BLM collected summertime stream temperature data in the Lower Cow Creek Watershed from 1994 to 2000 (see Tables 4 and 5). The range (bar) and average (point) annual maximum stream temperature data are shown in Figure 6. Seven out of the nine monitored sites in the watershed exceeded the water quality standards for rearing temperature regardless of yearly climate differences. Water temperatures in Cattle Creek, Iron Mountain Creek, Martin Creek, Middle Creek, Mitchell Creek, the South Fork of Middle Creek, and Union Creek exceeded water quality standards in July or August.

Figure 5. Lower Cow Creek Watershed Streams on the 1998 303(d) List of Water Quality Limited Streams for Exceeding the Temperature Standard

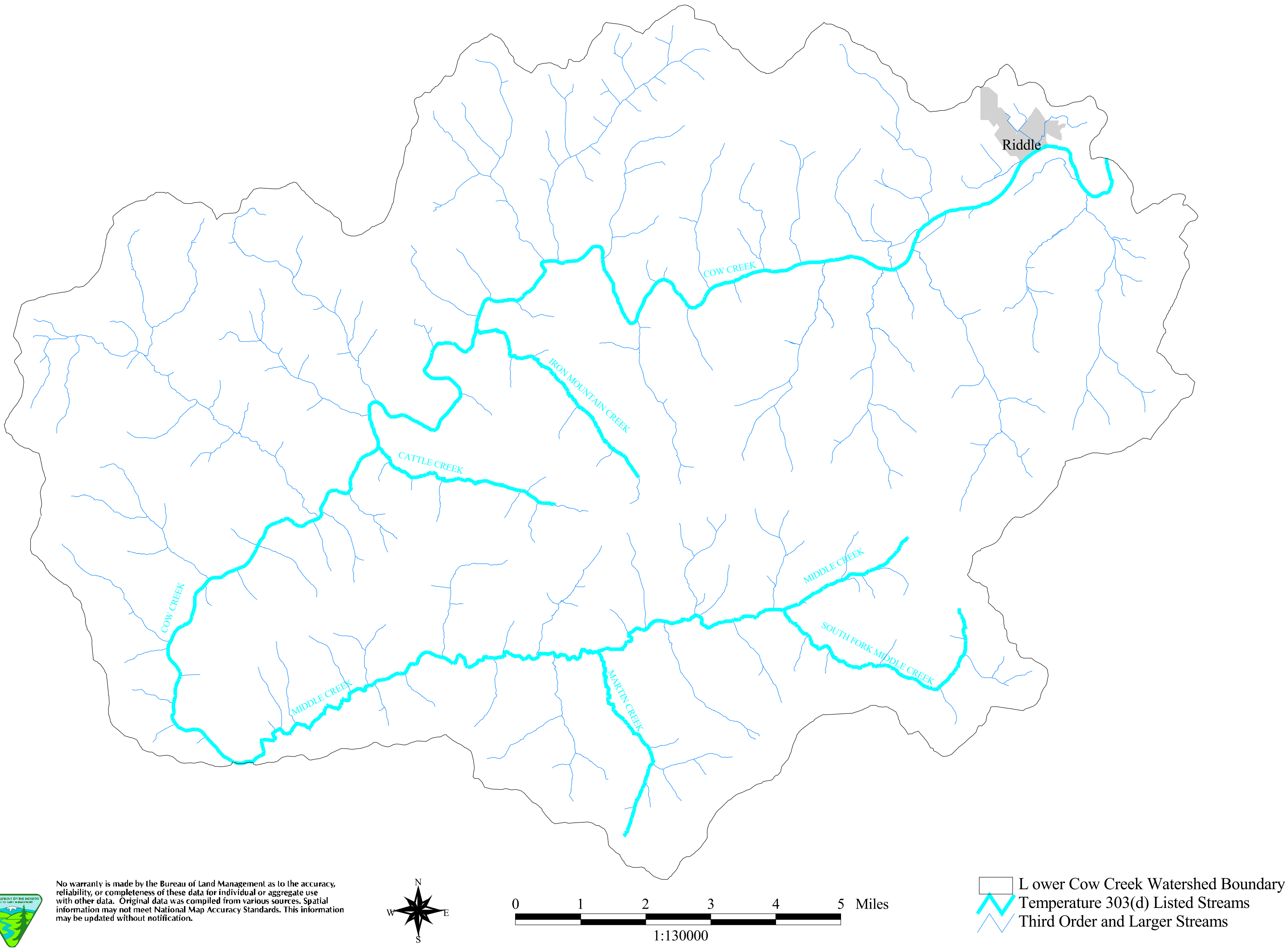
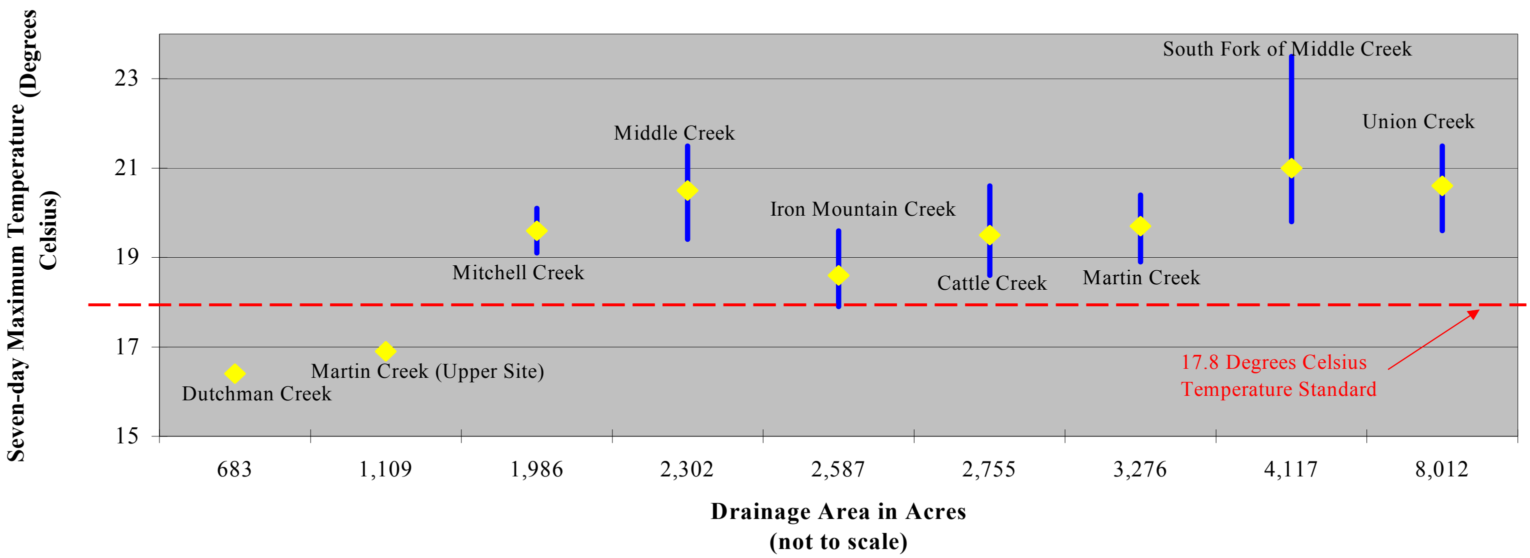


Figure 6. Correlation Between the Seven-day Maximum Stream Temperature and Drainage Area for Sites in the Lower Cow Creek Watershed



Stream temperature is driven by the interaction of many variables, such as stream channel characteristics. Streams with narrow channels tend to have cooler stream temperatures. A stream with a gentle gradient is typically wide, shallow, and has a slow velocity, which contributes to increased stream temperatures. Energy exchange may involve solar radiation, longwave radiation, evaporative heat transfer, convective heat transfer, conduction, and advection (Lee 1980 and Beschta and Weatherred 1984). For a stream with a given surface area and stream flow, an increase in the amount of heat entering a stream from solar radiation will produce a proportional increase in stream temperature (Brown 1972). Solar radiation is the most important radiant energy source heating streams during the day (Brown 1983).

Management activities that decrease riparian shade and contribute to the introduction of bedload sediment, which results in increased width to depth ratios and stream surface areas, can increase the amount of solar radiation intercepted by a stream. Water withdrawals during the summer may also increase the effect solar radiation has on water temperatures, as demonstrated by Brown's equation (Brown 1972). This WQRP was developed to address stream shade, flow, and stream channel morphology as factors affected by land management activities that may contribute to elevated water temperatures in the Lower Cow Creek Watershed.

Disturbance of the riparian area and stream channel from landslides and floods can also increase the amount of solar radiation intercepted by a stream. However, these are considered natural processes and are “expected” change agents considered by the ACS (USDA and USDI 1994). The changes in riparian vegetation caused by landslides and floods will likely fluctuate within the range of natural variability for this watershed. Such an analysis is considered to be outside the scope of this assessment. This WQRP focuses on areas where Federal land management activities have influenced natural disturbance and affected water quality.

Temperature Factor 1. Stream Shade

Riparian vegetation can effectively reduce the total daily solar heat load. Without riparian vegetation, most incoming solar energy would be available to heat the stream. The shadow model (Park 1993) was used to estimate the amount of existing shade in riparian areas along perennial streams in the Lower Cow Creek Watershed. Modeling parameters included active channel width, vegetative overhang, riparian tree height, shade density, and stream orientation. Active channel width, vegetative overhang, and the distance from the tree to the stream channel were calculated based on stream order or derived from field observations. Only data on BLM-administered lands were verified in the field. Data were not collected on private lands. Target shade was determined by using reference stream reaches. These reference stream reaches had trees in the riparian areas that were at the site potential tree height (which is considered to be the average maximum height and average maximum shade possible given site conditions). The number of years required for riparian vegetation to provide target shade was calculated based on the estimated number of years it would take trees to reach the site potential tree height. Tributary streams contributing at least 2.5 percent of the summer stream flow to Cow Creek, as measured at the point of confluence, were considered to influence Cow Creek stream temperatures and were included in the assessment.

Stream channel shade changes as forest stands grow. The target shade value is calculated based on site characteristics and site potential tree height. Target shade values represent the maximum potential stream shade. Tables 7 and 8 display the existing and target shade values for Federally-administered and all lands in the Lower Cow Creek Watershed. The type of disturbance listed was commonly “harvest”, which means timber harvesting. Fire disturbance may have reduced shade in some areas of the watershed but fire was not listed separately. Other natural processes that may reduce shade in riparian areas include drought, insect damage, disease, and blow down. Shade along some portions of Cow Creek has been reduced by agriculture and human settlement.

In the Lower Cow Creek Watershed, the largest decrease in shade on Federally-administered lands is due to the harvest of trees in the riparian area. Based on the percent of stream miles and amount of shade loss, the Lower Union, Buck Martin, and Lower Middle Creek Drainages would be the highest priority areas to conduct shade restoration activities on Federally-administered lands in the watershed (see Table 7). However, the decreased amount of shade on Federally-administered lands in these three Drainages probably had a small-to-moderate affect on increasing stream temperatures within the Lower Cow Creek Watershed.

Table 7. Current Shade Conditions and Potential Recovery on Federally-Administered Lands in the Lower Cow Creek Watershed.

Subwatershed Drainage	Percent of Stream Miles in the Watershed[1]	Percent Existing Shade	Percent Probable Target Shade	Percent Difference Between Target and Existing Shade	Type of Disturbance	Years to Shade Recovery[2]
Riddle Subwatershed	11.3	89	91	-2	Harvest	5
Catching Creek	3.1	87	91	-4	Harvest	8
Council Creek	0.7	94	94	-1	Harvest	8
Jerry Creek	N/A	N/A	N/A	N/A	N/A	N/A
Mitchell Creek	3.7	88	90	-2	Harvest	5
Riddle	N/A	N/A	N/A	N/A	N/A	N/A
Russell Creek	3.2	90	91	-1	Harvest	8
Shoestring	0.6	91	91	0	Harvest	0
Lower Cow Creek Subwatershed	12.9	76	89	-13	Harvest	22
Beatty Creek	0.2	69	86	-17	Harvest	56
Buck Creek	4.2	74	89	-16	Harvest	24
Doe Creek	2.7	77	91	-14	Harvest	24
Iron Mountain	4.4	84	91	-7	Harvest	8
Polan Creek	0.7	65	84	-20	Harvest	56
Rattlesnake Frontal	0.4	61	82	-21	Harvest	40
Salt Cow Creek	0.4	38	75	-37	Harvest	56
Middle Cow Creek Subwatershed	7.6	81	91	-11	Harvest	18
Cattle Creek	4.6	78	92	-14	Harvest	24
Mile 15 Frontal	0.2	76	88	-11	Harvest	40
Table Creek	2.9	85	90	-5	Harvest	8
Upper Cow Creek Subwatershed	11.9	73	89	-16	Harvest	29
Darby Creek	2.6	83	89	-7	Harvest	8
Lower Union	4.0	67	89	-22	Harvest	40
Middle Cow Frontal	0.8	71	87	-16	Harvest	40
Upper Cow Frontal	1.5	63	83	-19	Harvest	40
Upper Union	3.1	76	90	-14	Harvest	24
Lower Middle Creek Subwatershed	7.8	66	88	-21	Harvest	35
Buck Martin	2.5	66	92	-26	Harvest	40
Martin Middle	2.5	81	90	-10	Harvest	24
Lower Middle Creek	1.4	47	80	-33	Harvest	40
Smith Creek	0.6	75	88	-12	Harvest	40
Hare Creek	0.8	48	78	-29	Harvest	40

Table 7. Current Shade Conditions and Potential Recovery on Federally-Administered Lands in the Lower Cow Creek Watershed.

Subwatershed Drainage	Percent of Stream Miles in the Watershed[1]	Percent Existing Shade	Percent Probable Target Shade	Percent Difference Between Target and Existing Shade	Type of Disturbance	Years to Shade Recovery[2]
Upper Middle Creek Subwatershed	1.4	80	89	-9	Harvest	14
Brush Middle	0.4	88	90	-1	Harvest	0
Gravel Creek	N/A	N/A	N/A	N/A	N/A	N/A
South Fork Middle Creek	0.2	52	84	-32	Harvest	56
Upper Middle Creek	0.7	85	91	-6	Harvest	8

1. Percent of Stream Miles in the Watershed refers to the percent of stream miles in a Subwatershed or Drainage out of the total stream miles in the Lower Cow Creek Watershed.
2. Years to Recovery uses the weighted average tree height with DEQ's site index scale for trees in the riparian area to determine the number of years needed to reach the target height.
N/A The drainage does not contain Federally-administered land along the perennial stream channels.

Table 8. Current Shade Conditions and Potential Recovery for All Lands in the Lower Cow Creek Watershed.

Subwatershed Drainage	Percent of Stream Miles in the Watershed[1]	Percent Existing Shade	Percent Probable Target Shade	Percent Difference Between Target and Existing Shade	Type of Disturbance	Years to Shade Recovery[2]
Riddle Subwatershed	41.9	68	87	-18	Harvest	33
Catching Creek	8.3	77	91	-14	Harvest	24
Council Creek	6.5	83	90	-8	Harvest	24
Jerry Creek	2.7	29	61	-32	Harvest	40
Mitchell Creek	8.2	68	91	-23	Harvest	40
Riddle	4.1	42	68	-26	Harvest	40
Russell Creek	8.2	81	90	-9	Harvest	24
Shoestring	4.0	57	91	-35	Harvest	56
Lower Cow Creek Subwatershed	34.5	67	89	-22	Harvest	39
Beatty Creek	2.0	72	88	-17	Harvest	40
Buck Creek	7.8	66	89	-24	Harvest	40
Doe Creek	12.4	68	91	-23	Harvest	40
Iron Mountain	6.1	78	91	-13	Harvest	24
Polan Creek	3.3	56	82	-26	Harvest	56
Rattlesnake Frontal	1.4	55	80	-25	Harvest	24
Salt Cow Creek	1.7	50	80	-31	Harvest	56
Middle Cow Creek Subwatershed	19.8	67	89	-22	Harvest	37
Cattle Creek	8.0	70	92	-22	Harvest	40
Mile 15 Frontal	4.1	42	78	-36	Harvest	56
Table Creek	7.6	76	91	-15	Harvest	24
Upper Cow Creek Subwatershed	31.5	70	89	-19	Harvest	34
Darby Creek	5.1	68	91	-23	Harvest	40
Lower Union	7.1	68	91	-23	Harvest	40
Middle Cow Frontal	3.1	63	84	-22	Harvest	40
Upper Union	12.2	78	91	-13	Harvest	24
Upper Cow Frontal	4.0	57	80	-23	Harvest	40
Lower Middle Creek Subwatershed	20.3	64	87	-23	Harvest	41
Buck Martin	6.4	56	88	-32	Harvest	56
Hare Creek	2.9	44	78	-33	Harvest	56
Lower Middle Creek	2.6	50	80	-30	Harvest	40
Martin Middle	6.7	83	91	-8	Harvest	24
Smith Creek	1.6	72	89	-17	Harvest	24

Table 8. Current Shade Conditions and Potential Recovery for All Lands in the Lower Cow Creek Watershed.

Subwatershed Drainage	Percent of Stream Miles in the Watershed[1]	Percent Existing Shade	Percent Probable Target Shade	Percent Difference Between Target and Existing Shade	Type of Disturbance	Years to Shade Recovery[2]
Upper Middle Creek Subwatershed	13.0	73	92	-19	Harvest	40
Brush Middle	0.9	78	93	-14	Harvest	24
Gravel Creek	1.3	36	91	-54	Harvest	56
S Fork Middle Creek	8.6	78	92	-14	Harvest	40
Upper Middle Creek	2.3	72	90	-18	Harvest	40

1. Percent of Stream Miles in the Watershed refers to the percent of stream miles in a Subwatershed or Drainage out of the total stream miles in Cow Creek Watershed.
2. Years to Recovery uses the weighted average tree height with DEQ's site index scale for trees in the riparian area to determine the number of years needed to reach the target height.

Summary and WQRP Targets

The NWFP provides Standards and Guidelines for the removal of trees in Riparian Reserves on Federally-administered land (USDA and USDI 1994). Current management activities are designed not to decrease the amount of shade covering stream channels. Thinning in Riparian Reserves may decrease stream shade in some areas during the first few years. However, these activities are designed to promote the growth of riparian trees and decrease the number of years to shade recovery. The data in Table 9 are an average of all the stream reaches on Federally-administered land in the watershed contributing 2.5 percent or more of summer stream flow to Cow Creek. Shade recovery on Federally-administered land in the watershed is expected to occur in about 21 years. However, some areas will take longer while other areas already have the optimum amount of shade. Infrequent natural disturbances, such as floods and landslides, may affect shade recovery.

Table 9. Summary of Riparian Shade Conditions and Potential Recovery on Federally-Administered Lands in the Lower Cow Creek Watershed.

Percent Existing Shade	Percent Probable Target Shade	Percent Difference Between Target and Existing Shade	Type of Disturbance	Years to Shade Recovery[1]	Proposed Treatments
77	89	-12	Harvest	21	Follow the Aquatic Conservation Strategy for Management Activities in Riparian Reserves Adjacent to Perennial Streams.

1. Years to Recovery uses the weighted average tree height with DEQ's site index scale for trees in the riparian area to determine the number of years needed to reach the target height.

Temperature Factor 2. Flow

The temperature change produced by a given amount of heat is inversely proportional to the volume of water heated, such as the water in a stream (Brown, 1983). Water temperature in a stream with less flow will increase faster than a stream with more flow, if all other channel and riparian characteristics are the same.

Stream temperatures in the Lower Cow Creek Watershed can be affected by groundwater flows. Groundwater input has the tendency to cool streamflow. The groundwater may come from fractured bedrock or deep soils that produce sustained summer flows. Shallow soils have low water storage capacities and contribute less to summer flows. Melting snow may also contribute to summer flows and cool stream temperatures. Groundwater inflow tends to cool summer stream temperatures and augment summertime flows. Reducing or eliminating groundwater inflow allows streams to become warmer. Water withdrawals are addressed in the flow modification parameter. No federal water withdrawals are affecting stream temperatures in the Lower Cow Creek Watershed.

Temperature Factor 3. Stream Channel Morphology

While solar radiation and flow play a large role in determining stream temperature, stream channel morphology can also affect stream temperature. Streams that are narrow and have a high percentage of their streambed dominated by cobble and gravel are affected less than wide channels dominated by bedrock. Large wood plays an important role in creating stream channel morphology. Obstructions created by large wood help gravel accumulate. Gravel helps decrease the amount of water exposed to solar energy, since some of the water travels under the gravel. The removal of large wood has affected stream channel morphology. The large wood held the alluvial material in place, preventing the stream channels from down cutting and widening, which can increase stream temperatures. Stream morphology is discussed more in the habitat modification parameter section.

Management Actions

The NWFP Standards and Guidelines require Riparian Reserves along streams. Riparian Reserve widths, described in the ACS portion of the Standards and Guidelines, are based on the site potential tree height (160 feet in the Lower Cow Creek Watershed) or a minimum slope distance, whichever is greatest, unless described otherwise in a watershed analysis. Timber harvesting in Riparian Reserves is allowed under certain conditions, such as when catastrophic events result in degraded riparian conditions or when thinning, salvaging, or fuelwood cutting would help attain ACS objectives. In addition, silvicultural practices to control stocking, re-establish and manage stands, and acquire desired vegetation characteristics may be necessary to achieve ACS objectives.

Management activities to influence the amount of shade could include allowing riparian vegetation to grow to provide the target shade value and using silvicultural practices to meet ACS objectives. The watershed analysis recommends the following in Riparian Reserves:

- Thinning in Riparian Reserves to maintain or enhance the growth of conifers,

- Thinning in Riparian Reserves that are overstocked (due to fire suppression) to reduce fire hazard and loss of ecological function,
- Planting understocked Riparian Reserves.

Areas to focus activities might include:

- Dense stands,
- Dense stands with an elevated risk of catastrophic fires and loss of ecological function,
- Understocked stands that would provide the greatest benefit to streams on the water quality limited list for exceeding the water temperature standard.

Parameter 2. Habitat Modification

Introduction/Listing Validation

The beneficial uses affected by habitat modification include resident fish and aquatic life and salmonid fish spawning and rearing. The Oregon water quality standards that apply are:

> The creation of tastes or odors or toxic or other conditions that are deleterious to fish or other aquatic life, or affect the potability of drinking water, or the palatability of fish or shellfish shall not be allowed [OAR 340-41 – (basin)(2)(i)],

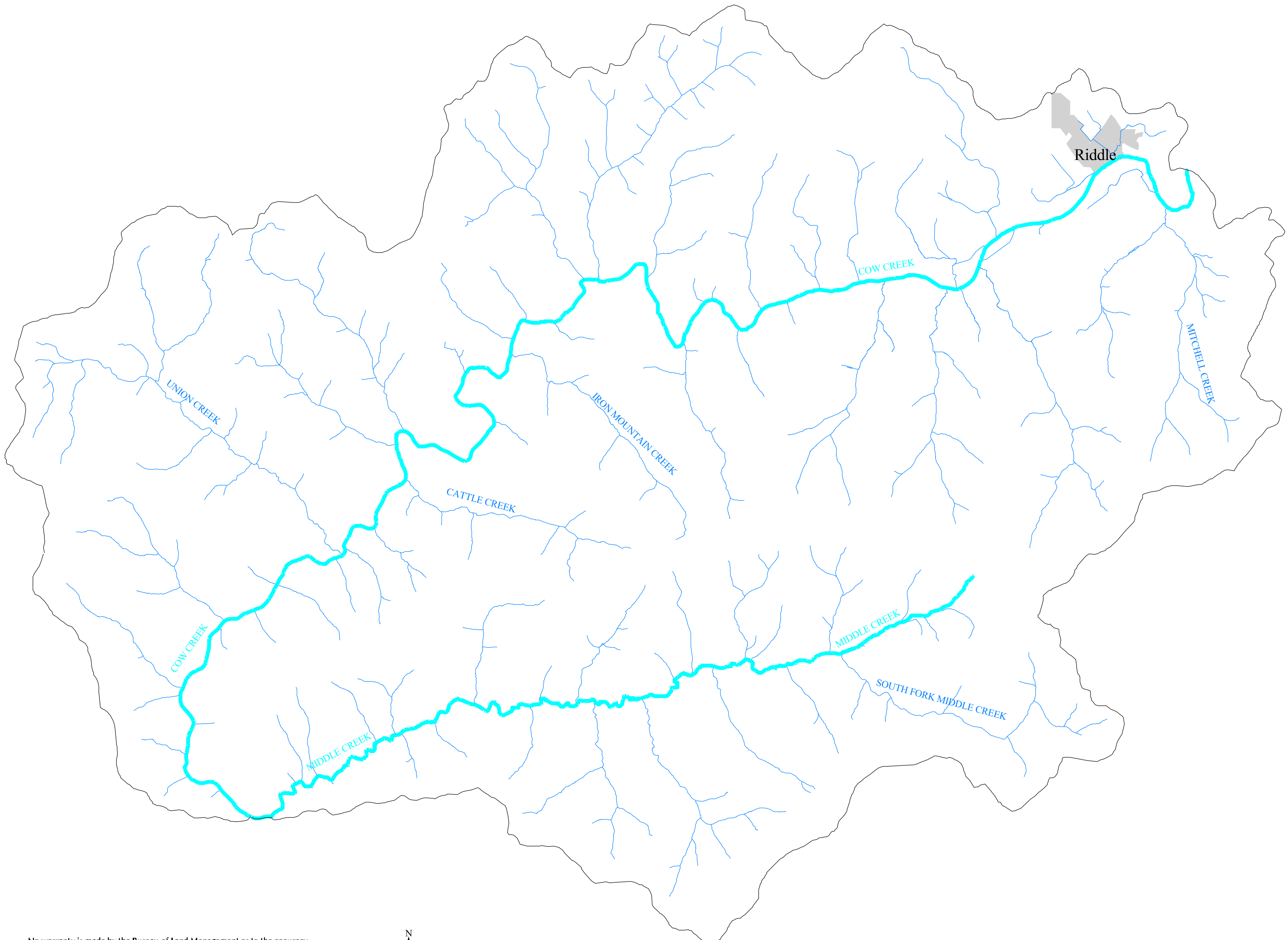
or:

> Waters of the State shall be of sufficient quality to support aquatic species without detrimental changes in the resident biological communities [OAR 340-41-027].

A stream is listed as water quality limited if there is documentation that habitat conditions are a limitation to fish or other aquatic life. Streams listed for habitat modification in the Lower Cow Creek Watershed include Cow Creek and Middle Creek (see Figure 7). Middle Creek was listed because the Oregon Department of Fish and Wildlife (ODFW) surveys indicated habitat conditions were a limitation to fish or other aquatic life.

The ODFW Aquatic Habitat Inventory (AHI) data and macroinvertebrate data collected by the BLM were used to document overall channel conditions and the biological potential of fish-bearing stream reaches in the watershed. The ODFW AHI surveys indicated many of the second through fifth order streams in the watershed do not meet the Large Woody Debris (LWD) Frequency (four or more functional key pieces of wood per 100 meters for 50 percent of the stream length) used by ODEQ to list a stream as water quality limited for habitat modification. Functional key pieces of wood are defined as at least 33 feet (10 meters) in length and 24 inches (0.6 meters) in diameter. Large woody debris is defined as a functional key piece of woody debris with an adequate length and diameter to be stable within a channel. All of the surveyed reaches on Middle Creek do not meet the Oregon Coast Salmon Restoration Initiative (CSRI) key LWD criteria used by ODEQ (see Table 10).

Figure 7. Lower Cow Creek Watershed Streams on the 1998 303(d) List of Water Quality Limited Streams for Exceeding the Habitat Modification Standard



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0 1 2 3 4 5 Miles

1:130000

Lower Cow Creek Watershed Boundary
Habitat Modification 303(d) Listed Streams
Third Order and Larger Streams

Therefore, the listing of Middle Creek appears to be valid for habitat modification based on key LWD frequency.

Pool Frequency was not summarized by ODFW for this watershed. However, low pool frequency was also identified by ODEQ as one of the causes for including Middle and Cow Creeks on the water quality limited list for habitat modification.

Table 10. Summary of ODFW Large Woody Debris Data Used by ODEQ to List Cow and Middle Creeks for Habitat Modification.

Stream Name	Reach Number	Large Woody Debris Frequency Per 100 Meters (CSRI standard = At Least 4 Per 100 meters)
Cow Creek	ND	ND
Middle Creek	1	0.9
	2	1.5
	3	1.7
	4	3.5

ND = No Data

Aquatic Habitat Inventory

The analysis of stream survey data for this WQRP concentrated on five attributes at the stream reach scale: 1) percent pool area, 2) riffle width/depth ratio, 3) riparian conifer size, 4) pieces of large wood, and 5) key pieces of large wood. All of these attributes, except for riparian conifer size, have been accepted by Federal and State teams in Oregon as core attributes needed to assess stream conditions. In addition, they are included in the Interagency Aquatic Database and GIS, which is a compilation of stream surveys from various agencies in Oregon. These attributes are inventoried by the Forest Service, BLM, and ODFW following similar protocols. Riparian conifer size is discussed in this WQRP because of important relationships between aquatic and riparian functions.

Data collected in the ODFW AHI can be used to identify the components that may limit the aquatic habitat and fishery resource from reaching their optimal functioning condition. The Habitat Benchmark Rating System is a method developed by the Umpqua Basin Biological Assessment Team (BAT) to rank aquatic habitat conditions. The BAT consists of fisheries biologists from the Southwest Regional Office of the ODFW, Coos Bay BLM District, Roseburg BLM District, Umpqua National Forest, and Pacific Power and Light Company. This group of local fisheries biologists addresses and resolves local questions and problems associated with the fisheries resource in the Umpqua Basin. The matrix designed by the BAT provides a framework to easily and meaningfully categorize habitat condition. This matrix is not intended to reflect quality of the habitat condition of each stream reach but to summarize the overall condition of the surveyed reaches. The matrix consists of four rating categories Excellent, Good, Fair, and Poor. How the ratings correlate with the National Marine Fisheries Service (NMFS) Matrix are shown in Table 11.

The NMFS Matrix is used during Section 7 consultation with NMFS to determine the effects of a land management action on fisheries and fish habitat.

Table 11. Comparison of the Aquatic Habitat Ratings (AHR) to the NMFS Matrix Ratings.

ODFW Aquatic Habitat Inventories	NMFS Matrix
Excellent or Good	Properly Functioning
Fair	At Risk
Poor	Not Properly Functioning

The ODFW conducted Aquatic Habitat Inventories on 22 streams in the Lower Cow Creek Watershed. Most of the 67 stream reaches identified in the inventories were rated as being in fair condition (see Table 12). Two of the stream reaches were rated as being in good condition and seven of the reaches were rated as being in poor condition. Six of the seven stream reaches rated as poor were located in the Upper or Lower Middle Creek subwatersheds. The lack of LWD seemed to be the limiting factor in most of the stream reaches. Increased sedimentation, hardwood dominated riparian areas, the lack of large conifers available for future recruitment of LWD, low percent pool area, and the lack of shade contributing to higher stream temperatures were other limiting factors in some of the stream reaches. About 97 percent of the surveyed stream reaches would be rated as At Risk or Not Properly Functioning (87 and 10 percent, respectively) according to the NMFS Matrix.

Table 12. Summary of ODFW Survey Data in the Lower Cow Creek Watershed

Stream	Reach	% Pool Area	Residual Pool Depth	Riffle W/D Ratio	% Fines in Riffles	% Gravel in Riffles	Riparian Vegetation (dom/subdom)	Riparian Conifer Size	% Shade	LWD pieces per 100m	LWD vol per 100m	Aquatic Habitat Rating (AHR)
Ash (Mitchell) Cr	1	41.2	0.5	24.3	1	69	hdwd/con	small	79	0.1	0.3	Fair
	2	28.8	0.5	22.0	2	69	hdwd/con	small	97	0.6	0.5	Fair
	3	4.7	0.6	18.9	1	52	hdwd/con	small	89	1.7	6.8	Fair
	4	7.1	0.5	18.5	0	42	hdwd/con	medium	94	6.9	13.6	Fair
Beatty Cr	1	8.3	0.5	17.0	3	75	con/hdwd	medium	99	6.3	19.0	Fair
Buck (Cow Cr)	1	13.6	0.5	13.3	3	26	hdwd/con	medium	91	16.6	43.7	Fair
	2	33.2	0.5	15.7	3	45	con/hdwd	medium	79	5.6	5.8	Fair
Buck (Middle Cr)	1	24.8	0.3	20.6	8	30	con/hdwd	small	83	8.4	11.8	Fair
	2	20.8	0.3	18.8	8	24	con/hdwd	small	82	1.2	1.1	Fair
	3	1.9	0.8	25	0	100	con/hdwd	small	96	3.5	9.2	Fair
Catching Cr	1	18.3	0.4	21.8	1	52	hdwd/con	small	93	0.5	0.3	Fair
	2	32.2	0.4	26.7	1	53	hdwd/con	small	93	1.0	1.2	Fair
	3	16.0	0.3	28.3	2	37	con/hdwd	small	95	0.7	0.9	Fair
	4	30.0	0.4	19.4	3	23	con/hdwd	medium	99	2.1	8.0	Fair
Cattle Cr	1	14.7	0.4	21.8	1	47	hdwd/con	small	88	1.4	3.2	Fair
	2	15.8	0.5	16.8	0	33	hdwd/con	small	62	1.6	1.4	Fair
	3	13.7	0.7	17.9	1	39	hdwd/con	small	66	5.1	8.1	Fair

Table 12. Summary of ODFW Survey Data in the Lower Cow Creek Watershed												
Stream	**Reach**	**% Pool Area**	**Residual Pool Depth**	**Riffle W/D Ratio**	**% Fines in Riffles**	**% Gravel in Riffles**	**Riparian Vegetation (dom/subdom)**	**Riparian Conifer Size**	**% Shade**	**LWD pieces per 100m**	**LWD vol per 100m**	**Aquatic Habitat Rating (AHR)**
Cedar Gulch	1	21.8	0.2	10.9	5	16	hdwd/con	small	87	5.1	8.0	Fair
	2	40.0	0.3	6.1	68	10	con/hdwd	medium	61	5.1	7.3	Poor
Council Cr	1	23.0	0.3	15.4	0	50	hdwd/con	small	94	0.5	0.3	Fair
	2	--	--	--	--	--	--	--	--	--	--	--
	3	23.0	0.4	17.8	4	32	con/hdwd	small	95	3.2	10	Fair
Darby Cr	1	22.4	0.6	13.1	0	58	hdwd/con	small	85	4.9	8.9	Fair
	2	15.8	0.5	15.0	0	55	hdwd/con	small	60	11.0	28.6	Fair
	3	14.9	0.6	14.0	0	59	con/hdwd	medium	90	19.0	50.8	Good
Doe Cr	1	12.8	0.5	16.7	3	42	hdwd/con	small	92	1.0	2.0	Fair
	2	26.1	0.5	20.9	1	58	con/hdwd	small	93	1.7	1.4	Fair
	3	17.4	0.4	15.9	1	63	con/hdwd	small	75	0.6	0.4	Fair
	4	15.4	0.4	14.0	1	57	con/hdwd	small	95	2.4	3.7	Fair
	5	8.5	0.4	10.0	0	52	con/hdwd	small	80	0.7	1.0	Fair
Iron Mountain Cr	1	20.9	0.5	16.2	0	29	hdwd/con	small	86	1.9	3.9	Fair
	2	24.3	0.6	15.0	3	56	hdwd/con	medium	91	2.4	6.2	Fair
	3	8.7	0.5	16.9	0	50	hdwd/con	medium	80	5.4	12.3	Fair
	4	12.1	0.6	11.3	0	62	con/hdwd	small	89	6.1	16.4	Fair

Table 12. Summary of ODFW Survey Data in the Lower Cow Creek Watershed

Stream	Reach	% Pool Area	Residual Pool Depth	Riffle W/D Ratio	% Fines in Riffles	% Gravel in Riffles	Riparian Vegetation (dom/subdom)	Riparian Conifer Size	% Shade	LWD pieces per 100m	LWD vol per 100m	Aquatic Habitat Rating (AHR)
Little Dads Cr	1	20.6	0.6	23.8	5	59	con/hdwd	medium	97	7.4	32.6	Fair
	2	17.7	0.4	26.0	10	80	con/hdwd	medium	96	8.8	30.5	Fair
Live Oak Cr	1	48.9	0.6	16.5	17	63	con/hdwd	small	84	4.4	9.4	Fair
	2	77.1	0.5	33.5	35	28	con/hdwd	small	45	0.7	0.7	Poor
Martin Cr	1	6.0	0.4	27.0	9	30	con/hdwd	medium	90	3.0	8.5	Fair
	2	--	0.0	15.8	6	24	con/hdwd	medium	72	2.9	4.6	Poor
Middle Cr	1	22.7	0.8	21.5	9	24	hdwd/con	small	69	0.9	2.5	Fair
	2	12.3	0.7	23.0	5	20	con/hdwd	medium	67	1.5	4.1	Poor
	3	7.8	0.4	28.6	8	36	hdwd/con	small	88	1.7	2.7	Fair
	4	0.3	0.4	35.0	17	40	hdwd/con	small	75	3.5	12.7	Poor
Peavine Cr	1	14.8	0.4	22.2	5	15	con/hdwd	small	69	1.0	2.0	Poor
	2	32.0	0.4	27.8	5	26	con/hdwd	small	70	2.5	2.1	Fair
	3	11.2	0.4	20.2	6	28	hdwd/con	small	98	2.6	9.7	Fair
Russell Cr	1	8.6	0.5	28.0	0	23	hdwd/con	small	82	1.5	1.2	Fair
	2	19.1	0.3	21.3	0	23	hdwd/con	small	99	3.4	7.6	Fair
Salt Cr	1	13.8	0.4	--	--	--	hdwd/con	small	96	9.6	32.2	--
	2	2.7	0.3	5.0	41	33	hdwd/con	medium	50	3.1	3.9	Fair

Table 12. Summary of ODFW Survey Data in the Lower Cow Creek Watershed

Stream	Reach	% Pool Area	Residual Pool Depth	Riffle W/D Ratio	% Fines in Riffles	% Gravel in Riffles	Riparian Vegetation (dom/subdom)	Riparian Conifer Size	% Shade	LWD pieces per 100m	LWD vol per 100m	Aquatic Habitat Rating (AHR)
	3	1.0	0.2	--	--	--	hdwd/con	small	72	4.3	1.3	--
Shoestring Cr	1	0.9	0.4	--	--	--	hdwd/con	small	87	1.5	0.4	--
	2	--	0.0	--	--	--	con/hdwd	small	95	0.5	1.0	--
S. Fork Middle Cr	1	2.8	0.5	23.5	10	22	hdwd/con	small	74	1.5	2.6	Poor
	2	5.0	0.4	22.8	10	35	hdwd/con	small	90	2.6	4.7	Fair
	3	2.5	0.4	16.3	15	36	con/hdwd	small	97	2.5	3.5	Fair
	4	60.6	0.7	31.0	63	31	hdwd/con	small	82	5.7	15.5	Fair
	5	28.5	0.6	17.4	48	45	con/hdwd	small	70	4.2	10.6	Fair
Table Cr	1	31.7	0.5	22.0	0	20	con/hdwd	medium	92	2.1	7.4	Fair
	2	50.8	0.5	3.0	0	75	hdwd/con	medium	96	3.4	12.6	Good
	3	26.3	0.7	--	--	--	hdwd/con	medium	74	4.0	15.2	--
	4	38.4	0.5	16.0	10	70	con/hdwd	med/large	86	4.8	13.8	Fair
Union Cr	1	28.3	0.7	23.6	4	39	con/hdwd	small	74	3.8	14.7	Fair
	2	35.8	0.6	24.6	3	41	con/hdwd	small	82	4.6	14.5	Fair
	3	32.3	0.6	21.1	6	56	hdwd/con	small	85	6.8	23.2	Fair
	4	4.0	0.4	25.0	0	64	con/hdwd	small	96	4.0	10.2	Fair

-- = no data available

Individual Attribute Discussion

Large Wood

Large woody debris is an important part of stream morphology. Large woody debris traps and stores sediment and organic material (which are important to aquatic species) and dissipates stream channel energy. Energy dissipation in a stream with adequate amounts of large wood varies greatly along the channel length and results in a channel form that is diverse. This channel form diversity is displayed by the frequent occurrence of pools, with scour occurring at stable LWD sites, rather than along the entire reach. Scouring can lead to channel incision, unstable banks, bank erosion, channel widening, and loss of channel complexity and habitat diversity (Montgomery and Buffington 1993). The presence of LWD in a system may also decrease peak flow magnitude and lengthen the time when the peak flow occurs (decreases the flashiness).

Past management practices, such as stream cleaning, road construction, and salvaging activities in riparian areas, left many streams lacking in LWD. The early seral vegetation along many of the streams does not allow the recruitment of LWD. The removal of large wood from the stream and potential woody debris from the riparian area had the greatest direct impact on stream channel morphology in the Lower Cow Creek Watershed.

Most of the anadromous fish-bearing stream reaches surveyed by ODFW in the watershed are deficient in LWD. The low frequency and volume of instream wood has resulted in fewer pool habitats for fish. The lack of instream large wood has, in most instances, negatively altered stream channel dynamics, such as bedload transport and stream substrate distribution. Other stream channel characteristics impacted by the lack of LWD include stream channel sinuosity, streambank stability, and floodplain interaction. Limiting a stream's ability to overflow onto the floodplain during high stream flow events inhibits stream channel hydraulics and channel dynamics. Normally, these conditions cause the channelization of stream flow and channel incision. Bureau of Land Management survey crews observed that many streams on BLM-administered land in the Lower Cow Creek Watershed are incised and disconnected from their floodplain.

Channel Complexity (Pools)

Research has demonstrated that channel complexity, especially slow water habitat, is a major limiting factor of fresh water habitat for coho salmon (Dolloff 1986). Pool habitat is an essential habitat component for rearing salmonids. Pools are most productive when large wood is present. Large woody debris provides cover in the summer and winter and velocity refuges during floods. Fish population surveys found the most coho salmon in slow water areas, pools behind beaver dams, and channel spanning pools (State of Oregon 1997).

Complex channels have higher proportions of slow water habitat created by LWD, meanders, and beaver activity (Meehan 1991). Although no direct links between pools and sedimentation have been found, studies indicate excessive sedimentation may play a role in reducing pool depth and frequency (Lisle and Hilton 1992).

Width to Depth Ratio

Increased channel widths have been attributed to changes in the stream flow regime due to timber harvesting, road construction, and simplification of the stream channel by the removal of LWD from the channel and riparian area (Dose and Roper 1994). Peak flows can introduce sediment into the channel from upslope and upstream and can simplify the channel by rearranging instream structures. Excess sediment delivery to streams usually changes stream channel characteristics and channel configuration. These changes in the stream channel decrease the depth, number of pool habitats, and space available for rearing fish (Meehan 1991). These changes in channel condition may have contributed to the decline of anadromous salmonid stocks in the Lower Cow Creek Watershed.

The ODFW habitat survey data (see Table 12) shows that most stream reaches surveyed in the Lower Cow Creek Watershed had riffle width to depth ratios ranging from excellent to poor, with an average rating of good. Forty-three percent of all reaches were rated as fair or poor. The criteria for the Aquatic Habitat Rating are shown in Table 13. The data indicates channel widening may have occurred in some stream reaches in the Lower Cow Creek Watershed.

Table 13. Aquatic Habitat Rating System.

Rating Category	% Pool Area	Pool Frequency (Riffle Widths Between Pools)	Riffle W/D Ratio	% Fines in Riffles	Riparian Conifer Size (≥ 50 cm DBH/305m)	LWD Pieces per 100m	Key LWD Pieces per 100m ≥ 60 cm Diameter
Excellent	$45	--	#10	#1	--	$30	--
Good	31-44	# 8	11 to 20	2 to 7	--	20-29	$ 4
Fair	16-30	--	21-29	8 to 14	--	11 to 19	--
Poor	#15	--	$30	$15	--	#10	--

-- = No Data.

Riparian Conifer Size

The historical condition of the riparian zone along Cow Creek probably favored conditions typical of old-growth forests found in the Pacific Northwest. Mature trees probably provided more shaded along Cow Creek and its tributaries than current conditions. In addition, streambanks were protected by the massive root systems of mature trees.

Management activities in the watershed have been extensive since the early 1900s. The railroad along Cow Creek was completed in 1889. Timber harvesting practices often removed standing trees, instream wood, and downed wood lying on floodplains. The ODFW aquatic habitat inventory data classified the riparian conifer size as small on 71 percent of the stream reaches surveyed.

Aquatic Macroinvertebrates

Aquatic macroinvertebrates sensitive to changes in habitat can be used to assess habitat conditions. Aquatic invertebrates are the primary food source for fish and perform an important role in the stream ecosystem. Macroinvertebrate community status is one accepted ODEQ 303 (d) listing criteria for determining impairment of aquatic life. Streams in the Lower Cow Creek Watershed on the water quality limited list due to habitat modification are Middle Creek and Cow Creek. The Oregon Department of Environmental Quality used the lack of LWD to support the listing.

Middle Creek

Water quality and macroinvertebrate surveys were conducted in Middle Creek by BLM personnel in 1999 because of mining related concerns (see Table 14). Although Middle Creek is on the water quality limited list for habitat modification and temperature, aquatic life uses are primarily limited due to the release of toxic metals from abandoned mining operations (USDI 2000). The ODEQ and BLM are developing a plan to improve water quality in Middle Creek (ODEQ 2000). The effects of habitat modification on aquatic life uses in Middle Creek would remain difficult to quantify until the mining related water quality concerns improve.

Cow Creek

Water quality and macroinvertebrate surveys were conducted in Cow Creek by BLM personnel in 1999 because of mining related concerns (see Table 14). Elevated levels of lead were measured in Cow Creek 100 yards downstream from the confluence with Middle Creek. Metal concentrations were not elevated in Cow Creek ½ mile downstream from the confluence with Middle Creek. However, impacts to macroinvertebrate communities in Cow Creek from toxics were not evident.

Macroinvertebrate data indicated aquatic life had been adversely impacted by habitat modification. Based on the ODEQ macroinvertebrate Biotic Index, sites in Cow Creek above and below the West Fork of Cow Creek were both classified as severely impaired. The site in the West Fork of Cow Creek was classified as severely to moderately impaired (see Table 14). About 58 to 78 percent of the total macroinvertebrates found at the surveyed locations consisted of the tolerant aquatic snail Juga juga. The dominance of Juga juga was attributed to the presence of filamentous green algae in Cow Creek and the West Fork of Cow Creek in the summer of 1999. Filamentous algal growth is often associated with human caused habitat modification. Human caused habitat modification conditions may include:

1. Decreased stream shade, which may increase absorbed sunlight and summer water temperatures;

2. Increased stream width/depth ratio, which may increase absorbed sunlight and summer water temperatures;

3. Decreased amount of LWD, resulting in fewer deep pools and a greater percentage of riffle to run habitat.

The objective of the 1999 macroinvertebrate surveys conducted by the Roseburg BLM District was to determine the impacts from toxics. However, a stream without extensive habitat modification to use as a comparison was not sampled at the same time. Additional macroinvertebrate sampling should be conducted (see the Monitoring section in this WQRP).

Table 14. Summary of the 1999 Roseburg BLM District Macroinvertebrate Data Collected In and Near the Lower Cow Creek Watershed.

Stream	303(d) Listed Segment/parameters	Location of Macroinvertebrate Sites	Macroinvertebrate Community Status Evaluation
Middle Creek	Mouth to headwaters 1. Habitat Modification 2. Temperature	5 sites located from the headwaters to the confluence with Cow Creek.	**Severely impaired**. Water quality and macroinvertebrate data indicate toxic metals are the limiting factors.
Cow Creek above Middle Creek and the West Fork of Cow Creek	Not listed	100 yards above the confluence with Middle Creek.	**Severely impaired.** Biotic Index score = 18
Cow Creek below the West Fork of Cow Creek	Mouth to the West Fork of Cow Creek 1. Habitat Modification 2. Temperature	1 mile downstream from the confluence with the West Fork of Cow Creek.	**Severely impaired.** Biotic Index score = 18
West Fork of Cow Creek	Mouth to Wilson Creek 1. Temperature	100 yards above the confluence with Cow Creek.	**Severely/Moderately impaired** Biotic Index score = 20

Management Actions

Protective and restorative management actions would be used to achieve water quality and fish habitat goals. Protective actions are the cessation of human activities that cause habitat modification or prevent recovery. They include maintaining LWD in stream channels, thinning in riparian reserves to promote large conifer growth, and allowing riparian vegetation to grow. These protective actions would improve large wood recruitment and bank stabilization.

Restorative actions recover aquatic processes and functions. Placing large wood in streams would actively restore the aquatic habitat. Reducing the amount of sediment entering streams would focus on the source and placing structures in streams would address the symptoms. Placing large wood in streams will be done as opportunities occur and based on an assessment of local conditions (where it historically accumulated, where downed wood is readily available, where habitat is needed, and in depositional stream reaches).

Restorative measures to address the temperature listings will also improve aquatic habitat. Table 15 provides a summary of habitat elements, affected processes, and management actions. The table shows a particular management action can affect numerous processes and that it is important actions occur in both the upland and riparian areas.

Table 15. Habitat Elements, Affected Processes, and Potential Management Activities to Restore Aquatic Habitat.

Habitat Element	Affected Process	Management Actions	
		Upland	Riparian
Water Temperature	Riparian canopy closure		Maintain effective stream buffers. Apply silviculture treatments to maintain or enhance tree growth or diversity in riparian areas
	Sedimentation	Locate and avoid unstable areas Decommission or improve roads	Decommission or improve roads
	Increased peak flows and channel scour	Maintain canopy closures Decommission or improve roads	Maintain effective stream buffers
	Instream wood		Add large wood to streams
Sediment	Landslides	Decommission or improve roads Locate and avoid unstable land	Maintain effective stream buffers
	Road surface erosion	Decommission or improve roads	Decommission or improve roads
	Stream crossing failures	Decommission or improve roads	Decommission or improve roads
	Stream bank erosion	Maintain canopy closures	Add large wood to streams
Flow	Bank erosion and channel scour	Maintain canopy closures	Add wood to streams
	Stream extension and road ditch lines	Decommission or improve roads	Decommission or improve roads
Stream Structure	Stream cleaning		Add large wood to streams
	Bank erosion and increased peak flows	Maintain canopy closures Decommission or improve roads	Apply silviculture treatments to maintain or enhance tree growth or diversity in riparian areas
	Riparian harvest		Apply silviculture treatments to maintain or enhance tree growth or diversity in riparian areas

Parameter 3. pH

Introduction/Listing Validation

The beneficial uses affected by pH are resident fish and aquatic life and water contact recreation. The Oregon water quality standard [OAR 340-41 – (basin) (2) (d)] that applies is:

> Summary: pH shall not fall outside the following ranges:
> General basin standards (adopted as of 1/11/96): Umpqua Basin: 6.5 to 8.5

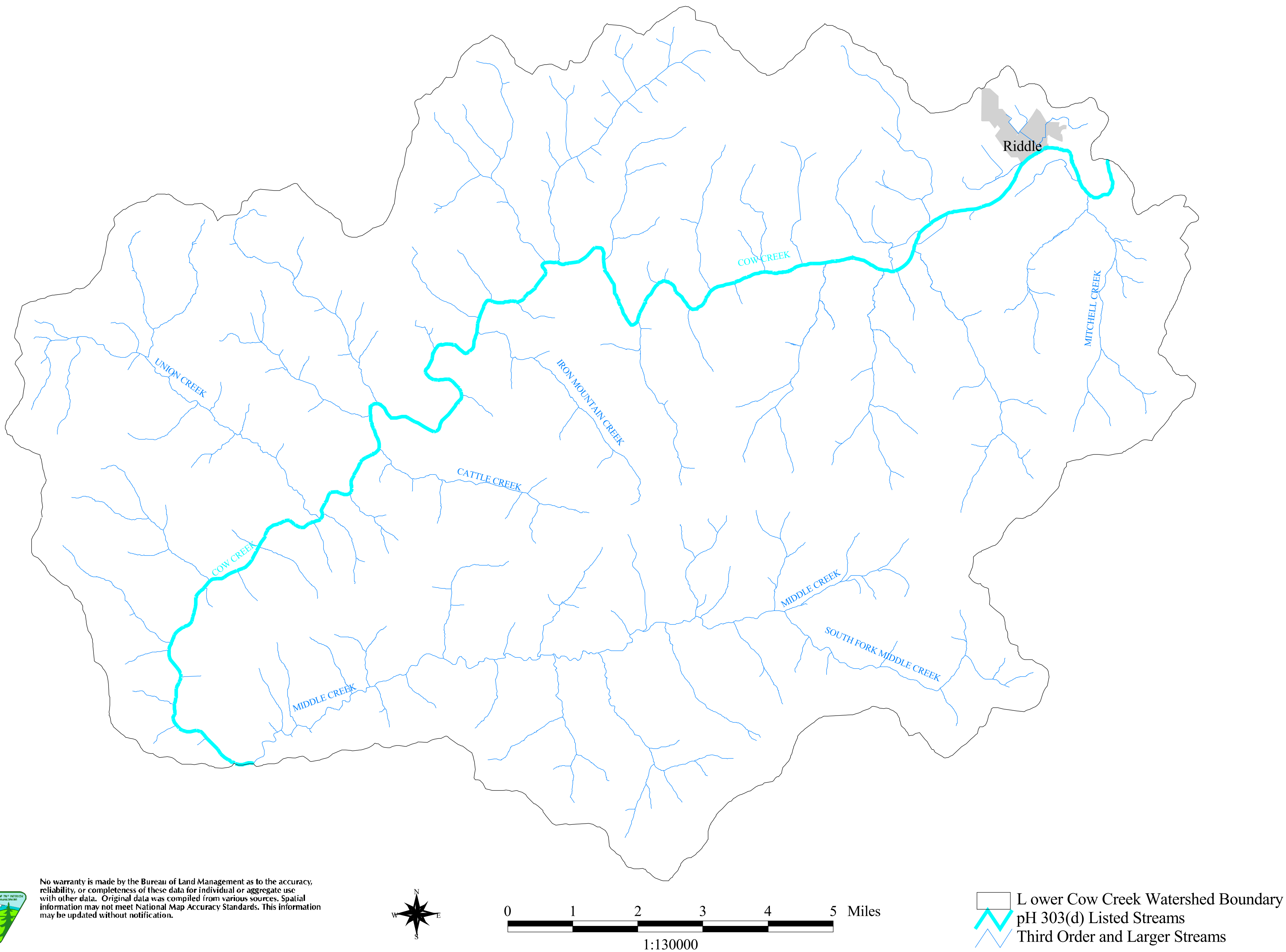
A stream may be listed as water quality limited if greater than ten percent of the samples exceed the standard and a minimum of at least two samples exceed the standard for a season of interest. The season of interest is from June 1 through September 30. Levels above or below the standard may have adverse effects on some life cycle stages of certain fish and aquatic macroinvertebrates (MacDonald et al. 1991).

Cow Creek within this watershed is listed because the pH was greater than 8.5 (see Figure 8). The listing is based on ODEQ and USGS data. Data collected on tributary streams by the BLM in 2000 did not exceed the pH standards (see Figure 9).

Many chemical and biological processes in a stream are affected by pH. The pH standards are the lower and upper limits that allows most aquatic species in western Oregon to survive. Values outside of the range (within which salmonid fish species evolved) may result in toxic effects to resident fish and aquatic life (Environmental Protection Agency 1986). When the pH falls outside of this range, stream diversity can decrease because the physiological systems of most aquatic organisms are stressed and reproduction may decline. However, the effects of elevated pH on wild fish in a natural system have not been determined.

Aquatic plants, in unpolluted rivers, use dissolved carbon dioxide during photosynthesis in the day and release carbon dioxide at night through respiration, which may cause the pH to fluctuate. The maximum pH value may reach 9.0 (Hem 1985). Algae accumulations can cause streams to become more alkaline. Photosynthesis during daylight hours consumes hydrogen ions and elevates pH. At night the pH decreases. On cloudy days or in shaded stream reaches not as much photosynthesis occurs and pH levels are lower.

Figure 8. Lower Cow Creek Watershed Streams on the 1998 303(d) List of Water Quality Limited Streams for Exceeding the pH Standard



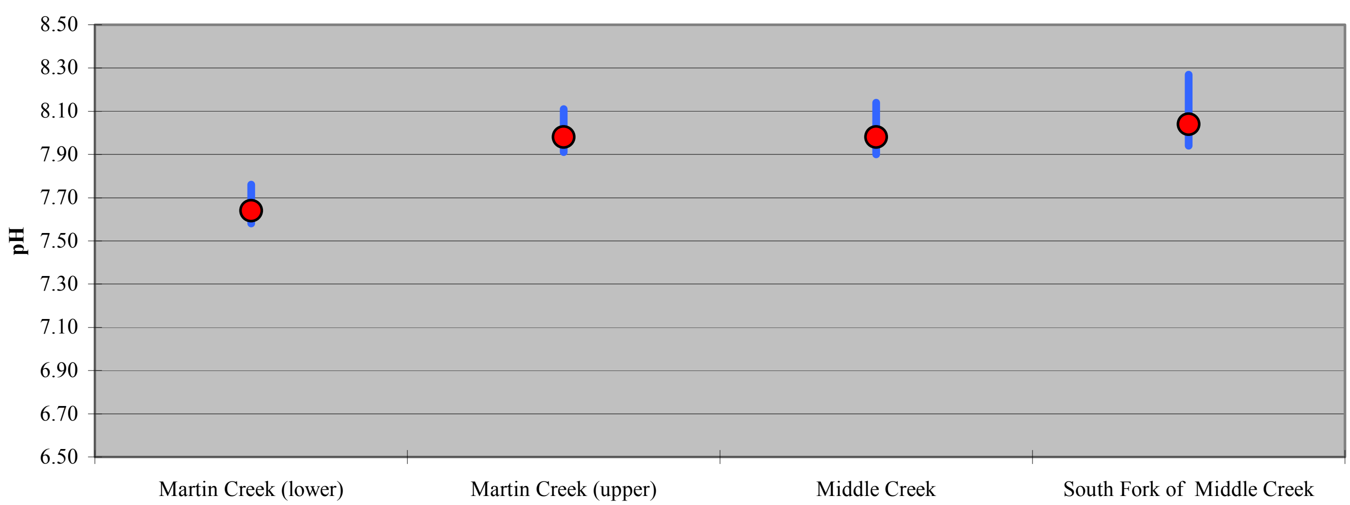
Conditions that promote higher pH by increasing algae growth and accumulation are: 1) lack of riparian shade allowing the sun to stimulate algae growth, 2) the presence of bedrock streambeds which is ideal habitat for algae and poor habitat for algae-eating aquatic insects, and 3) a nutrient supply. Conditions that promote lower pH are: 1) effective riparian shade, 2) streambeds with large wood and associated gravel/cobble substrate where algae-eating insects thrive, and 3) up slope forest stands that use nitrogen and store it in the soil and vegetation, so the nitrogen does not enter streams. Nutrient runoff into streams plays a primary role in increased algae and pH levels. Increased nutrients in streams have been reported following timber harvesting and road construction (MacDonald et al. 1991). Domestic livestock and agriculture are additional sources of nutrients.

Existing Data

Stream pH values are greatest in the afternoon, an indirect result caused by the consumption of carbon dioxide during photosynthesis (Stumm and Morgan 1981). Photosynthesis and aquatic plant growth follow annual and diurnal cycles. The highest pH values in the Lower Cow Creek Watershed measured by the BLM occurred on summer afternoons. The highest pH values correspond with periods of maximum photosynthesis. Conversely, pH values tend to be lower during the early morning hours and during the winter. Photosynthesis in dense algae mats can cause carbon depletion in the water by using dissolved carbon dioxide faster than it is produced.

Bureau of Land Management personnel deployed instruments at four locations to collect pH data every 30 minutes for two to four days during the summer of 2000. These data are summarized in Figure 9. The pH standard was not exceeded at the time of sampling. All sites were located on BLM managed lands.

Figure 9. Lower Cow Creek Watershed pH Data Collected in the Summer of 2000 by the Bureau of Land Management.



Possible Causes of High pH

High summertime stream pH values in Cow Creek probably result from algae growth due to the combined effects of inadequate shade, increased nutrient levels, increased channel scouring, a lack of LWD, and natural events or naturally high pH values.

Increased nutrient levels from forest management, agriculture, poorly sited or faulty septic systems, and sewage treatment system discharges promote algae growth and elevated pH levels. Chemical fertilizers applied to forest lands, agricultural fields, and residential yards may be nonpoint sources of nutrients. Although studies are being conducted, data are not available to determine the effects fertilizer application has on water quality.

High wintertime peak flows often scour streambeds, creating channel bottoms dominated by bedrock or large grained substrate, which algae prefers. Bedrock streambeds, which have been observed in Cow Creek, provide habitat and surface area for algae and is poor habitat for algae eating aquatic insects.

Channel simplification may also promote algae growth and accumulations. Timber harvesting along streams decreases the recruitment potential of large wood to the channel and floodplain. Decreased large woody debris recruitment can increase pH (Powell 1996). Large woody debris plays an important role in shaping stream channel complexity and bed form. Streams with a deficiency of LWD offer poor habitat for grazing macroinvertebrates that eat algae.

Natural processes that may increase stream pH include floods, fires, insect damaged vegetation, diseased vegetation, spent fish (after spawning), and wind throw in riparian areas. These natural processes affect stream pH by increasing the amount of nutrients entering the stream, increasing solar exposure, and scouring streambeds. River systems may also have naturally occurring high pH levels due to geology and the lack of connectivity between the floodplain and the riparian area, which may affect the buffering capacity of the riparian area.

Management Actions

Due to the relationship between stream shade, LWD, stream simplification, and elevated pH values restoration measures to address sedimentation and the water quality limited listing for temperature are also expected to improve elevated pH values (see Table 13). Restoration measures include:

- Improving or maintaining riparian vegetation growth to increase shade and meet target shade values, which will reduce photosynthetic chemical reactions and algal productivity and improve large wood recruitment potential.

- Decreasing sediment delivery to streams will help improve channel complexity.

- Decreasing the effects of roads on peak flows will reduce streambed scour and alluvial erosion.

- Placing large wood in tributaries of Cow Creek.

Parameter 4. Toxics

Introduction/Listing Validation

The beneficial uses affected by toxics are resident fish and aquatic life and drinking water. The Oregon water quality standards that apply are:

> Toxic substances shall not be introduced above natural background levels in the waters of the state in amounts, concentrations, or combinations which may be harmful, may chemically change to harmful forms in the environment, or may accumulate in sediments or bioaccumulate in aquatic life or wildlife to levels that adversely affect public health, safety, or welfare, aquatic life, wildlife, or other designated beneficial uses. Levels of toxic substances shall not exceed the criteria established by EPA and published in Quality Criteria for Water (EPA 1986), unless otherwise noted. Where no published EPA criteria exist for a toxic substance, public health advisories and other published scientific literature may be considered and used, if appropriate, to set guidance values [OAR 340-41-445(2)(p)].

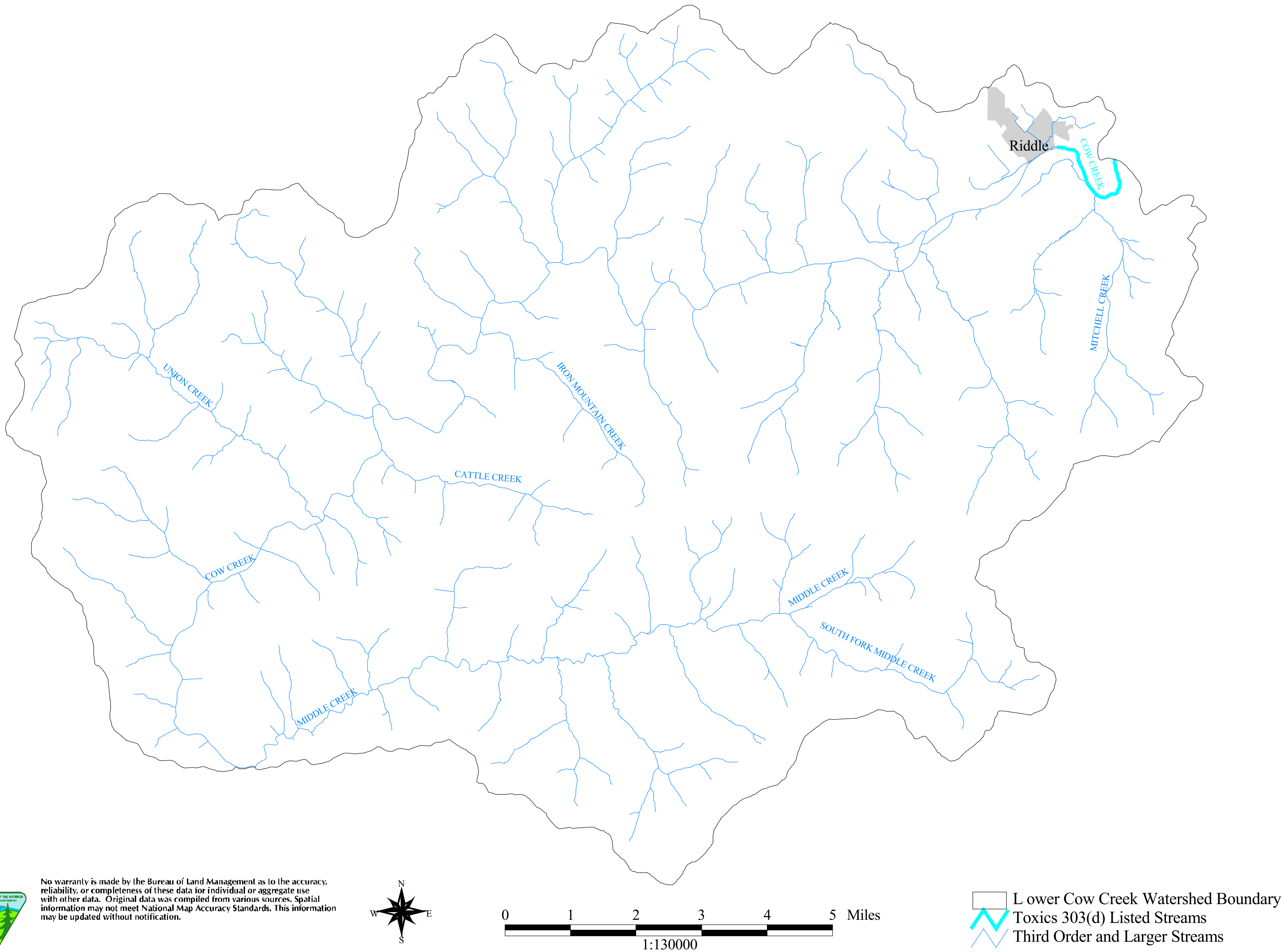
A stream is listed as water quality limited if the water quality standard for a chemical is exceeded more than ten percent of the time with a minimum of two values. Other evidence of beneficial use impairment include a fish or shellfish consumption advisory or recommendation issued by the Health Division for a specific chemical or the chemical has been found to cause a biological impairment by a field test of significance, such as a bioassay. The field test must involve comparison to a reference condition.

Cow Creek, from the mouth to Riddle, is on the water quality limited list for toxics (see Figure 10). The chlorine toxicity in Cow Creek is associated with the Riddle wastewater treatment plant discharge. Oregon Department of Environmental Quality data were used to place Cow Creek on the water quality limited list for toxics due to chlorine. The season of interest is June through April.

Management Actions

Management activities on BLM-administered land are not contributing to the chlorine toxicity in the Lower Cow Creek Watershed. Management actions to address other water quality limited listings in the Lower Cow Creek Watershed are being implemented.

Figure 10. Lower Cow Creek Watershed Streams on the 1998 303(d) List of Water Quality Limited Streams for Exceeding the Toxics Standard



Chapter 3 - Recovery Goals, Objectives, and Restoration Plan

Recovery goals and plans associated with this WQRP are designed to maintain components of the ecosystem currently functioning and improve sites showing the greatest potential for recovery in the shortest amount of time. This WQRP maximizes recovery while minimizing expensive and ineffective restoration treatments.

The objective of this plan is to prescribe activities to meet water quality standards, where they are not being met. When the water quality standards are met, beneficial uses for the Umpqua Basin under Oregon Administrative Rules (OAR) 340-41-362 will be protected.

The recovery of habitat conditions in the Lower Cow Creek Watershed is dependent, in part, on implementation of the Roseburg BLM District Resource Management Plan. However, since 61 percent of the watershed is privately owned, habitat recovery would require involvement by private owners in cooperative restoration plans. Recovery projects on Federally-administered lands will follow the NWFP Standards and Guidelines to meet the ACS objectives. This includes designating Riparian Reserves and conducting silvicultural activities to reach vegetative potential most rapidly. Some instream large woody debris placement may be beneficial where favorable channel and riparian conditions exist.

Restoration Plan to Achieve Objectives

The following NWFP Standards and Guidelines, summarized in Table 16, will be used to attain the goals of the Lower Cow Creek WQRP:

Stream Temperature - Shade

Aquatic Conservation Strategy - B-9 to B-11 and C-30 to C-38
Key Watersheds - B- 18 to B-20 and C-7
Riparian Vegetation - B-31
Riparian Reserves - B-12 to B-17 and ROD 9
Watershed Restoration - B-30 to B-34

Stream Temperature - Channel Form

Aquatic Conservation Strategy - B-9 to B-11 and C-30 to C-38
Key Watersheds - B-18 to B-20 and C-7
Riparian Vegetation - B-31
Riparian Reserves - B-12 to B-17 and ROD 9
Watershed Restoration - B-30 to B-34
Roads - B-31, C-32, and C-33
Instream Habitat Structures - B-31

Habitat Modification

Aquatic Conservation Strategy - B-9 to B-11 and C-30 to C-38
Key Watersheds - B-18 to B-20 and C-7
Riparian Vegetation - B-31
Riparian Reserves - B-12 to B-17 and ROD 9
Watershed Restoration - B-30 to B-34
Roads - B-19 and B-31 to B-33
Instream Habitat Structures - B-31

pH

Aquatic Conservation Strategy - B-9 to B-11 and C-30 to C-38
Key Watersheds - B18 to B-20 and C-7
Riparian Vegetation - B-31
Riparian Reserves - B-12 to B-17 and ROD 9
Watershed Restoration - B-30 to B-34

Toxics

Aquatic Conservation Strategy - B-9 to B-11 and C-30 to C-38

Adaptive Management, Review, Prioritization, and Revision

Monitoring will provide information whether Standards and Guidelines are being followed and actions prescribed in the WQRP are achieving the desired results. In addition to the monitoring identified in Chapter 4 of the WQRP, Resource Management Plan (RMP) monitoring occurs annually to assess implementation of Standards and Guidelines. Information obtained from both monitoring sources will determine whether management actions need to be changed. The monitoring plan will be evaluated periodically to assure the monitoring remains relevant and will be adjusted as appropriate.

Maintenance of Effort Over Time

In the 1994 Record of Decision, the Secretary of Agriculture and the Secretary of the Interior jointly amended current planning documents with the Land Use Allocations and Standards and Guidelines of the NWFP. The Roseburg District RMP incorporated the final Land Use Allocations and Standards and Guidelines. The RMP can be revised if resource or the management conditions change.

Assessing the Potential for Recovery of Water Quality

Recovery of riparian areas, stream channels, and aquatic habitat requires a base condition with adequate vegetation, channel form, and LWD to dissipate stream energy associated with high stream flows. The potential for recovery on BLM-administered lands will be assessed using watershed analysis and information stored on GIS as a first step in determining the feasibility of restoration and recovery.

Restoration in the Lower Cow Creek Watershed will be both active and passive (see Table 16). Growth of vegetation on floodplains is important to recovery. The overall goal is to improve pool frequency, large wood, riffle width/depth ratio, and riparian vegetation conditions from the present poor and fair ratings to fair and good ratings using the ODFW benchmarks. These conditions are used to determine if and when the stream is nearing its biological potential for supporting aquatic and riparian species, including anadromous and resident fish. These conditions and benchmarks should be validated with subsequent inventory and monitoring in the watershed. The goals would be refined to fit the range of conditions expected in the stream channels as more is learned about the watershed.

Table 16. Active and Passive Restoration in the Lower Cow Creek Watershed.

Element	Goals	Passive Restoration	Active Restoration
Temperature - Shade Component	Achieve maximum shading possible per segment. Margin of Safety: Recognize wildfire and flood effects on riparian vegetation.	Let riparian vegetation grow to reach potential.	Prescriptions to increase or maintain growth rates and insure long term health.
Temperature - Channel Form Component	Restore channel form, focusing on reducing width/depth ratios. Reduce sediment inputs to the stream channel. Increase wood-to-sediment ratio during mass failures.	Allow natural channel evolution to continue (time required varies with channel type). Allow historic mass wasting areas to re-vegetate. Maintain Riparian Reserves for slope stability. Maintain Riparian Reserves to provide potential large woody debris and slope stability.	Place large wood in streams to manipulate channel form. Minimize failures through stability review and land reallocation, if necessary. Retain large wood on unstable sites to increase wood-to-sediment ratio. Decommission, obliterate, or improve roads that are sediment sources. Reconstruct roads to reduce erosion, channel network extension, diversion potential, and accommodate a 100 year flood event. Increase or maintain growth rates and vegetation diversity in Riparian Reserves.
Habitat Modification	Increase size and number of large wood pieces in the channel. Restore channel form, focusing on reducing width/depth ratios and increasing the volume and frequency of pools. Restore channel and floodplain connections. Reduce sediment input to stream channels.	Allow large wood to remain in streams. Maintain Riparian Reserves to provide potential large woody debris. Allow natural channel evolution to continue. Maintain Riparian Reserves for slope stability.	Increase or maintain vegetation growth rates and diversity in Riparian Reserves. Place large wood in stream to manipulate channel form. Decommission, obliterate, or improve roads that are sediment sources. Reconstruct roads to reduce erosion, channel network extension, diversion potential, and accommodate a 100 year flood event.

Table 16. Active and Passive Restoration in the Lower Cow Creek Watershed.

Element	Goals	Passive Restoration	Active Restoration
pH	Reduce influences on pH fluctuation.	Maintain Riparian Reserves for stream shade and nutrient uptake. Allow large wood to remain in streams. Maintain Riparian Reserves to provide potential large woody debris.	Increase or maintain vegetation growth rates and diversity in Riparian Reserves. Place large wood in streams to manipulate channel form. Decommission, obliterate, or improve roads that are sediment sources. Reconstruct roads to reduce erosion, channel network extension, diversion potential, and accommodate a 100 year flood event.
Toxics.			Regularly pump contained sewage systems at designated recreation sites. Prevent herbicides from entering streams. Implement hazardous material BMPs on Federally-administered land.

Restoration Prioritization and Funding

Restoration funds received by the Roseburg BLM District are dependent on the amount of money appropriated each year. Restoration funds for activities on BLM-administered land are mostly available through the NWFP Jobs-In-The-Woods program. The District prioritizes projects based on if they are located in a Key Watershed and the resource benefits the project provides. The State Office evaluates the submitted projects and prioritizes the projects at the State level using similar criteria.

Part of the Lower Cow Creek Watershed is a key watershed and is a high priority watershed for restoration. The Roseburg BLM District will seek funds for implementing and monitoring components of this WQRP as a high priority. However, due to the limitations of the Federal budget process, the funds cannot be guaranteed. As part of the Clean Water Action Plan, the State of Oregon began an interagency effort that identifies high priority watersheds in need of restoration and protection as part of the Unified Watershed Assessment. It is possible that funding associated with the Clean Water Action Plan could be pursued to carry out protection and restoration actions in the Lower Cow Creek Watershed. Efforts will be made to apply for grants under the Clean Water Action Plan and Oregon Watershed Enhancement Board (OWEB).

Another potential funding source, starting in Fiscal Year 2001, is Douglas County funds received through section 103 of the "Secure Rural Schools and Community Self-Determination Act of 2000" (P.L. 106-393). Title II of the Act allows the County to spend a significant portion of these funds for restoration projects on Federal and non-Federal lands.

Recovery to Full Physical and Biological Potential

Current stream and riparian habitat conditions in the Lower Cow Creek Watershed are discussed in previous sections. Even if changes in land management practices and comprehensive restoration are initiated, it is possible that all degraded aquatic systems will not completely recover within the next 100 years (USDA et al. 1993). It is estimated recovery of aquatic habitat conditions to full biological potential in this watershed will take more than 100 years. The estimate accounts for some variability in recovery based on current aquatic and riparian conditions and natural foreseeable events (floods or fires).

Many interrelationships exist between riparian and floodplain vegetation, summer stream temperatures, sediment storage and routing, and the complexity of habitats in the Lower Cow Creek Watershed. Large mature conifers or hardwoods would continue to be rare on private lands, particularly agricultural lands, within the watershed unless major changes in land uses or land use regulations occur. These agricultural lands include streams with low gradients that have a high biological potential for salmon. Improving or maintaining the number of large trees on upstream public lands would not directly benefit the habitat on private lands but would have indirect impacts, such as decreased sediment delivery and cooler stream temperatures.

Generally, in transport or steeper reaches of the watershed, the aquatic and riparian habitats are in fair to good condition. Downstream, in lower gradient stream reaches, aquatic and riparian habitat is in poor to fair condition. The low gradient reaches are generally not located on Federally-administered lands.

Stream shade will recover quicker than the aquatic habitat. The aquatic habitat and sediment storage and routing in the channel will recover to an optimum range of conditions with the maturation of riparian trees. A mature riparian forest will provide shade, increase bank and channel stability, decrease channel width, and increase pool depths. Lower summer water temperatures and higher quality habitat conditions for salmonids will be created by the maturation of riparian forests, addressing road related problems, and reduced amount of timber harvesting on BLM-administered under the NWFP.

Margin of Safety

The Clean Water Act requires a margin of safety (MOS). A margin of safety is to account for uncertainty in available data or in the actual effect activities will have on load reductions and water quality.

Assumptions

Natural Fire Disturbance

The Lower Cow Creek Watershed has a variable fire history. Generally, the lower elevations burned more frequently than the higher elevations of the watershed. Recovery of riparian vegetation in areas disturbed by fire and flood may be interrupted by future events. This is a conservative assumption that does not account for fire suppression as a management tool. Fire suppression has reduced the number of acres burned by wildfire in riparian areas.

Channel Form Recovery

Stream habitat surveys, conducted by ODFW, measured channel widths in the Lower Cow Creek Watershed. Increased channel widths are probably contributing to elevated stream temperatures. Channel recovery was not considered when projecting shade recovery values. Narrower channels will allow stream temperatures to decrease. Restoration activities will also lead to channel recovery by decreasing the amount of sediment entering streams. Improved pool frequency conditions will help restore the groundwater and floodplain connection and increase the groundwater and stream interaction with an expected increase in cool water refugia. Increased amounts of LWD will reduce flow velocity and bed and bank shear stress. Increased channel stability and bank building processes will help restore channel width/depth conditions. The improved temperatures and channel widths were not included in the shade recovery values.

Wind Speed

Wind speed is one of the controlling factors for evaporation, which is another stream cooling process. The shade recovery targets do not account for any cooling from evaporation due to wind speed.

Riparian Restoration

Riparian restoration will increase storage capacity for subsurface and groundwater inflow. Two benefits that have not been included in the shade recovery values are groundwater inflow cooling stream temperatures directly by the mass transfer of energy and groundwater inflow increasing streamflow and maintaining stream temperatures.

Timber Harvesting on Private Land

Sixty-one percent of the watershed is privately owned. Some of the private lands are managed for timber production. Because of the lack of information, shade recovery was not determined on private lands. The assessment of private lands in this watershed is beyond the scope of this WQRP. The WQMP prepared by ODEQ will decide how to determine the shade recovery expected, as well as, the site potential for recovery on private lands. While Standards and Guidelines on Federally-administered land establish wider stream shade buffers than the Oregon Forest Practices Act, the Oregon Forest Practices Act guidelines do offer some stream shade protection.

A statewide demonstration of the Oregon Forest Protection Act's ability to protect water quality is expected to address the specific parameters affected by forest management practices (temperature, sediment and turbidity, aquatic habitat modification, and biological criteria). The schedule and other requirements for addressing these parameters are included in the ODEQ/ODF Memorandum of Understanding (MOU) of May 16, 1998.

Riparian Reserves

The Standards and Guidelines for Riparian Reserve widths on fish bearing streams are used to protect fish habitat and other riparian dependent species and resources. The additional protection for the other species and resources provides an additional margin of safety for fish and stream protection.

Chapter 4 - Monitoring Plan

The NWFP provides the framework[1] to accommodate a nesting of geographic scales (region, province, subbasin, watershed, and site) in a manner that allows localized information to be compiled and summarized in a broader context. Monitoring at all scales should:

- Detect changes in ecological systems from both individual and cumulative management actions and natural events
- Provide a basis for natural resource policy decisions
- Provide standardized data
- Compile information systematically
- Link overall information management strategies for consistent implementation
- Ensure prompt analysis and application of data in the adaptive management process
- Distribute results in a timely manner

The NWFP monitoring provides a framework for three types of monitoring (implementation, effectiveness, and validation) to meet objectives and evaluate the efficacy of management practices. The Roseburg BLM Resource Management Plan (RMP) contains a monitoring plan that addresses implementation, effectiveness, and validation monitoring. It includes statements of expected future conditions and outputs along with key questions and specific monitoring requirements (USDI 1995, page 84 and Appendix I, page 189).

Implementation monitoring is meant to ensure that management actions are following the prescribed management direction. The Roseburg District Annual Program Summary and Monitoring Report tracks how management actions are being implemented according to standard and guidelines. It also outlines the progress of watershed restoration work. Roseburg BLM produces this document yearly and it shows the success and progress of implementing water quality related objectives.

Effectiveness monitoring answers the question of whether or not prescribed management actions meet the desired objectives. For aquatic and riparian objectives (including water quality) this will provide the necessary information to evaluate natural conditions, ranges, and distributions of water quality parameters and watershed processes, and the dominant processes determining their distribution and trends. Inventory and monitoring will help identify sources and causal factors for water quality and watershed condition. The goal is to improve prescribed management actions and achieve the goals of the standards and guidelines. If results of monitoring indicate existing management practices are not achieving water quality objectives, plan amendments may be written to provide for new actions. The amendment process includes programmatic compliance with NEPA and other environmental laws.

Validation monitoring, the testing of basic assumptions, will be accomplished through formal research. The Roseburg District could be involved in some of this research but most likely would defer to larger scale efforts.

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[1] Final Supplemental Environmental Impact Statement, Appendix I

The NWFP calls for an interagency monitoring network using a common design framework and common indicators. The Aquatic/Riparian Effectiveness Monitoring Plan (AREMP), which was approved March 12, 2001 and published in 2003 (Reeves et al. 2003) is a broad based tool spanning the NWFP area for meeting this need. The Aquatic/Riparian Effectiveness Monitoring Plan will provide information in a decade or more at the province scale. In the adaptive management process, adjustments would take place as the result of feedback from action-based planning, monitoring, researching, and evaluation.

Key questions from the effectiveness and validation monitoring section of the Roseburg RMP provide a framework to address water quality and aquatic issues (USDI 1995, Appendix I, pages 191, 196, and 198). These questions are valid for the life of the RMP however they would need to be revisited if a new planning document were adopted. The following are a sample of monitoring questions that could be answered through AREMP or by other means initiated by the Roseburg District:

- Is the health of Riparian Reserves improving?
- Are the management actions that are designed to rehabilitate Riparian Reserves effective?
- Are State water quality criteria being met? When State water quality criteria are met, are the beneficial uses of riparian areas protected?
- Are prescribed Best Management Practices maintaining or restoring water quality consistent with basin specific State water quality criteria for protection of specified beneficial uses?
- Is the ecological health of the aquatic ecosystems recovering or sufficiently maintained to support stable and well-distributed populations of fish species and stocks?
- Is fish habitat in terms of quantity and quality of rearing pools, coarse woody debris, water temperature, and width to depth ratio being maintained or improved as predicted?
- Are desired habitat conditions for listed, sensitive, and at-risk fish stocks maintained where adequate, and restored where inadequate?

The Roseburg District is developing a water quality/aquatics monitoring strategy. This strategy will provide the framework for how to answer monitoring questions, what tools to use for answering these questions, as well as for coordinating with other agencies within the Umpqua Basin to monitor aquatic and riparian issues. The AREMP may be incorporated into this strategy for answering some of the above questions and providing feedback for changes in management. Completion of this strategy is expected sometime in 2004.

Over the last several years the Roseburg District has cooperated with ODEQ, ODFW, and the Umpqua Basin Watershed Council in monitoring efforts. The following is a summary of the types of monitoring completed over the last several years:

- Stream Temperature – Approximately 150 Sites
- Macroinvertebrate Sampling - Approximately 20 Sites
- Riparian and Stream Condition Classification – 50 to 100 Stream Miles

The Roseburg District will continue to cooperate with these types of efforts and with other agencies as needed. The Roseburg District monitoring strategy will guide future monitoring efforts.

References

Beschta, R. L. and J. Weatherred. 1984. A Computer Model for Predicting Stream Temperatures Resulting From the Management of Streamside Vegetation. USDA Forest Service. WSDG-AD-00009.

Brown, G. W. 1972. An Improved Temperature Model for Small Streams. Water Resources Research Institute Report 16. Oregon State University. Corvallis, OR.

Brown, G. W. 1983. Forestry and Water Quality. Chapter 3. Water Temperature. Oregon State University. Corvallis, OR. pp. 47-57.

Dolloff, C. A. 1986. Effects of Stream Cleaning on Juvenile Coho Salmon and Dolly Varden in Southeast Alaska. Transactions of the American Fisheries Society 115:743-755.

Dose, J. J. and B. B. Roper. 1994. Long Term Changes in Low-flow Channel Widths Within the South Umpqua Watershed, Oregon. Water Resources Bulletin 30(6):993-1000.

Environmental Protection Agency. 1986. Quality Criteria for Water. No. 440/55-86-001.

Harrelson, C. C., C. L. Rawlins, and J. P. Potyondy. 1994. Stream Channel Reference Sites: An Illustrated Guide to Field Technique. Gen. Tech. Rep. RW-245. Fort Collins, CO. USDA, Forest Service, Rocky Mountain Forest and Range Experiment Station.

Hem, J. D. 1985. Study and Interpretation of the Chemical Characteristics of Natural Water. United States Geological Survey. Water-Supply Paper 2254. 263 pp.

Johnson, S. L. and J. A. Jones. 2000. Stream Temperature Responses to Forest Harvest and Debris Flows in Western Cascades, Oregon. Can. J. Fish. Aqua. Sci. 57(Suppl. 2):30-39.

Lee, R. 1980. Forest Hydrology. Columbia University Press, New York. 349 pp.

Lisle, T. E. and S. Hilton. 1992. The Volume of Fine Sediment in Pools: An Index of Sediment Supply in Gravel-bed Streams. Journal of the American Water Resources Association. April Edition Paper No. 2. pp. 371-383.

MacDonald, L. H., A. W. Smart, and R. C. Wissmar. 1991. Monitoring Guidelines to Evaluate Effects of Forestry Activities on Streams in the Pacific Northwest and Alaska. United States Environmental Protection Agency. EPA 910/9-91-001.

Meehan, W. R., editor. 1991. Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. American Fisheries Society. Special Publication 19. Bethesda, Maryland.

Montgomery, D. R. and J. M. Buffington. 1993. Channel Classification, Prediction of Channel Response and Assessment of Channel Condition.

Oregon Department of Environmental Quality. 1998. 303(d) List of Water Quality Limited Waterbodies. State of Oregon. Portland, Oregon.

Oregon Department of Environmental Quality. 1998b. Listing Criteria for Oregon's 1998 303(d) List of Water Quality Limited Water Bodies.

Oregon Department of Environmental Quality. 2000. Removal Assessment Formosa Abandoned Mine Land Site Douglas County, Oregon. Available from the U.S. Bureau of Land Management, Roseburg District, Roseburg, Oregon.

Park, C. 1993. Shadow v.2.3: Stream Temperature Management Program. USDA Forest Service. Pacific Northwest Region. Portland, Oregon. 20 pp.

Powell, M. A. 1996. Steamboat Creek Water Quality Study. Colliding Rivers Research, Inc. Corvallis, OR.

Reeves, Gordon, D. Hohler, D. Larsen, D. Busch, K. Kratz, K. Reynolds, K. Stein, T. Atzet, P. Hays and M. Tehan. 2003. Aquatic and Riparian Effectiveness Monitoring Plan for the Northwest Forest Plan. Gen. Tech. Rep. PNW-GTR-577. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 70 p.

Stumm, W. and J. J. Morgan. 1981. Aquatic Chemistry. 2nd edition. John Wiley, New York.

State of Oregon. 1997. The Oregon Plan – Coastal Salmon Restoration Initiative. Salem, Oregon.

USDA Forest Service, USDC National Oceanic and Atmospheric Administration, USDC National Marine Fisheries Service, USDI Bureau of Land Management, USDI Fish and Wildlife Service, USDI National Park Service, and Environmental Protection Agency. 1993. Forest Ecosystem Management: An Ecological, Economic, and Social Assessment. Report of the Forest Ecosystem Management Assessment Team. (FEMAT).

USDA Forest Service and USDI Bureau of Land Management. 1994. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl. Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl.

USDA Forest Service, USDI Bureau of Land Management, and EPA Environmental Protection Agency. 1999. Forest Service and Bureau of Land Management Protocol for Addressing Clean Water Act Section 303(d) Listed Waters. USDA Forest Service. Pacific Northwest Region. Portland, Oregon.

USDI Bureau of Land Management. 1995. Roseburg District Record of Decision and Resource Management Plan. Roseburg, Oregon.

USDI Bureau of Land Management and USDA Forest Service. 1998. South Coast-Northern Klamath Late-Successional Reserve Assessment. Coos Bay, Roseburg, Medford, and Florence, Oregon.

USDI Bureau of Land Management. 2000. Formosa Abandoned Mine Land Site Remedial Investigation. South River Field Office. Roseburg, Oregon.

USDI Bureau of Land Management. 2001. Lower Cow Creek Watershed Analysis. South River Field Office. Roseburg, Oregon.

Wellman, R. E., J. M. Gordan, and R. L. Moffatt. 1993. Statistical Summaries of Streamflow Data in Oregon: Volume 2– Annual Low and High Flow, and Instantaneous Peak Flow. United States Geological Survey. Open-File Report 93-63. Portland, Oregon. 406 pp.