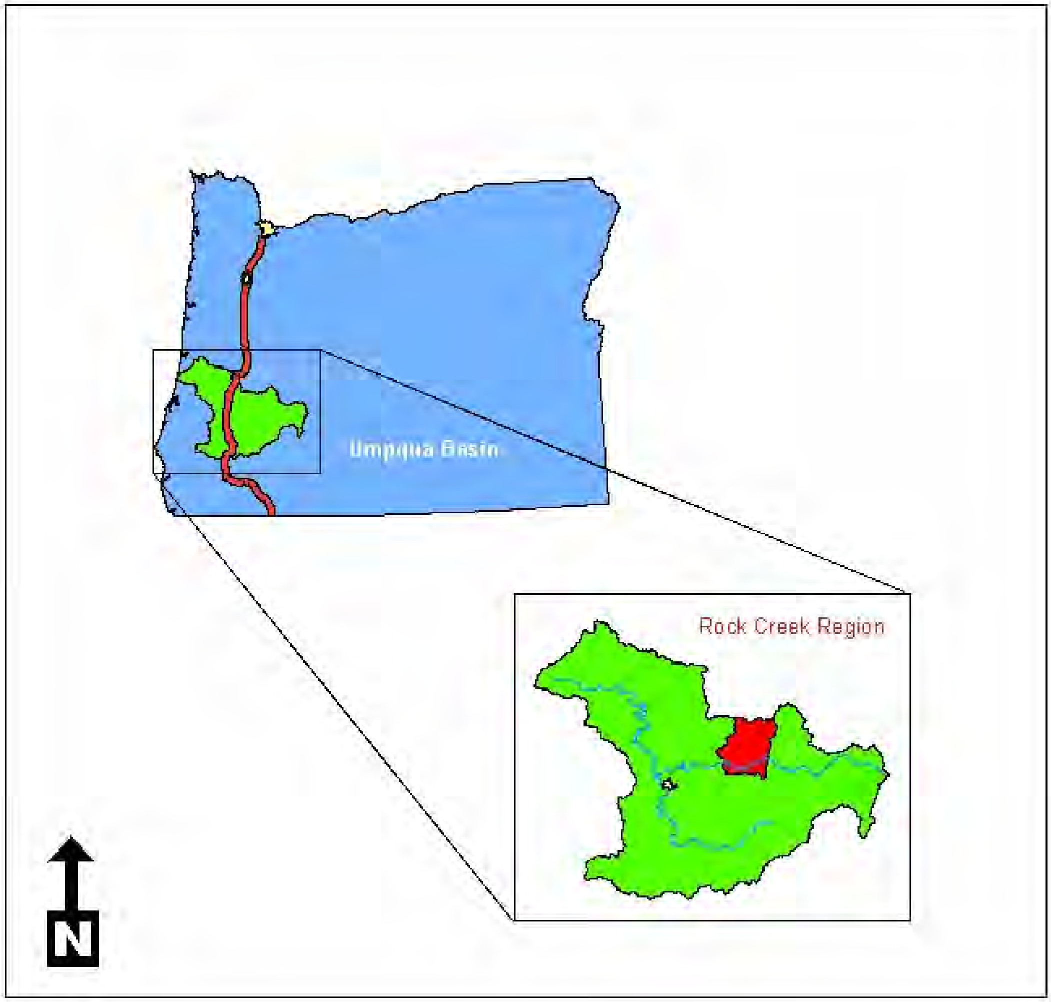
Rock Creek Region

Assessment and Action Plan



Prepared by Lisa A. Winn for the

Umpqua Basin Watershed Council

Roseburg Bureau of Land Management

March, 2006

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Acronym List

BLM	Bureau of Land Management
Cfs	Cubic feet per second
DFPA	Douglas Forest Protective Association
GIS	Geographic information system
NTU	Nephelometric turbidity units
ODEQ	Oregon Department of Environmental Quality
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish and Wildlife
OWEB	Oregon Watershed Enhancement Board
OWRD	Oregon Water Resources Department
TMDL	Total maximum daily load
TSZ	Transient snow zone
UBFAT	Umpqua Basin fish access team
UBWC	Umpqua Basin Watershed Council
UNF	Umpqua National Forest
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
USFS	United States Forest Service
USGS	United States Geological Survey
WAB	Water availability basin

Forward

We often hear the term "watershed" these days. We all live within a watershed. Fish habitat and water quality can be affected by the watershed's condition and by the activities within it. All of us depend upon the water that flows from our watershed. But what exactly is a watershed?

A watershed is the area of land where all surface and groundwater drains into the same body of water, such as a river, wetland, or the ocean. Watersheds can be many millions of acres like the Colombia River Basin, or less than a dozen acres for a single small stream. Since the term "watershed" can be used for drainage areas of any size, the US Geological Survey (USGS) has divided watersheds into distinct units, or "fields," based on size. Sizes range from multi-million acre first-field watersheds to seventh-fields that can be less than 3,000 acres.

For this assessment, the most important fields are third-field and fifth-field watersheds.[1] Third-field watersheds are large river basins. The Umpqua River Basin includes the South, North, and main Umpqua Rivers, as well as Smith River, and has roughly the same boundary as Douglas County. Third-field watersheds are usually referred to as "basins," and in this document "basin" will be used to refer to the Umpqua Basin third-field watershed. Fifth-field watersheds have become the standard size used for research and projects by a variety of agencies and organizations. Therefore, it is convenient for fifth-field watershed to be the unit usually referred to herein by the term "watershed." Watersheds are around 40,000 to 120,000 acres, and there are 33 fifth-fields in the Umpqua Basin.

Although the borders of the watersheds are standardized, the names are not. Different organizations and agencies may call the watersheds by different names, but, in general, all watersheds are named for the creek or the section of stream into which all tributaries drain.[2] For example, the Rock Creek Watershed includes all land that drains into Rock Creek or its tributaries. A very large stream, such as the North Umpqua River, is usually separated into multiple fifth-field watersheds.

All watersheds have their own features, challenges, and potential. The conditions in one watershed may not reflect the conditions in a neighboring watershed. This assessment evaluates the unique past, present, and potential future conditions of the Rock Creek Region in terms of fish habitat and water quality. The Rock Creek Region is composed of two complete fifth-field watersheds (Rock Creek and Canton Creek) and approximately half of a third fifth-field watershed (Middle North Umpqua).

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[1] Fourth-field watersheds refer to sub-basins. Just as there are three main rivers in the Umpqua Basin, there are also three fourth-field watersheds, or sub-basins: the Umpqua River fourth-field watershed, the North Umpqua River fourth-field watershed, and the South Umpqua River fourth-field watershed.

[2] When one watershed does not encompass the entire drainage area, such as with a river or large creek, names reflect the relative location of the watershed along the mainstem. Upper North Umpqua would be near the headwaters of the North Umpqua River, while Middle North Umpqua is in the middle of the North Umpqua River drainage.

1. Introduction

The introduction provides a general description of the watersheds in terms of their natural and human-made features, ownership and current land uses, and the communities within and adjacent to the watersheds. Information in Sections 1.2 and 1.3 was compiled from the *Oregon Watershed Assessment Manual* (Watershed Professionals Network, 1999), the *North Umpqua Watershed Analysis Synthesis Report,* (Stillwater Sciences, 1998), *Middle North Umpqua Watershed Analysis* (USDI Bureau of Land Management, 2001), the *Middle North Umpqua Watershed Analysis* (USFS North Umpqua Ranger District, 2001), the *Canton Creek Watershed Analysis* (USDI Bureau of Land Management, 1995a) and the *Rock Creek Watershed Analysis* (USDI Bureau of Land Management, 1996). Additional information is from the following sources' databases: The Oregon Climate Service, the US Census Bureau, and the Douglas County Assessor.

<u>Key Questions</u>

- What is the Umpqua Basin Watershed Council?
- What is the purpose of the watershed assessment and action plan document?
- How was the watershed assessment developed?
- Where are the watersheds of the Rock Creek Region and what are their defining characteristics?
- What are the demographic, educational, and economic characteristics of the Rock Creek Region residents and nearby communities?
- What are land ownership, use, and parcel size characteristics within the Region?

1.1. Purpose and development of the assessment

1.1.1. The Umpqua Basin Watershed Council

The Umpqua Basin Watershed Council (UBWC) is a non-profit, non-government, non-regulatory charitable organization that works with willing landowners on projects to enhance fish habitat and water quality in the Umpqua Basin. The council has its origins in 1992 as the Umpqua Basin Fisheries Restoration Initiative (UBFRI) and was changed to the UBWC in May of 1997. Three years later, the council was incorporated as a non-profit organization. The UBWC's 17-member Board of Directors represents resource stakeholders in the Umpqua Basin. The board develops localized and basin-wide fish habitat and water quality improvement strategies that are compatible with community goals and economic needs. Activities include enhancing salmon and trout spawning and rearing grounds, eliminating barriers to migratory fish, monitoring stream conditions and project impacts, and educating landowners and residents about fish habitat and water quality issues in their areas. Depending on the need, the UBWC will provide direct assistance to individuals and groups, or coordinate cooperative efforts between multiple partners over a large area.

1.1.2. The Bureau of Land Management

The Roseburg office of the Bureau of Land Management (BLM) is responsible for management of the BLM public lands within the Rock Creek Region. The BLM and US Forest Service management within the Rock Creek Region follow the guidelines of the 1994 Northwest Forest Plan. In compliance with this policy, the Roseburg BLM's District Office developed a Record of Decision and Resource Management Plan in 1995. All of the BLM's activities are guided by the resource management plan. The BLM is currently in the early stages of updating the 1995 Resource Management Plan (see Section 4.2.4 for more information).

Within the Umpqua Basin, BLM-administered lands and privately-owned lands are arranged in a checkerboard pattern. Due in part to this mixed pattern of ownership, the BLM works closely with both private landowners and the UBWC to implement restoration activities that affect fish habitat and water quality across ownerships. The Roseburg BLM does watershed analyses to help guide its management activities. It previously completed watershed analyses in all three of the watersheds within the Rock Creek Region. The analyses for the Rock Creek and Canton Creek watersheds were finished in 1996 and 1995, respectively, while the Middle North Umpqua Watershed Analysis was completed more recently in 2001. Watershed conditions are not static and assessments from the mid 1990s are somewhat outdated. For this reason, the BLM has become a partner in this watershed assessment to meet their needs of updating watershed analyses and targeting the needs for restoration within the Rock Creek Region watersheds. Its contribution to this assessment has included both technical inputs from a variety of natural resource specialists, data, and GIS support.

The BLM goals for watershed analysis extend beyond those of the UBWC. It has a broader need to understand terrestrial conditions outside the scope of the UBWC's mission and restoration activities. The BLM's needs within the assessment include more thorough analyses of resource areas not covered in this initial assessment such as botany and wildlife. However, the UBWC timeline for completion of this assessment could not be met by the BLM resource staff, due in part to their current work to update the 1995 Resource Management Plan. For this reason, the Roseburg BLM anticipates amending this assessment at a future date with additional information to meet their management needs for these watersheds.

1.1.3. The assessment and action plan

The Rock Creek Region Assessment has two goals:

1) To describe the past, present, and potential future conditions that affect water quality and fish habitat within the Rock Creek Region; and
2) To provide a research-based action plan that suggests voluntary activities to improve fish habitat and water quality within the Region.

The action plan developed from findings in Chapter Three is a critical component of the assessment. The subchapters include a summary of each section's key findings and a list of action recommendations developed by UBWC and BLM staff, landowners, and restoration specialists. Chapter Six is a compilation of all key findings and action recommendations and includes a summary of potential UBWC and BLM Rock Creek Region enhancement opportunities. Activities within the action plan *are suggestions for voluntary projects and programs*. The action plan should not be interpreted as landowner requirements or as a comprehensive list of all possible restoration opportunities.

1.1.4. Assessment development

This document is the product of a collaborative effort between the UBWC, Roseburg Bureau of Land Management (BLM), Oregon Department of Fish and Wildlife (ODFW), Umpqua National Forest (UNF), and Rock Creek Region residents, landowners, and stakeholders. Consultants working for the UBWC and BLM resource staff assembled information about each assessment topic and compiled the data into graphic and written form.[3] Landowners and other interested parties met with Lisa Winn, consultant for the UBWC, to review information about the Rock Creek Region and offer comments and suggestions for improvement.

Landowners and residents met for seven meetings and one field trip from November, 2004, through January, 2006. A total of 53 people attended one or more meetings and the field trip, with an average of 11.8 participants per meeting. Meeting participants included ranchers, family forestland owners, industrial timber company employees, city officials, city residents, and resource management agency personnel.

A fish summit meeting was held on November 1, 2005 with the goal of identifying limiting factors to fish and prioritizing possible restoration projects to improve fish habitat in the Region. Participants included fish biologists, hydrologists, and other resource professionals with specific knowledge of the area from six different agencies. Results from that meeting are incorporated throughout this assessment. Refer to Appendix 7 for a summary of that meeting.

1.2. Region description

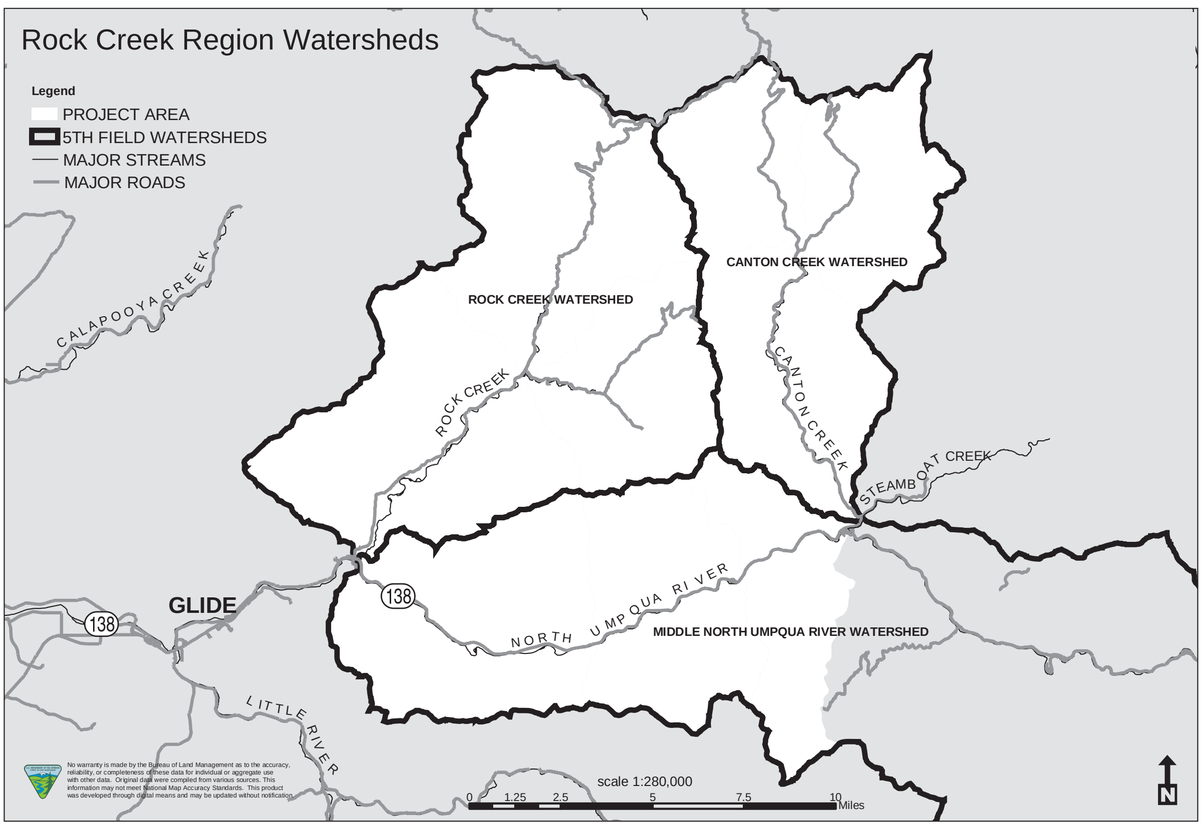
1.2.1. Location, size, and major features

The Rock Creek Region includes the Rock Creek Watershed, Canton Creek Watershed, and just under half of the Middle North Umpqua Watershed. All three of these are fifth-field watersheds. There are three sub-watersheds (sixth-field watersheds) within the west half of the Middle North Umpqua Watershed that are part of this assessment. These sub-watersheds include Susan Facial, Blitzen Facial, and Williams Facial. The assessed area extends along the North Umpqua River from the confluence of Rock Creek to just below where it is joined by Steamboat Creek (see Map 1-1). The remaining five sub-watersheds within the Middle North Umpqua Watershed that are not included in this assessment are almost entirely comprised of public land managed by the Umpqua National Forest. The UBWC does not assess watersheds that are entirely under federal management, but instead focuses on areas with private land. For this reason, only the western half of the Middle North Umpqua Watershed is included in this assessment. Although this

[3] Unless otherwise indicated, all text, tables, maps, and figures were developed by UBWC consultants Lisa Winn and Heidi Kincaid and by BLM staff members Craig Ericson, Trixy Moser, and Gary Passow.

assessment does not include the entire watershed, the assessed portion of the Middle North Umpqua Watershed will be referred to as the "Middle North Umpqua Watershed" throughout the text for purposes of readability.

The entire region is 154,215 acres located mostly in Douglas County, Oregon, with a smaller northeast portion of the Canton Creek Watershed in Lane County. The Region stretches a maximum of 20 miles north to south and 19.8 miles east to west (see Map 1-1). There are no population centers within the Rock Creek Region. The unincorporated town of Glide and the residential area of Idleyld Park are located west of the Region. The nearest city is Roseburg, located 21 miles west of the Rock Creek Region. Highway 138 bisects the Middle North Umpqua Watershed from east to west and crosses through the Cascades to Roseburg where it continues north and then west to Highway 38 in Elkton. Rock Creek Road (county road 78) branches north from the highway along Rock Creek (turning into BLM road 26-3-1) and Canton Creek Road (BLM road 25-1E-31) follows north along Canton Creek originating from the Steamboat Creek Road (Forest Service road 3803) near its intersection with Highway 138.



Map 1-1: Location of the Rock Creek Region.

1.2.2. Ecoregions

Ecoregions are areas with similar type, quality, and quantity of environmental resources, including landscape, climate, vegetation, and human use.[4] Ecoregion information is not specific to an individual watershed and is too general for the purposes of this assessment. However, ecoregions are useful because they give a general description of the area based on natural characteristics rather than on political boundaries or township, ranges, and sections. The Rock Creek Region falls almost entirely within the Umpqua Cascades Ecoregion; only two percent of the Canton Creek Watershed is classified as the Western Cascades Montane Highlands Ecoregion. For general landscape descriptions of the Rock Creek Region, the Umpqua Cascades Ecoregion information is used to supplement other data.

1.2.3. Topography

Highly dissected mountains with deep, "V" shaped valleys characterize the Umpqua Cascades Ecoregion. Stream channels are usually moderate to high gradient, and stream density is high.

In the Rock Creek Region, slopes along the lower portions of Rock Creek, Canton Creek, and the North Umpqua River mostly range from 5 to 35 percent with the exception of some steeper ground (35 to 70 percent) along lower portions of Canton Creek. Further upstream on both Rock Creek and the North Umpqua River, slopes increase to include many areas well over 85 percent. Upland area slopes vary greatly by sub-watershed with the steepest concentrated sections along the upper Northeast Fork and East Fork of Rock Creek and in the Williams Creek and Fairview Creek sub-watersheds within the northeast portion of the Middle North Umpqua Watershed (see Map 1-2).

The elevation ranges from 745 feet to 4,854 feet. The lower elevations occur along the North Umpqua River and near the mouth of Rock Creek. The highest elevations occur in four areas: Chilcoot Mountain along the eastern boundary of the Canton Creek Watershed, Huckleberry Mountain above the headwaters of Northeast Fork Rock Creek, Old Fairview and Mace Mountain along the ridge between the Rock Creek and Middle North Umpqua watersheds, and Willow Flats in the southeast portion of the Region (see Map 1-3). In the Rock Creek Region, 74 percent of the land base is above 2,000 feet. Areas between 2,000 and 5,000 feet in elevation are known as the transient snow zone (TSZ). These areas have a higher potential of rain falling on accumulated snow causing rapid melting and water run off. These events, known as "rain-on-snow" events, can cause higher peak flows and increase the potential for landslides and surface erosion. (See Sections 3.3.7 and 3.4.3 for more information on landslides and peak flows.)

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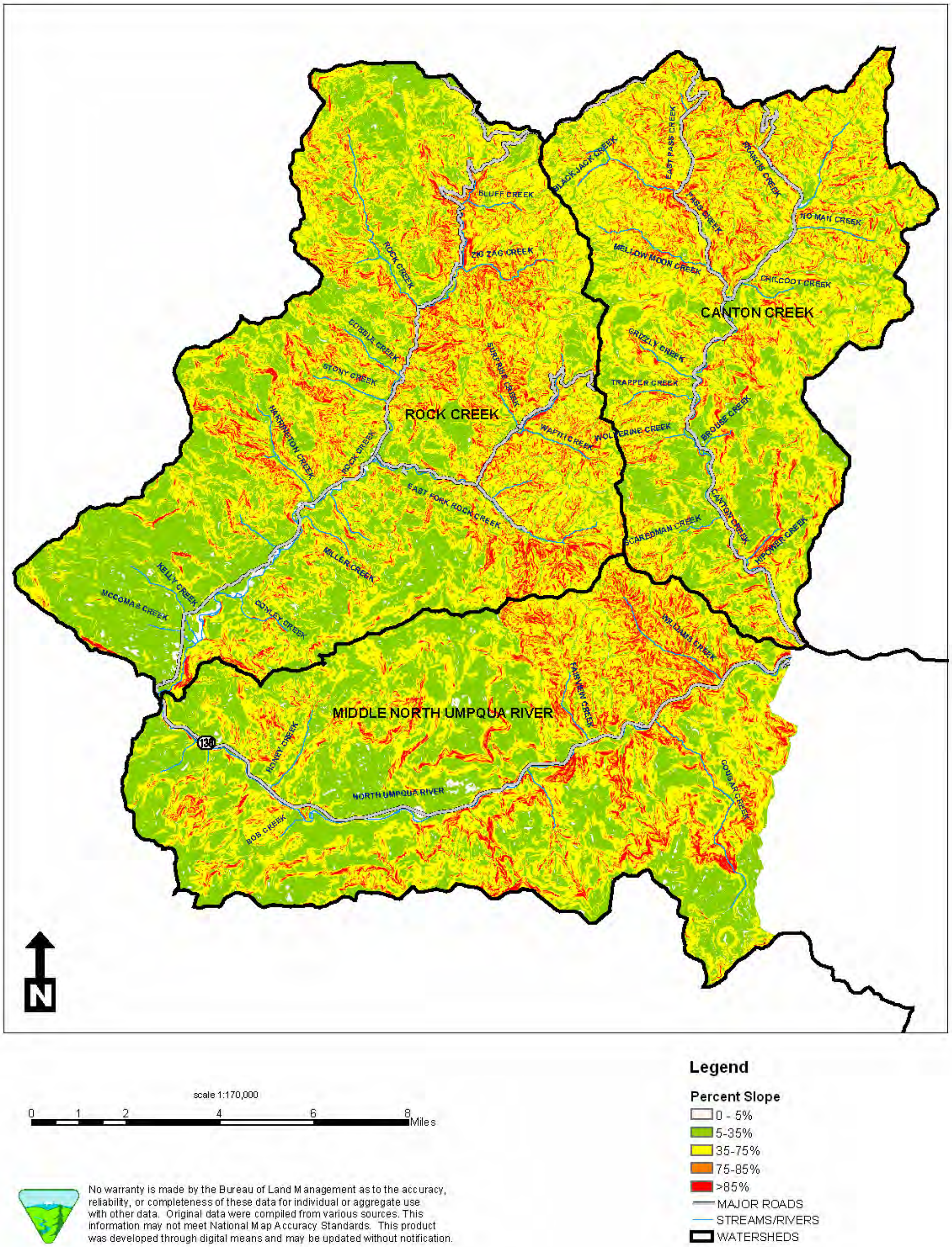
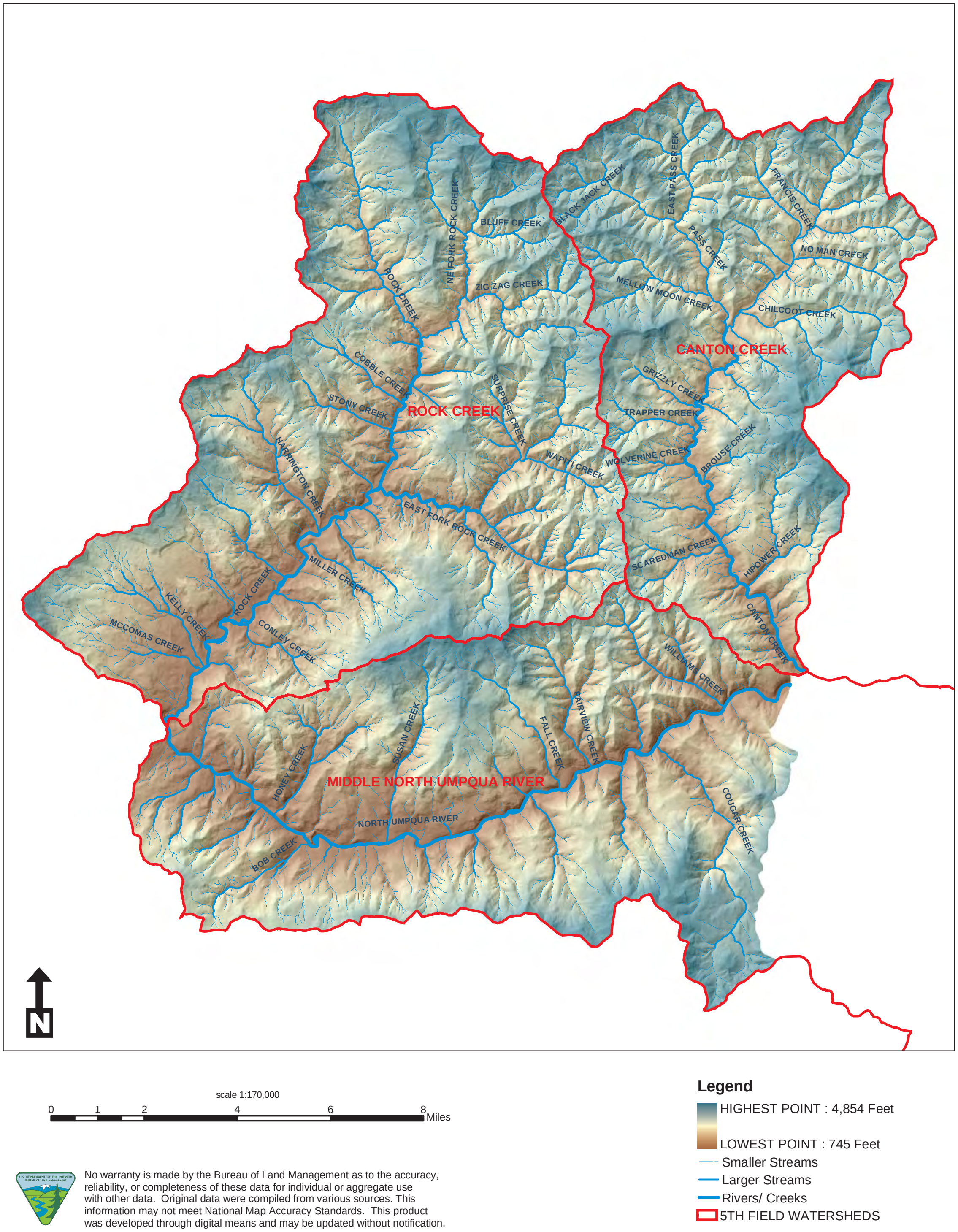
[4] The Environmental Protection Agency (EPA) and the Oregon Natural Heritage Program (ONHP) developed ecoregion boundaries for the State of Oregon.



Map 1-2: Percent slope for the Rock Creek Region.



Map 1-3: Elevation and stream network of the Rock Creek Region.

1.2.4. Geology

Oregon has a complex geological history resulting in a variety of landscapes throughout the state. In southwestern Oregon, the history of the landscape is dominated by the collision of the Western North America with the floor of the Pacific Ocean and fragments of earth crust lying on it.[5] This report summarizes the geology and geomorphology of the Rock Creek Region. Appendix 1 includes a glossary of geologic terms used in this report. Information in this section has been summarized from several previous watershed analyses covering the Region including: the *South Umpqua River Watershed Assessment*, (Geyer, 2003a, *North Umpqua Cooperative Watershed Analysis Synthesis Report*, (Stillwater Science 1998), *Middle North Umpqua Watershed Analysis*, (US Forest Service, 2001); and the *Middle North Umpqua Watershed Analysis*, (USDI Bureau of Land Management 2001). The geologic units section is based on information from the Geologic Map of Oregon (Walker and MacLeod, 1991).

Geologic processes

The Cascade Range in Oregon is typically divided into two sub-provinces: Western Cascades and High Cascades. These coarse scale divisions are based on age and composition of rock. The High Cascades sub-province encompasses the younger, little eroded, active volcanic region at higher elevations. The older Western Cascades sub-province is a deeply eroded terrain of volcanic and sedimentary rock. The entire Rock Creek Region falls within the Western Cascades sub-province.

Three geologic processes shaped the physical appearance of the present-day Rock Creek Region: the on-going movement of the earth's plates, ancient volcanic activity, such as lava and ash flows, and landslides and slope failures, which together are known as "mass wasting." Since the end of volcanic activity, mass wasting has become the dominant earth-shaping process. Erosion intensified dramatically with the uplifting of the earth's surface that formed the Cascade Range. The rapid rise of the landmass provided energy to existing stream systems that deeply eroded into the volcanic terrain, which resulted in a highly dissected landscape.

In the 1998 North Umpqua Cooperative Watershed Analysis (Stillwater Sciences, 1998), the area is delineated into "terrains" that affect fluvial geomorphology and channel conditions. Terrains incorporate characteristics including underlying geology, runoff, and erosional processes. The Rock Creek Region is comprised entirely of the Western Cascades Terrain with inclusions of Earthflow Terrain.[6]

Western Cascades Terrain

Mass wasting is the dominant erosion process in the Western Cascades Terrain. As the Cascade Range was uplifted by tectonic activity, slopes became steeper; thus increasing the velocity of flow and down-cutting of channels. This accelerated incising of streams

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[5] See Appendix 1 of the South Umpqua River Watershed Assessment and Action Plan (Geyer, 2003a for more information about the geological history of the Umpqua Basin. This document can be found at www.ubwc.org.

[6] Earthflow is not typically characterized as a terrain but for purposes of the 1998 Stillwater Sciences analysis, it was described as a separate terrain within the Western Cascades Terrain.

created more unstable hill slopes. Slope failures were probably triggered by strong, infrequent seismic events resulting in massive landslides and earth flow complexes of jumbled rock and earth, and deep-seated failures involving bedrock. These slope failures created stair-stepping slump/bench topography across much of the terrain. Landslide frequency would have been relatively high in the area's history compared to other terrains (see Section 3.3.7 for more on landslides).

The Western Cascades Terrain is composed of mostly volcanic rock that has been weathered and hydrothermally altered by hot solutions rising from the cooling of hot magma. However, the geology within the Rock Creek Watershed is somewhat different from the rest of the Region in that it contains a higher component of sedimentary bedrock rather than the more typical volcanic basaltic bedrock located within much of the Western Cascades Terrain.

Soils that develop in the Western Cascades Terrain are derived from weathered volcanic rock with high clay content and nutrient holding capabilities. Susceptibility of soils to mass wasting and other forms of erosion ranges from moderate to very high depending on the slope and clay content of the soils. The sedimentary rock in the western half of the Rock Creek Watershed may have caused historically higher erosion rates.

Earthflow Terrain

Earthflow Terrain is characterized by gently sloping and hummocky ground. It is the result of deep-seated landslides in weaker, intensively weathered mostly volcanic rocks of the Western Cascades Terrain. However, in the Rock Creek Watershed these areas are most likely comprised of sedimentary rock since the majority of Earthflow Terrain occurs within or adjacent to these sedimentary bedrock areas. Earthflow Terrain affects stream development and function by creating higher sediment input rates and inducing undefined stream channels. Subsurface flow is often high as stream channels are attempting to redefine themselves through the jumble of rock and earth deposits.[7] Inclusions of Earthflow Terrain occur mostly in the southwest Rock Creek Watershed and the western half of the Middle North Umpqua Watershed, with a few small areas mapped near the middle of the Canton Creek and Middle North Umpqua watersheds. (Map 1-4).

Soils that develop in the Earthflow Terrain are deep, fine-textured, and clay-rich with abundant groundwater. Earthflows appear to have contributed 60 percent of the total annual sediment delivery to channels within the upper North Umpqua basin (including the area from the Rock Creek Watershed east to Lemolo Watershed) and were probably the predominant source of large wood and coarse sediment in the smaller source streams in some areas under historical conditions.

Geologic units

The geologic units within the Rock Creek Region shown in Map 1-4 are composed of volcanic and associated sedimentary rocks. Most of the volcanic geology in the Region is characterized by andesitic and basaltic flows, ash flow tuffaceous rock, landslide and

[7] Personal communication with Dan Cressy, BLM soil specialist on September 14, 2005.

debris flows that include broken volcanic bedrock from upslope, and small isolated areas of silicic vent complexes. (See Appendix 1 for descriptions of the map units.) The basalt flows are more resistant to weathering and resulted in more cliffs, knobs and buttes in the area. These basaltic areas tend to have more of the moderately, less-incised mountain terrain. In the northeast section of the Rock Creek Watershed is an intrusion of diorite and andesite rock. Another smaller intrusion of basalt and andesite is located near the center of the Middle North Umpqua Watershed near Fairview Creek.

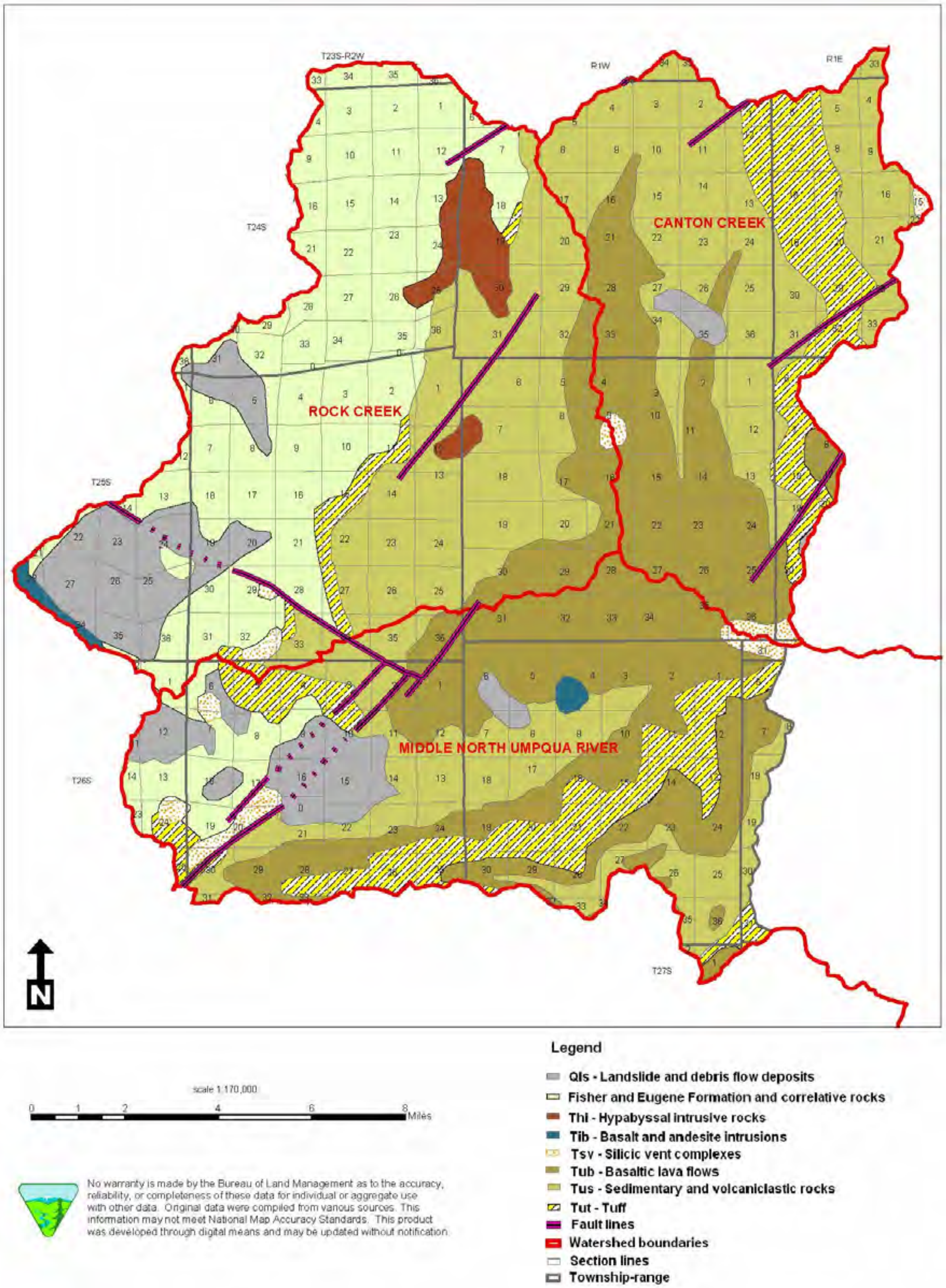
The tuffaceous rocks have been altered to varying degrees by metamorphism and hydrothermal activity. Deep-seated slope failures occurred more frequently in the altered tuffaceous rock. Chemical weathering occurred relatively rapidly making these formations more incised and unstable. Strong bands of tuffaceous rock can be seen in all three watersheds (Map 1-4). Both the Forest Service and BLM watershed analyses for the Middle North Umpqua Watershed identified tuffaceous rock as the most common areas for deep-seated hill-slope failures.

The western half of the Rock Creek Watershed and the western corner of the Middle North Umpqua Watershed are composed of sedimentary rock (Map 1-4), while most of the remaining portions of the Region are a mixture of sedimentary and harder volcanic rock. This sedimentary rock is largely composed of sandstone and siltstone that are somewhat high in feldspar and mica. These areas of sedimentary rock are usually more erosive than the harder volcanic areas that contain more igneous and metamorphic rock. These more erosive areas may be one reason for the larger meandering found in the middle to lower reaches of Rock Creek, relative to other streams in the Region.

Impacts of geology on stream characteristics

The geology of an area impacts the water resources of that area. Geologic processes govern the topography of an area, which in turn greatly influences the morphology of streams. The hydraulic conductivity, or permeability, of rock units plays a significant role in determining the groundwater inputs to streams, and groundwater can contribute to stream water quality. Generally, groundwater has a more consistently high quality than surface water. However, many streams in mountainous areas, such as the Rock Creek Region, are naturally surface water dominated, with groundwater playing a relatively minor role. However, the Earthflow Terrain within the Region supports more groundwater flow near the lower portions of Rock Creek and the North Umpqua River.

The composition of rocks can impact the quality of fish habitat and water quality. Generally, rocks high in silica are more acidic, while calcareous rocks are more alkaline. Fish prefer neutral to alkaline conditions (Hastings et al., 2002). Erosion of rocks and subsequent delivery of sediments to streams as well as groundwater inputs delivered to streams through rock units influence the water chemistry of those streams. The Rock Creek Region is generally high in andesite and basalt that are fairly low to intermediate in silica. The basalt tends to be richer in calcium, iron and magnesium and the andesite richer in feldspar. This promotes a more neutral to alkaline environment conducive to fish (Pidwirny, M., 1999).



Map 1-4: **Geology of the Rock Creek Region.**

The topography that results from geologic processes helps to shape the steepness of slopes and their likelihood of failing. Topography also influences the local climate, causing, for instance, more rain on the western slopes of large hills than on the eastern slopes. This may influence runoff and sediment inputs locally. Geology largely governs the process of soil formation. Rocks provide the parent material for soil development. The minerals within rocks also influence the organisms that grow and abide within the soil. Relief and climate, both influenced by geology, also impact soil genesis. The characteristics of the resulting soil impact the contribution of sediment to streams (see Section 3.3.7 for more information on stream sedimentation).

1.2.5. Stream network

As mentioned previously, the Rock Creek Region is defined by three distinct watersheds; Rock Creek, Canton Creek, and approximately half of the Middle North Umpqua. The Middle North Umpqua Watershed begins at the intersection of Rock Creek and the North Umpqua River approximately at stream mile 36 and includes 18.3 stream miles of the North Umpqua River.[8] Rock Creek begins at the same intersection with the North Umpqua River and extends 19.9 miles northeast. Canton Creek flows into Steamboat Creek (one watershed to the east). Canton Creek begins near the intersection of Steamboat Creek and the North Umpqua River at approximately stream mile 55 of the North Umpqua River and extends 7.3 miles north. Map 1-3 shows all of the tributaries that feed into these main channels. Stream density is fairly high in the Umpqua Cascades Ecoregion, illustrated by Map 1-3 for all of the watersheds in the Rock Creek Region. Table 1-1 shows the stream miles for each watershed's main channel, the longest tributary, the total miles of stream, and the stream density within each watershed.

	Rock Creek	**Canton Creek**	**Middle North Umpqua**
Stream miles of main channel	19.9	7.3	18.3
Longest tributary	East Fork Rock Creek	Pass Creek	Cougar Creek
Total stream miles in watershed	391.0	281.8	263.1
Stream density[9] (miles/mi^2)	4.0	4.4	3.2

Table 1-1: Stream characteristics for each watershed in the Rock Creek Region.

[8] Stream miles and river miles measure distance from the mouth following the center of the stream channel to a given point. "Total stream miles" is the length of a stream in miles from the mouth to the headwaters. "Stream mile zero" always refers to the mouth.

[9] Stream density is based on GIS maps that use a 1:24,000 scale, and are for comparison only. Actual stream densities when measured on the ground often are between 30 and 50 percent higher than from using GIS. Personal communication, Joy Archuletta, Hydrologist, US Forest Service, January, 2006.

1.2.6. Climate

As is typical of southwest interior Oregon, the Umpqua Cascades Ecoregion is drier and colder than the northwest interior because much of the area is within the Coastal Mountain Range rain shadow. Precipitation typically ranges from 50 to 80 inches with up to 90 inches in the higher elevations.

A climate station (station #4126) that collects both temperature and precipitation data is located at Idleyld Park just west of the Rock Creek Region at 1,080 feet in elevation.[10] This station has collected daily weather data for the last 45 years. As the ecoregion information indicates, temperatures are generally mild. Figure 1-1 shows the average daily minimum and maximum temperatures by month for Idleyld Park. Maximum temperatures in the summer are generally in the mid 70s or low 80s. Minimum winter temperatures are usually just at or above freezing.

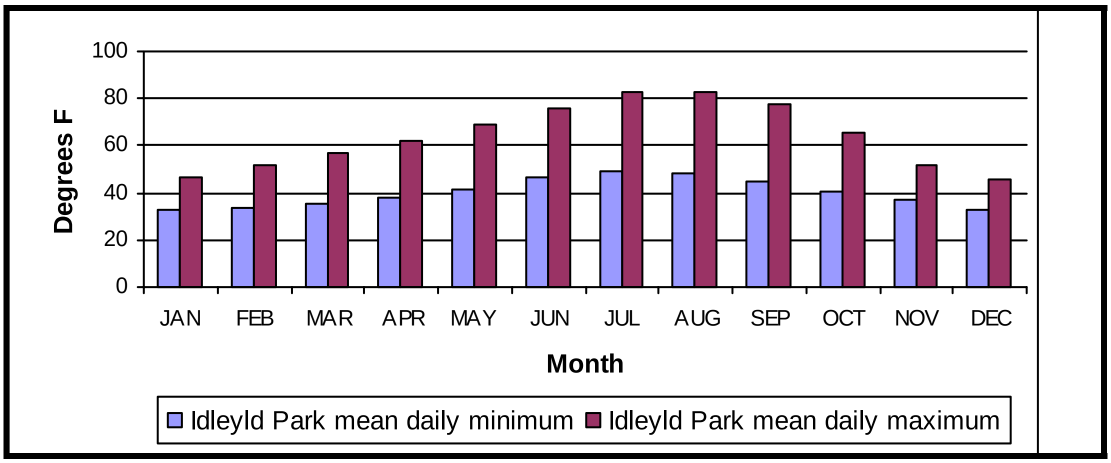


Figure 1-1: Average minimum and maximum temperature for Idleyld Park (station #4126).

Rainfall averages 63.3 inches in Idleyld Park, but can vary widely depending upon the year (see Figure 1-2). The lowest measured precipitation was 42 inches in 1985 while the highest was 95.4 inches in 1996. As is typical of southwest Oregon, most precipitation occurs in the winter months (see Figure 1-3). In Idleyld Park, rainfall averages 10.1 inches for the months of November through January and 1.3 inches for June through September.

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[10] The National Oceanographic and Atmospheric Administration (NOAA) administers this station. Data are available from the Oregon Climate Station website http://ocs.oce.orst.edu/.

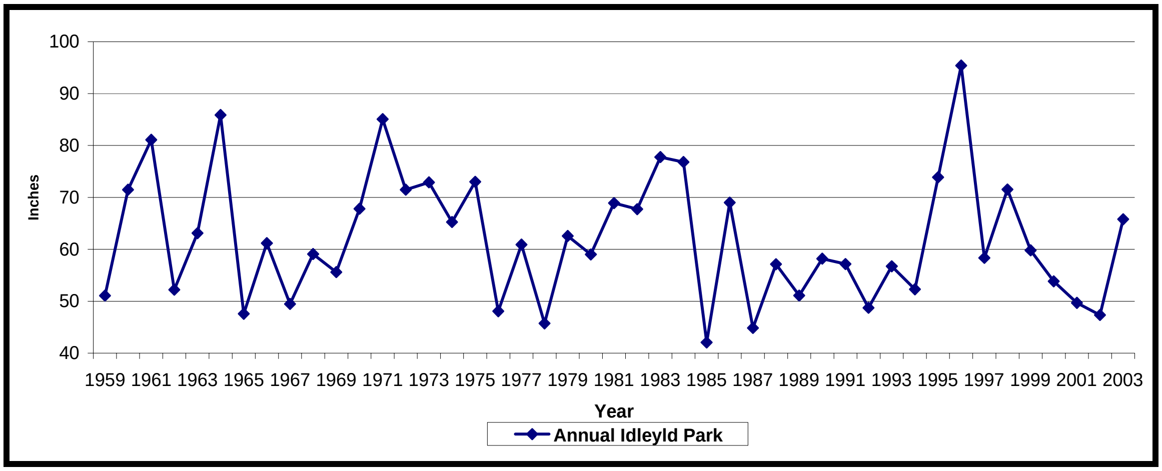


Figure 1-2: Annual precipitation for Idleyld Park (station #4126).

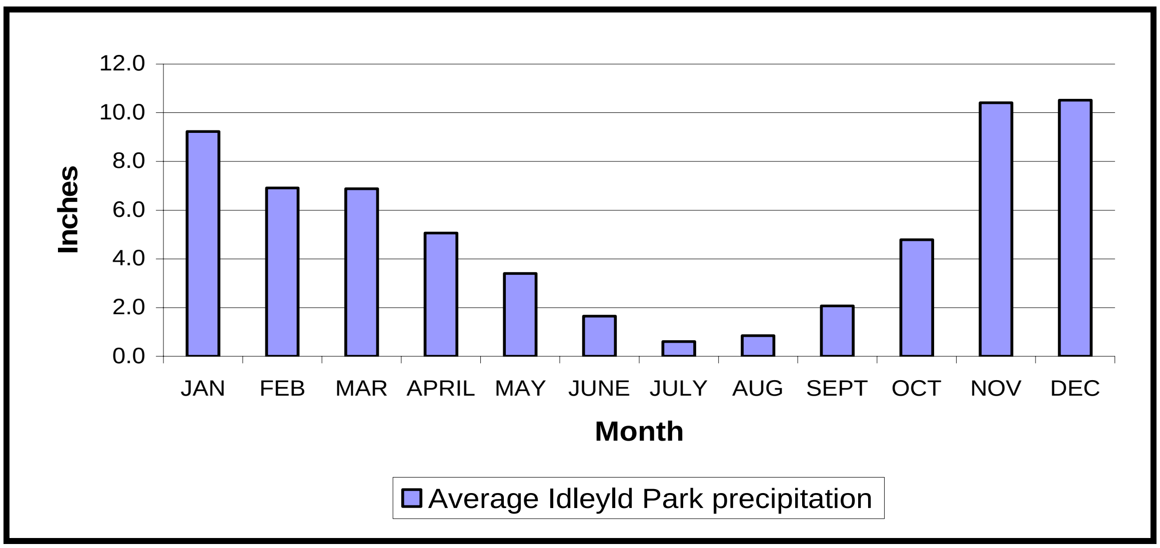


Figure 1-3: Average monthly precipitation for Idleyld Park (station #4126).

Although this weather station is located just adjacent to the analysis region, it is at the lower end of its elevation (1,080 feet). Approximately 75 percent of the Rock Creek Region is located at or above 2,000 feet in elevation. We expect higher precipitation levels and cooler temperatures as the elevation increases. For this reason, we expect that the actual precipitation and temperatures for the Region are higher than these data but probably follow a similar trend. In addition, much of the precipitation in the winter months would occur as snow since 2,000 feet is considered a common transition zone into snow for many winter storms.

1.2.7. Vegetation

The high elevations of the eastern Umpqua Cascades are dominated by Douglas-fir and western hemlock. Overstories also include western redcedar, sugar pine, Pacific yew, grand fir, and white fir. Some madrone is present on warmer south-facing slopes.

Canyon oaks can be found on stony soils on all aspects. Understory vegetation includes rhododendron, Oregon grape, salal, golden chinquapin, red huckleberry, western sword fern, and bracken fern. In the very high eastern elevations, vegetation is the same as for the rest of the Umpqua Cascades Ecoregion; however, the growing season is much shorter.

Forest structure

Forest structure and species composition can be described in terms of three distinct seral stages: early, mid, and late. Seral stages are intermediate stages in the process of forest succession. They help us understand what the forest vegetation may look like at different time intervals after disturbances kill and/or remove forest stands or portions of stands. Forest succession occurs at different rates depending on the productivity of the site, plant species growing at the site, and disturbances that may change the progression of plant development. The three stages described below are typical of the stands in the Rock Creek Region.

Early-seral

This stage occurs when growing space is occupied and shared by many species of plants. In plantations, these early plants compete with trees and are often removed as part of management. In natural stands, conifers become established over time and eventually expand to exclude many of the early plants so that the primary competition that develops is between trees rather than with shrubs. In general, stand age is less than 30 years and the average diameter of trees is less than ten inches.

Mid-seral

The mid-seral stage begins when plants have captured all of the available growing space and new plants will not invade unless there is further disturbance to the site. The dominant plants compete with each other for available growing space, often forming a continuous closed canopy that allows little light to reach the ground. Diversity of species and structure is more limited than in other seral stages. Understory plants are few, and in the later portion of this stage shade intolerant trees that are not in a dominant position to reach light begin to die out. This is the beginning of stand differentiation where some new trees will establish under a more uniform overstory, initiating the process of structural diversity. Growing space becomes available slowly as plants die from competition. In managed stands, thinning is often used to more quickly open up the canopy and release growing space to the remaining trees. This speeds up the differentiation process that would otherwise occur more slowly. Mid-seral forests typically range in age from about 30 to 80 years with average tree diameters of ten to over 20 inches.

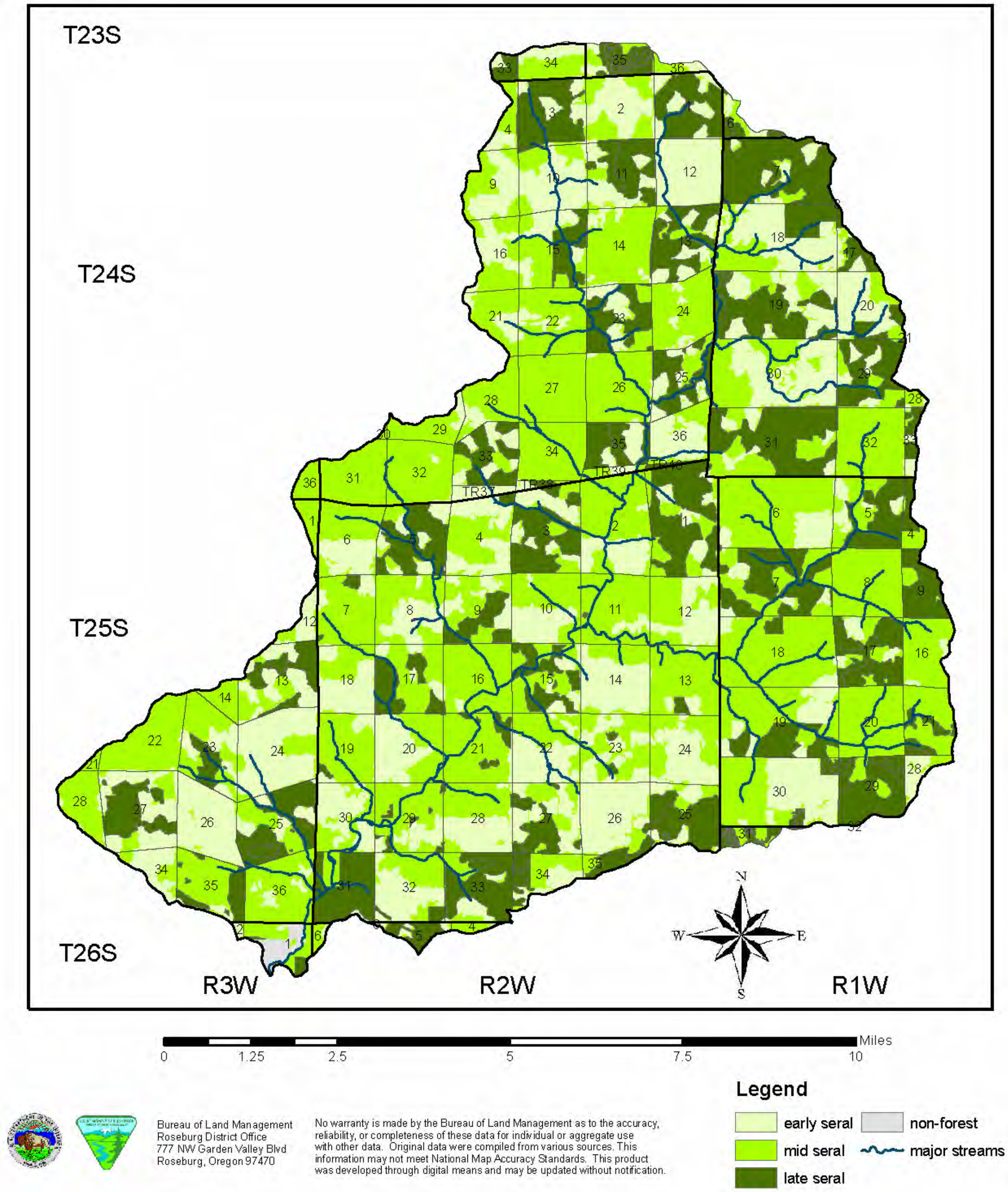
Late-seral

This stage is characterized by multi-canopy (two or more) layers that developed following the establishment of shade tolerant trees in the understory. There is usually a diversity of tree size, form and condition. Canopy gaps are common as trees grow in a clumpy arrangement. Snags, large wood on the ground and rot associated with breaks in trees, age, and tree-form are typical. The diversity of species is high in these forests that often include a mixture of early and mid-seral development interspersed in a complex variable arrangement. Natural stands are usually at least 80 years old. Some take much longer to develop these characteristics.

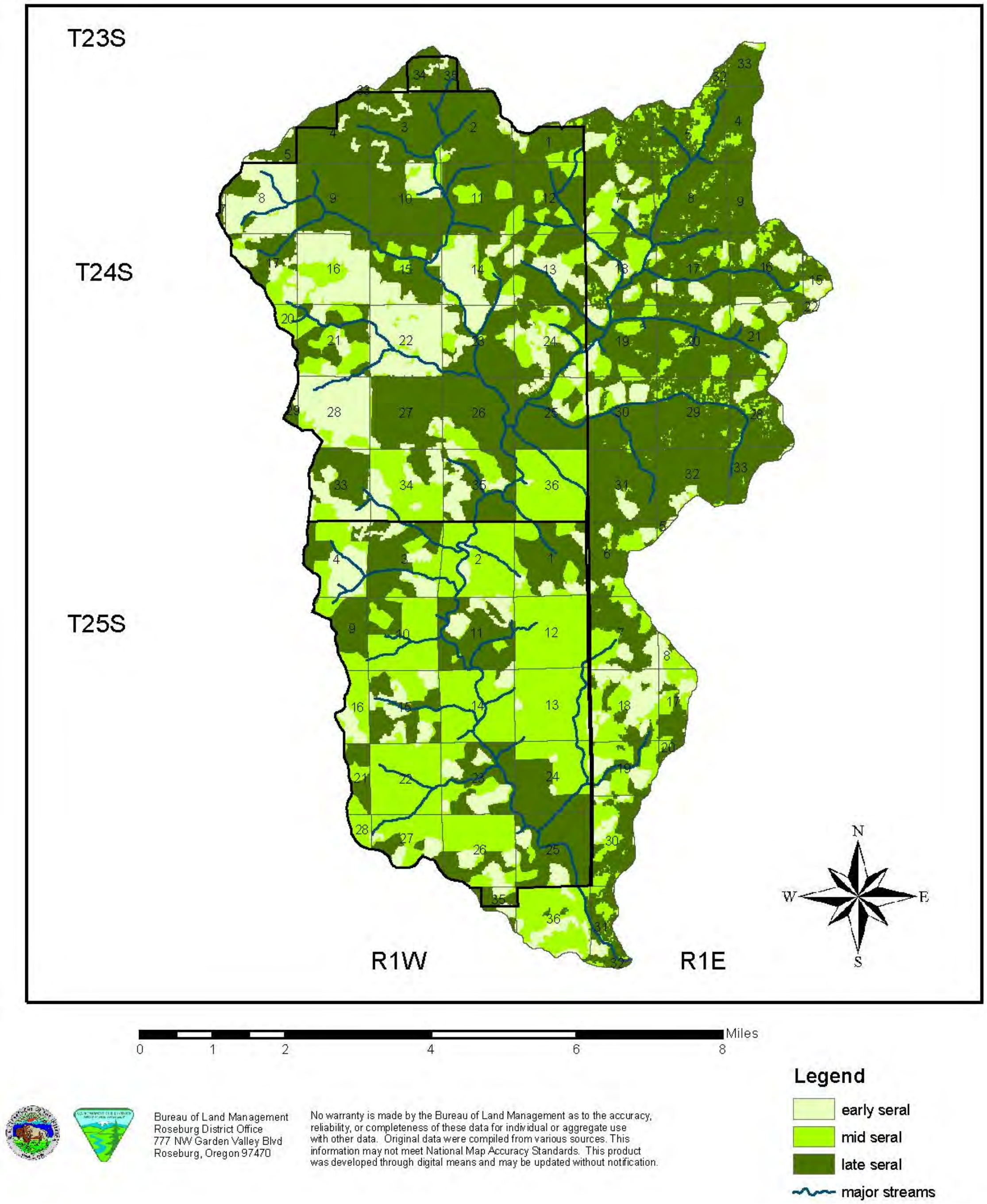
Maps Map 1-5, Map 1-6, and Map 1-7 show the current seral stages in each of the watersheds in the Rock Creek Region, and Table 1-2 lists the percent of each seral stage by watershed and the percent of each seral stage in the Region.

	Rock Creek	**Canton Creek**	**Middle North Umpqua**	**Total Region**
Early-seral (<30 yrs)	28%	17%	16%	21%
Mid-seral (30 to 80 yrs)	49%	31%	38%	41%
Late-seral (>80 yrs)	23%	52%	44%	38%

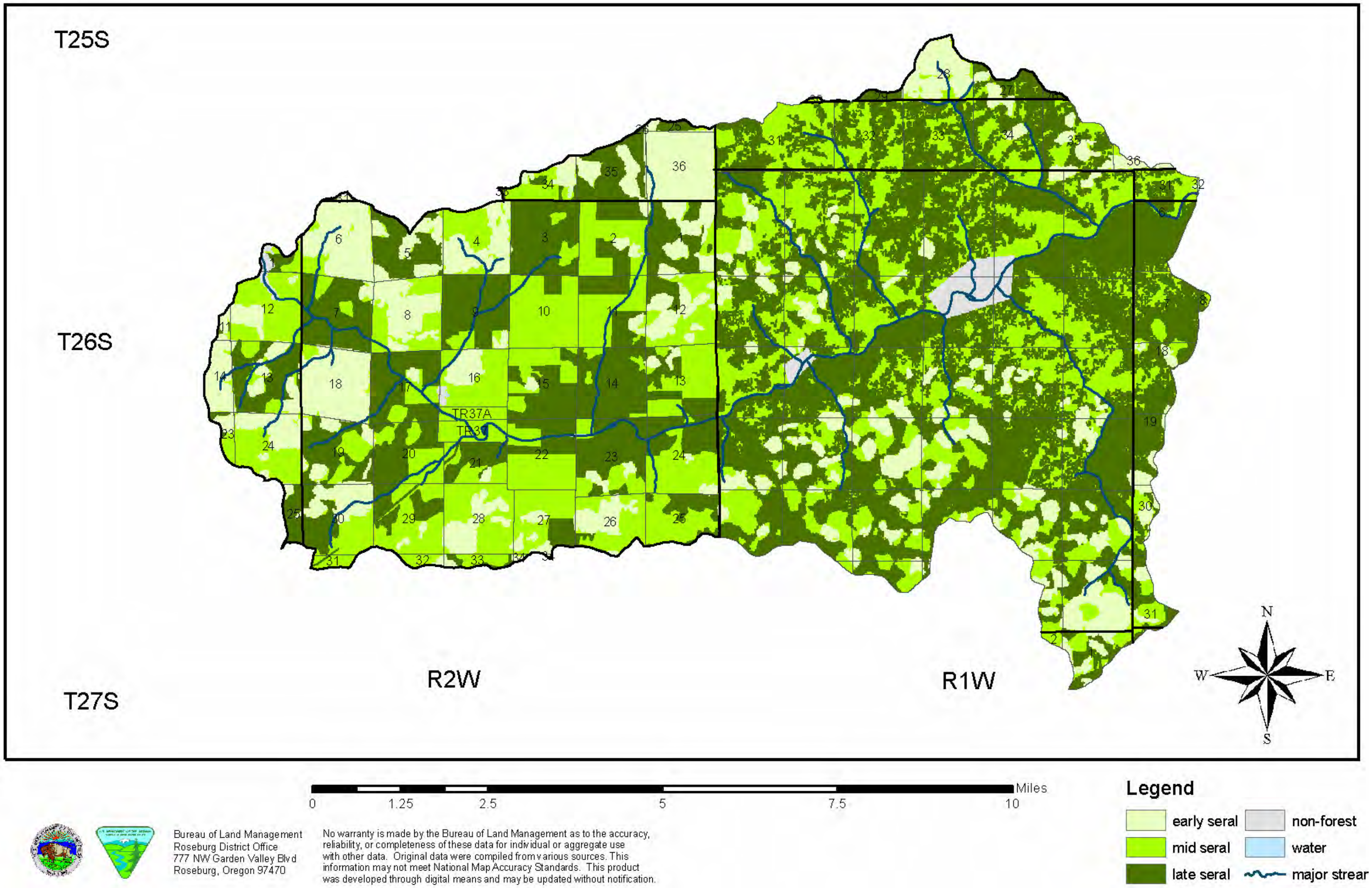
Table 1-2: Seral stage distribution within the Rock Creek Region.



Map 1-5: **Seral stage distribution within the Rock Creek Watershed.**



Map 1-6: Seral stage distribution within the Canton Creek Watershed.



Map 1-7: Seral stage distribution within the Middle North Umpqua Watershed.

1.3. Land use, ownership, and population

1.3.1. Land use and ownership

As shown in Map 1-8, the most common land use in the Rock Creek Region is forestry, with 55 percent of the land base used for public or private forestry.[11] "Federal Reserve" areas are those acres identified in the Northwest Forest Plan to be managed primarily for old growth characteristics and riparian habitat protection. In general, timber harvest does not occur in these areas, or is limited to harvest that promotes these goals. Reserve areas constitute 44 percent of the land use, and mostly occur in the Canton Creek Watershed and the northeast portion of the Middle North Umpqua Watershed, although riparian reserve areas also occur throughout the federal lands around streams. Farm, residential, and empty rural lands each constitute less than one percent of the region.

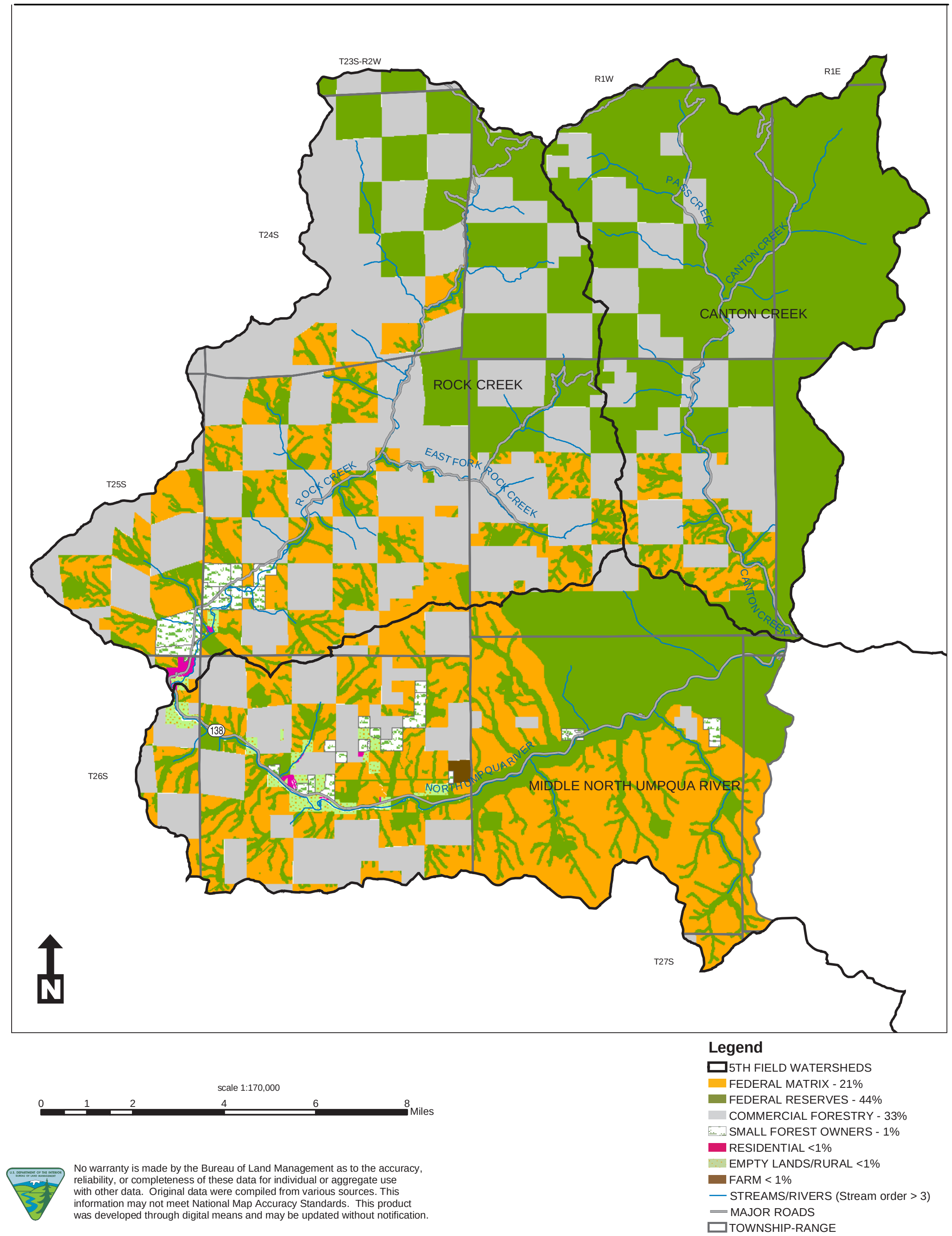
Land ownership is primarily public (64 percent) with the majority managed by the Roseburg District, Bureau of Land Management (BLM) and the rest by the Umpqua National Forest. The BLM manages all of the public land in the Rock Creek Watershed, while federal management is split between both agencies within the Canton Creek and Middle North Umpqua watersheds (Map 1-9). Private industrial landowners own 33 percent of the Region, while small private landowners, Douglas County, and the State of Oregon own or manage less than four percent of the Region.

Table 1-3 and Map 1-10 show parcel size distribution and percent by class for the Rock Creek Region as of 2001. Nearly the entire watershed (99 percent) consists of ownership parcels that are over 100 acres that are owned or managed by 20 landowners. Less than one percent is in parcels less than 101 acres. These smaller parcels are mostly located within and around the mouth of Rock Creek and on the North Umpqua River just south of Honey Creek. There are no small landowners in the Canton Creek Watershed.

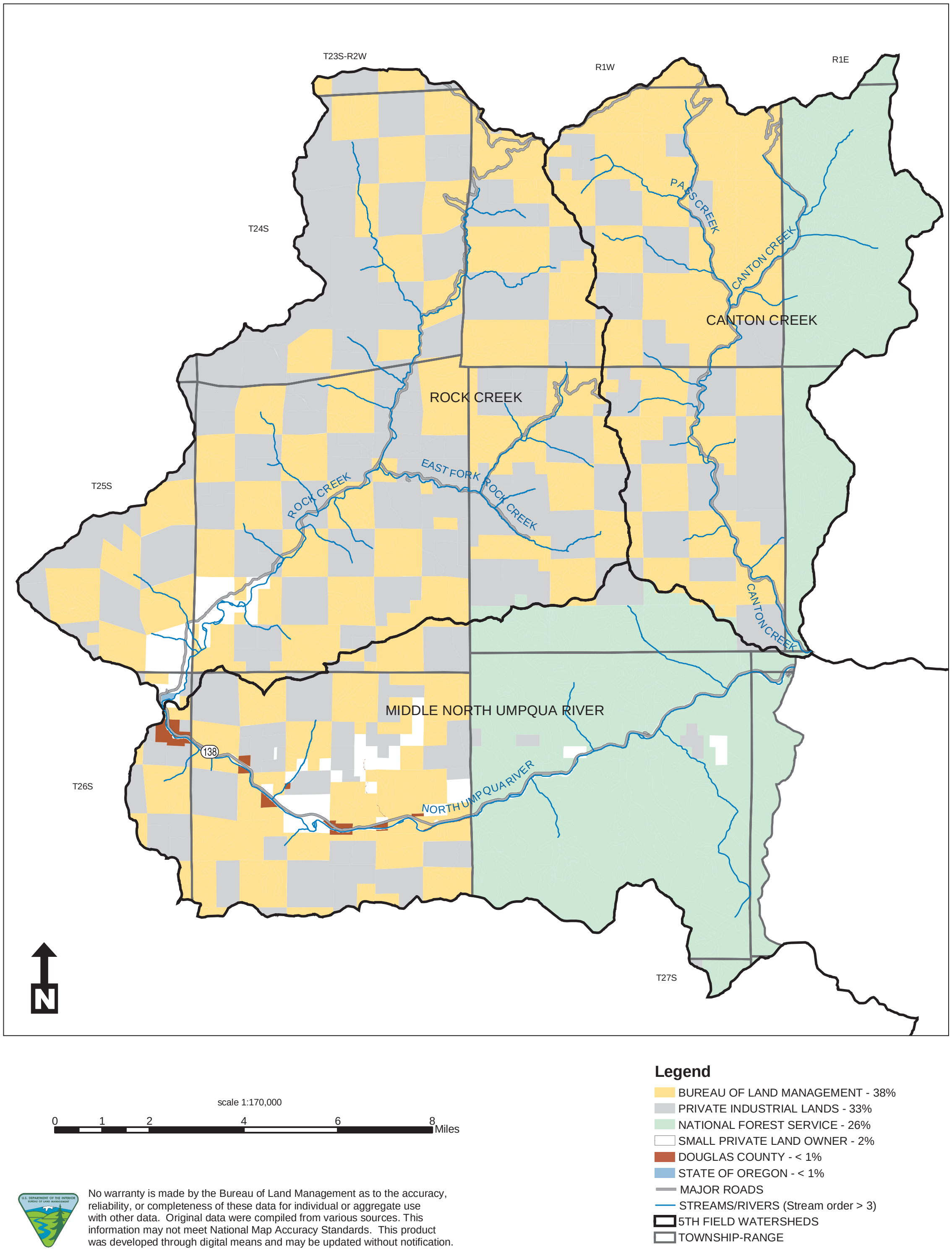
Parcel size	**Percent of area**	**# Landowners**
0-5	<0.1	41
6-10	<0.1	19
11-100	0.8	35
101+	99.0	20

Table 1-3: Percent of landholdings by parcel size for the Rock Creek Region.

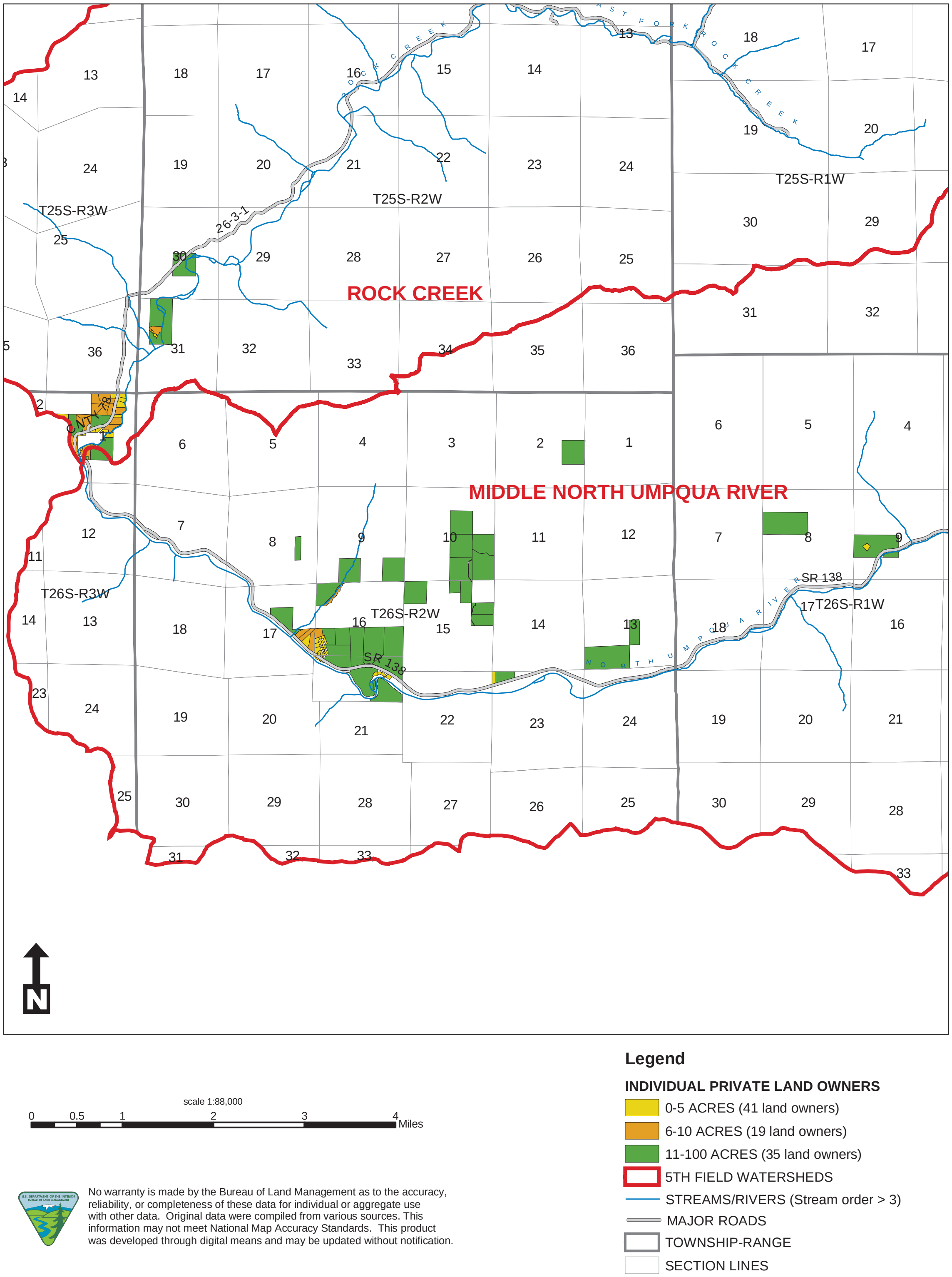
[11] The "Forestry" land designation includes those areas likely to be actively managed for timber production. Included in this designation are Federal lands identified with a matrix management objective in the 1994 Northwest Forest Plan, private commercial forestry, and small forest owners.



Map 1-8: Land use in the Rock Creek Region.



Map 1-9: Land ownership in the Rock Creek Region.



Map 1-10: Parcel size distribution for small landowners (<101 acres) in the Rock Creek Region.

1.3.2. Population and demographics

Areas for which the US Census Bureau has population and demographic information do not correspond with the Rock Creek Region boundary. There are no data collection areas that fall entirely within the Rock Creek Region. Part of the North Umpqua Census County Division (CCD) includes the assessment area (see Map 1-11).[12] However, this collection area is much larger than the Rock Creek Region. Data from the nearby community of Glide are also presented here. Data from these areas are included in this section to provide an overview of the populations that live within and adjacent to the Rock Creek Region, and are most likely to use the area frequently.

Map 1-11: Location of the North Umpqua Census County Division (CCD).[13]

Population

There are no cities located within the Rock Creek Region. Glide is the closest city for which population data are collected. In 2000, the population of Glide was 1,690 people. The population of the North Umpqua CCD was 5,212. Unofficial estimates on the population of Idleyld Park vary from 785 to 887 people. Many of the addresses listed in Idleyld Park are for residents within the Rock Creek Region; however the actual number of Rock Creek Region residents is unknown. The Douglas County parcel taxlot

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[12] According to the US Census Bureau (http://factfinder.census.gov/servlet/BasicFactsServlet), a census county division (CCD) is "a subdivision of a county that is a relatively permanent statistical area established cooperatively by the Census Bureau and state and local government authorities. Used for presenting decennial census statistics in those states that do not have well-defined and stable minor civil divisions that serve as local governments."

[13] This map is from the US Census Bureau's American FactFinder website: http://factfinder.census.gov.

information lists 112 landowners on 58 parcels located within the Rock Creek Region with local Idleyld Park addresses.

General demographic characteristics and housing

Table 1-4 provides Census 2000 information about general demographic characteristics and housing for the City of Glide and the North Umpqua CCD; Douglas County data are provided for comparison. The median age for Glide is lower than for the North Umpqua CCD and Douglas County. The largest racial group for all areas is white, with the next largest groups being Hispanic or Latino except in Glide where the second largest groups are American Indian or Alaskan Native. Average household size and family size are comparable for all three areas. Glide and the North Umpqua CCD's percent of owner-occupied housing are higher than the percent for the county. The North Umpqua CCD has a higher housing vacancy rate than the county or the City of Glide.

Parameter	**Glide City**	**North Umpqua CCD**	**Douglas County**[14]
Median age (years)	35.4	40.8	41.4
Race			
White	92.9%	92.8%	93.7%
Hispanic or Latino	1.8%	2.6%	2.8%
Asian	1.0%	0.6%	0.6%
American Indian or Alaskan Native	2.1%	2.6%	1.6%
African American	0.0%	0.1%	0.2%
Native Hawaiian or Pacific Islander	0.0%	0.1%	<0.1%
Some other race	0.0%	0.0%	0.9%
Two or more races	4.0%	3.7%	3.0%
Households			
Avg. household size (#)	2.77	2.60	2.48
Avg. family size (#)	3.08	2.99	2.91
Owner-occupied housing	76.8%	75.9%	71.7%
Vacant housing units	5.6%	13.9%	8.0%

Table 1-4: 2000 Census general demographic characteristics and housing for the City of Glide, the North Umpqua CCD, and Douglas County.

Social characteristics

Table 1-5 provides information from the 2000 Census for education, employment, and income for the City of Glide and the North Umpqua CCD; Douglas County data are included for comparison. Both areas are above Douglas County for the percent of high school graduates and the percent of people with at least a four-year college degree. The percent of unemployed persons in the labor force is much lower in Glide than for the

[14] In 2000, the population of Douglas County was 100,399 people.

county or the North Umpqua CCD. The top three occupations in Table 1-5 account for around 70 to 75 percent of the labor force in all three areas, and the top three industries employ around 45 percent of the workers in the North Umpqua CCD and between 60 and 70 percent for the other areas. Many more people work at home and are self-employed in both the Glide and North Umpqua CCD than the county. Per capita income and median family income for the City of Glide and the North Umpqua CCD are higher than for Douglas County, and poverty levels are lower, although the poverty level in Glide is not much lower than for the county.

Parameter	**Glide City**	**North Umpqua CCD**	**Douglas County**
Education – age 25+			
High school graduate or higher	84.0%	85.7%	81.0%
Bachelor's degree or higher	15.9%	18.4%	13.3%
Employment- age 16+			
In labor force	69.9%	66.3%	56.9%
Unemployed in labor force	2.5%	4.0%	4.3%
Top three occupations	(1) Management, professional, and related occupations; (2) Production, transportation, and material moving; (3) Sales and office.	(1) Management, professional, and related occupations; (2) Sales and office; (3) Production, transportation, and material moving.	(1) Management, professional and related occupations; (2) Sales and office; (3) Production, transportation, and material moving.
Top three industries	(1) Manufacturing; (2) Educational, health, and social services; (3) Retail trade.	(1) Educational, health, and social service; (2) Manufacturing; (3) Retail trade.	(1) Educational, health, and social services; (2) Manufacturing; (3) Retail trade.
Work at home	10.0%	8.8%	4.8%
Self-employed in own not incorporated business	12.7%	12.8%	9.5%
Income			
Per capita income	$18,444	$18,406	$16,581
Median family income	$45,313	$48,354	$39,364
Families below poverty	9.4%	8.0%	9.6%

Table 1-5: 2000 Census information for education, employment, and income for the City of Glide, the North Umpqua CCD, and Douglas County.

2. Past Conditions[15]

The past conditions section provides an overview of events since the early 1800s that have impacted land use, land management, population growth, and fish habitat in Douglas County and in the Rock Creek Region. The first four sections that follow (Sections 2.1 through 2.4) are arranged by time period and describe the history of Douglas County with information specific to the Rock Creek Region included where available. Most of the information in these sections is based on S.D. Beckman's 1986 book *Land of the Umpqua: A History of Douglas County, Oregon* and from the *South Umpqua River Watershed Assessment* (Geyer, 2003a. The last three sections (2.5 through 2.7) contain historical information on the changes in population, fish abundance and use, and forest vegetation over time. Information in these latter sections is from the following groups' documents, websites, and specialists: the Roseburg Bureau of Land Management (BLM), the Oregon Department of Fish and Wildlife (ODFW), and the USDA Forest Service, Umpqua National Forest. Material obtained from other sources will be cited in the text and included in the reference list at the end of the section.

Key Questions

- What were the conditions of the Umpqua Basin watersheds before the arrival of the settlers?
- What events brought settlers to Douglas County?
- How did land management change over time and how did these changes impact fish habitat and water quality?
- What were the major socioeconomic changes in each period?
- When were laws and regulations implemented that impacted natural resource management?

2.1. Pre-settlement: prehistory to early 1800s

Little detail is known about the prehistoric use of Douglas County but evidence suggests a rich land that supported numerous Native Americans. The pre-settlement period was a time of exploration and inspiration. In 1804 President Thomas Jefferson directed William Clark and Meriwether Lewis to "secure data on geology, botany, zoology, ethnology, cartography, and the economic potentials of the region from the Mississippi Valley to the Pacific" (Beckham, 1986, p. 49). The two men successfully completed their journey in 1806 and returned with field collections, notes and diaries. The information they collected soon became an inspiration for others to follow their path. Fur trappers came first, reaching Douglas County in the 1820s. The pre-settlement period was an eye-opener for both the Euro-American explorers and the native Indians.

2.1.1. Indian lands

Although no one knows when Indians first settled in the Umpqua Basin, archeologists have uncovered artifacts that show the valley of the Umpqua was used by Indians for

[15] Robin Biesecker of Barnes and Associates, Inc., contributed to Sections 2.1 through 2.5.

thousands of years. Evidence found in the Steamboat Creek Watershed (just east of the Canton Creek Watershed) shows use of the area as early as 3,000 to 6,000 years ago. Tools found in this area suggest hunters camped on the ancient stream terraces along Steamboat Creek, and archeologists believe Indians continued to use the locations on into the 19th century.

Over 32 prehistoric cultural sites exist in the Middle North Umpqua Watershed. Nearly all are located on the north side of the North Umpqua River. Cultural site locations range from lowland riverside terraces to the highest ridge crests. Major base camps occur along the river while upland areas include hunting camps, ridge crest tool stone quarries and at least one vision quest site. Prehistoric use includes the oldest documented occupation in the Umpqua Basin. Some of the highest prehistoric site densities in the Umpqua Basin are on the north side of the North Umpqua River within the Rock Creek Region (USDI Bureau of Land Management, 2001).

When pioneer settlement came to the valley in the late 1840s and early 1850s, Douglas County was the homeland of several different bands of Indians. The Molalla (also known as the South Molalla) occupied the Western Cascades including the Rock Creek Region. They were known as the “hill dwellers.” The Yoncalla occupied the northern section of the county with their main villages on Calapooya Creek and Elk Creek as well as the Coast Fork of the Willamette River in the area north of the Calapooya Mountains. The Lower Umpqua or Kalawatset Indians lived along the coast and on tidal river sections, and the Cow Creek Band of the Umpqua Tribe had villages on the South Umpqua and throughout the Cow Creek Valley and surrounding hills.

The Southern Molalla in Douglas County principally lived along the North and South Umpqua rivers where they entered the main valley. Their population was small and little is known about their way of life. In 1910 to 1911, Leo J. Frachtenberg had frequent interactions with Indians in western Oregon. He documented being told by Indians that during the winters, the Molalla left the Cascades to reside in villages in the river canyons or foothills. As soon as weather allowed, they moved back east to higher elevations to hunt deer, elk, and bear, and to pick berries and dig roots. They fished in the streams for salmon, steelhead, eels, and trout. They shared their land with those to the East and West who came each year to high ridges to pick huckleberries.

The Indians of Douglas County used fire to manipulate the local vegetation to improve their hunting success. George Hall, Sr., a settler of Douglas County in the 1850s, found the hills in the Oakland area with only a few large fir trees. In the draws were poison oak, small shrubs and abundant deer. “The Indians kept these hills burned off for good hunting,” (Chenoweth, 1972, p. 66). Early white men told of the Indian custom of burning during the late summer months in southern Douglas County. Burning stimulated the grasses and helped eliminate the undergrowth. “Reports from some of the first white men to see the Cow Creek Valley compared it to a giant wheat field,” (Chandler, 1981, p. 2). Grass covering the rolling prairies often was waist high. An expedition in the fall of 1841, funded by the federal government and led by Lt. George F. Emmons, met with dense, choking smoke as they traveled through the Umpqua Valley. Indians had created the smoky conditions by burning grasslands on the hillsides and along the river.

Accounts of the Douglas County native vegetation reveal extensive prairies and large trees. In June of 1826 David Douglas crossed the Calapooya Mountains and entered Yoncalla. His purpose was to collect specimens of native vegetation for the Royal Horticultural Society of London. Douglas was searching for stands of sugar pine. In the Umpqua Valley he was fortunate to meet and, with the help of beads and tobacco, make friends with an Indian. The Indian pointed to the south after Douglas drew pictures of the sugar pine and its huge cones. The pine stand was located and Douglas later described the largest pine windfall he had found: "57 feet nine inches in circumference; 134 feet from the ground, 17 feet five inches; extreme length, 215 feet" (Lavender, 1972, p. 148).

Origin of the name "Umpqua"

Many ideas exist about the origin of "Umpqua." An Indian chief searching for hunting grounds came to the area and said "umpqua" or "this is the place." Other natives refer to "unca" meaning "this stream." One full-blooded Umpqua Indian interviewed in 1960 believed the term originated when white men arrived across the river from their village and began shouting and gesturing their desire to cross. "Umpqua," she feels means "yelling," "calling," or a "loud noise" (Minter, 1967, p. 16). Another Indian when asked the meaning of "Umpqua" rubbed his stomach, smiled, and said, "Uuuuuump-kwa – full tummy!"

Explorers and early settlers described the trees and other vegetation found in Douglas County. Large yellow and red cedar trees were found along the South Umpqua River. The Pacific Railroad Surveys passed through the Umpqua Valley in 1855. The oak groves found in the valleys were reported to grow both in groups and as single trees in the open. The oaks were described as reaching two to three foot diameters and to have a low and spreading form. Many early visitors describe the fields of camas (see Photo 2-1). Hall Kelley traveled the Umpqua River in 1832. "The Umpqua raced in almost constant whitewater through prairies covered with blue camas flowers and then into dense forest" (Cantwell, 1972, p. 72). In the present-day Glide area, Lavola Bakken (1970) mentions the Umpqua Indian diet of sweet camas bulbs taken from the "great fields of camas" (p. 2). The Cow Creek Indians of southern Douglas County also ate the camas bulb (Chandler, 1981).

Photo 2-1: Blue camas flower and field of blue camas (National Park Service photos).

The diet of the native Indians also included fish and wildlife. The Cow Creek Indians built dams of sticks across stream channels to trap the fish. Venison was their main game meat that, prior to the use of guns, was taken with snares and bows and arrows (Chandler, 1981). Salmon was the fundamental food of the Indians along the main Umpqua River. The Lower Umpqua Indians fished with spears and by constructing barriers along the narrow channels. The large number of fish amazed a trapper working for the Hudson's Bay Company: "The immense quantities of these great fish caught might furnish all London with a breakfast" (Schlesser, 1973, p. 8). Wildlife was prevalent throughout Douglas County and included elk, deer, cougar, grizzly bear, beaver, muskrat, and coyotes.

2.1.2. Euro-American visitors

The Lewis and Clark expedition gave glowing reports of the natural riches to be found and proved travel to Oregon was difficult but not impossible. Fur seekers, missionaries, and surveyors of the native geology, flora, and fauna were among the first Euro-American visitors to Douglas County. Methodist missionary Gustavus Hines preached to the Indians of the Umpqua in 1840. He concluded "the doom of extinction is suspended over this wretched race and that the hand of Providence is removing them to give place to a people more worthy of this beautiful and fertile country" (Beckham, 1986, p.59).

Fur trading in Douglas County began in 1791 in the estuary of the Umpqua River. Captain James Baker traded with the Indians for about 10 days and obtained a few otter skins. The first land contact by fur traders in the Umpqua Valley was in 1818 by the Northwest Company of Canada. Trapping did not expand until Alexander Roderick McLeod – working for Hudson's Bay Company - explored the Umpqua Valley in 1826. The number of trappers steadily increased along the Umpqua River from 1828 to 1836. Hudson's Bay Company established Fort Umpqua first near the confluence of Calapooya

Creek and the Umpqua in the 1820s and then, in 1836, near the present-day city of Elkton. Fort Umpqua was reduced in size in 1846 and finally destroyed in a fire in 1851. By 1855, the beaver were trapped out and fur trading had ended along the Umpqua River (Schlesser, 1973).

The travel routes of the trappers and early explorers closely parallel many of Douglas County's current roads. For example, Interstate Five (I-5) is located in the vicinity of an old trade route. The main difference is the original trail followed Calapooya Creek to its mouth and then up the Umpqua and South Umpqua rivers to Roseburg (Schlesser, 1973). Interstate Five uses a more direct route from Calapooya Creek to Roseburg via Winchester. The Umpqua Indian trails followed the major rivers and streams of the county including the main Umpqua and the North and South Umpqua Rivers, Little River, Rock Creek, and Steamboat Creek (Bakken, 1970).

<u>Pre-Settlement timeline</u>

1804 - 1806	Lewis & Clark Expedition
1810	John Jacob Astor establishes Pacific Fur Company in Astoria
1818	Umpqua Massacre – North West Company fur seekers kill at least 14 Indians in northern Douglas County
1826	David Douglas (botanist) travels Douglas County
1828	Smith Massacre – Jedediah Smith's party attacked by Indians at the junction of the Smith and Umpqua Rivers; 14 killed

The population of the Umpqua Valley is estimated to have been between 3,000 and 4,000 before the arrival of the white man (Schlesser, 1973). The Europeans brought diseases that reduced the population of Oregon Indians. Disease occurrences in Douglas County probably started between 1775 and the 1780s with the first smallpox outbreak. A smallpox or measles outbreak may have affected the far western part of the county in 1824 and 1825. The possibility of malaria in the central portion of the county occurred in 1830 through 1837. Smallpox was documented in the coastal portions of Douglas County in 1837 and 1838. Measles occurred in the western portions of the county in 1847 and 1848 (Allan, 2001). "The five bands of Athabascan speakers who lived along the Cow Creek were decreased to half their original number due to an epidemic during the severe winter of 1852-53" (Chandler, 1981, p. 9).

2.2. *Settlement period: late 1840s to the 1890s*

2.2.1. Early settlement

California's gold rush was one factor in the early settlement of the county. First of all, the new miners demanded goods and services. "The California Gold Rush of 1849 suddenly created a market for Oregon crops and employment for Oregonians" (Allan, 2001). Secondly, travelers on their way to the gold fields in southern Oregon passed through Douglas County. Many of these visitors observed the great potential for farming and raising stock and, after the trip to California, returned to Douglas County to take up permanent residence

The Donation Land Act of 1850 was a further impetus for the settlement of Douglas County. This act specified married couples arriving in Oregon prior to December 1850 could claim 640 acres; a single man could obtain 320 acres. Men arriving after December 1850 were allowed to claim 320 acres if married and 160 acres if single. The patent to the land was secured with a four-year residency. The Donation Land Act was scheduled to end in December of 1853 but an extension increased this deadline to 1855. After 1855, settlers in Oregon were allowed to buy their land claims for $1.25 per acre following a one-year residency (Allan, 2001; Patton, 1976).

In 1846, an emigrant wagon and supply road into southwest Oregon was opened (Applegate Trail) and brought new settlers to the Umpqua Valley. The Glide area began being settled around 1852 and Honey Creek by the early 1890s (USDA Forest Service, 2001). Large numbers of settlers entered Douglas County between 1849 and 1855. Lands were settled along Calapooya Creek, in Garden Valley, at Lookingglass, at the mouth of Deer Creek (Roseburg), in Winchester, and along Myrtle and Cow creeks. For example, in Cow Creek Valley almost all open lands were claimed by 1855 (Chandler, 1981). The rich bottomland of the Umpqua Valley was very attractive to the emigrants looking for farmland. As the number of settlers increased, the Indian population of the county decreased. Diseases, as mentioned previously, took a toll, as did the Indian Wars of the 1850s. Douglas County Indians were relocated to the Grand Ronde Reservation in the 1850s.

2.2.2. Gold mining

One of the earliest mines in Douglas County was the Victory Mine, close to Glendale. The Roseburg Review on November 6, 1893, reported the mine consisted of 800 acres of gold-bearing gravel. In order to work the Victory Mine, miners built a dam across a canyon with a reservoir capable of holding millions of gallons of water.

The early 1850s brought placer mining to the South Umpqua near Canyonville and Riddle. The miners worked many different branches of Cow Creek. Coffee Creek, a tributary of the South Umpqua, was one of the most important mining areas. A minor rush occurred in the Steamboat area - east of Canton Creek - in the 1870s.

<u>Mining techniques</u>

Placer mining was commonly used to recover gold. Gravel deposits were washed away using water from ditches (often hand-dug) and side draws. The runoff was directed through flumes with riffles on the bottom. The gold settled out of the gravel and was collected by the riffles.

Hydraulic mining was placer mining on a large scale. A nozzle or “giant” was used to direct huge amounts of water - under pressure - at a stream bank. The soil, gravel, and, hopefully, gold was washed away and captured downstream.

In May of 1890 construction was begun on the "China Ditch." This ditch was to bring water from Little River to the Lower South Umpqua River area. The initial purpose was for use in hydraulic mining with future goals of floating logs and irrigating the local fruit orchards. In 1891, 200 Chinese laborers were hired, giving the ditch its name. About 18 miles of ditch were dug before the work was stopped in 1893 by a court order - employees had not been paid. The target destination of Little River was never reached (Tishendorf, 1981).

Gold mining affected the fish habitat of the streams and rivers. The drainage patterns were changed when miners diverted and redirected water flow. The removal of vegetation along the stream banks increased erosion and added sediment to the waterways. Salmon spawning grounds were destroyed when the gravels were washed away and the stream bottom was coated with mud. On the other hand, placer and hydraulic mining may have created spawning areas by washing new gravels into the streams.

Settlement period timeline

1849	California gold rush
1850	Donation Land Act
1850s	Indian Wars; Douglas County Indians relocated to Grand Ronde Reservation
1860	Daily stages through Douglas County
1861	Flood
1862	Homestead Act
1870	*Swan* travels Umpqua River (Gardiner to Roseburg)
1878	Timber and Stone Act
1872	Railroad to Roseburg
1873	Coos Bay Wagon Road completed
1887	Railroad connection to California

2.2.3. Agriculture

The early settlers brought livestock and plant seeds to use for food and for trade. Settler livestock included cattle, sheep, hogs, and horses. The early farmers sowed cereal crops of oats, wheat, corn, rye, and barley. Gristmills - used to grind the cereal crops into flour or feed - were first established in Douglas County in the 1850s and within 20 years almost every community in the county had one. Water was diverted from nearby streams and rivers to create power for the gristmills.

The early farmers reduced the indigenous food sources and changed the natural appearance of Douglas County. Hogs ate the acorns in the oak groves. The camas lilies were nipped by the livestock and diminished in number when the bottomlands were plowed to plant cereal crops. The deer and elk herds decreased as the settler population increased. Indians were not allowed to burn the fields and hillsides in the fall because the settlers were concerned about their newly constructed log cabins and split rail fences.

In 1855 William H. Wilson and Henry Beckley left the Scotts Valley area due to grasshopper problems and brought their cattle into the upper reaches of Rock Creek to find forage (perhaps to the Elk Meadows area). This is the earliest known agricultural use of the Rock Creek Watershed (USDI Bureau of Land Management, 1996).

2.2.4. Commercial hunting

Wild animals were sources of income for some families. County officials posted bounties for animals that killed sheep and chickens. Hunters redeemed scalps of wolves, coyotes, bobcats, cougars and raccoons. The construction of the railroad in the 1870s provided opportunity for commercial sale of deer. Fresh meat or jerky was shipped to Willamette Valley settlements.

In the 1880s, many people hunted for pelts. They worked the Coast Range and Camas Valley areas. In summer and early fall, they moved into the Western Cascades and the Rogue River country. Some killed as many as 2,000 animals per year. Pelters hunted only for hides while others carried out meat and shipped it to Portland. Hides were sold for gloves. Buyers also purchased antlers for making cutlery with horn handles. These activities peaked in the 1890s and began to subside with scaricity of game, growing interest in conservation, and efforts by state and federal officials to regulate the killing of animals on public land.

2.2.5. Commercial fishing

The bountiful trout and salmon of the Umpqua were first sold commercially in the 1850s and 1860s. By the 1870s, with the invention of the steam pressure cooker and canning, conditions had changed to create a salable commodity on the world market. William Rose caught trout and salmon at the confluence of the North and South Umpqua rivers and sold them as far north as Portland. He caught the fish at night with nets and then shipped them out early the next morning. In 1877 the *Hera* – a boat with 100 Chinese workers and canning machinery – visited the lower Umpqua River. Local fishermen used gill nets stretched from the shore into the river to capture large numbers of fish as quickly as possible. Six-foot-long sturgeons were unwelcome captives. They were clubbed and thrown back in the river to rot on the shore. Yearly visits by the *Hera* and other cannery boats continued for three decades. Commercial fishing at a much smaller level occurred along the North Umpqua River. The fishermen constructed small dams and breakwaters. These obstructions created eddies and slow-moving water - ideal for capturing fish with gill nets.

2.2.6. Logging

The first wood product export was shipped from the Umpqua estuary in 1850. Trees were felled into the estuary, limbed, and loaded out for pilings and spars on sailing ships.[16] An additional market was found in San Francisco for piles for wharfing. The earliest sawmills in Douglas County appeared in the 1850s. Sawmills were water powered, often connected with a gristmill, and scattered throughout the county. Early sawmills were built on South Myrtle Creek, Pass Creek (north of Drain), the main

[16] Spars (or masts) are tall poles rising from the deck or keel of ships used to support the yards, booms, and rigging.

Umpqua River (at Kellogg), Calapooya Creek, and in Canyonville. In 1892, the Bowler brothers moved a portable sawmill into Rock Creek with the intention of developing a lumber business. Their enterprise did not succeed but it led the way for future uses of the Rock Creek Region. Dams were created to secure water to drive the mills.

Log drives were used on many of the streams and rivers of Douglas County to deliver logs to the mill. The most common form of log drive included loading up the drainages with logs in the drier part of the year and then waiting for a winter freshet. When the rains came and the logs began to float, the "drive" would begin. Loggers would be positioned along the banks and at times would jump on and ride the logs. They used long poles to push and prod the logs downstream. Stubborn log jams would be blasted apart with dynamite. Log drives were often aided by the use of splash dams (see box).

> Splash dams
>
> Loggers created splash dams to transport logs to the mills. A dam was built across the stream creating a large reservoir. Logs were placed in the reservoir. The dam timbers were knocked out and the surge of water started the logs on their journey downstream

The Homestead Act of 1862 brought more migration of settlers into Douglas County. Its greatest influence was in the mid 1890s to 1910s and persisted until the time of World War I. Timber speculation played an important role in the filings on forested homesteads in that period. In 1878, the Timber and Stone Act applied to lands that were "unfit for cultivation" or "valuable chiefly for timber" or stone. The law allowed for citizens to purchase up to 160 acres at $2.50 per acre. This was a bonanza to Douglas County lumbermen. They could get an acre of virgin forest for about the price of a good log.

The Oregon and California (O&C) Railroad Act was passed in 1866 and amended in 1869 to encourage a railroad connecting Oregon and California for lumber trade as well as other commodities. The alternating sections of land within 30 miles of the railroad were given to the railroad company as the incentive to complete the Oregon segment. According to the Oregon State University Forest Sciences Laboratory (1988):

> The Oregon and California Railroad Act of 1866 provided for 3,700,000 acres in Oregon in alternate sections to go to the builder of a railroad line down the Willamette Valley to California (12,800 acres for each mile of track laid)…. The land grant was made on condition that the company sell the land in small tracts (no more than 160 acres each) to bonafide settlers, at a price of no more than $2.50 per acre….[The] railroad had deferred the taking of title to unsold grant lands until there was a market for the property, thus avoiding taxes. This kept those lands unavailable for acquisition by anyone else. On the request of the Oregon legislature, the federal government investigated and discovered that the terms of the O&C land grant had been violated. Litigated before the Supreme Court in 1915, the remaining unsold O&C grant lands, over 2,800,000 acres, were revested by Congress to the United States in 1916.

These revested acres eventually ended up under the Department of Interior and most are currently managed by the BLM (with some small portions managed by the USFS). This led to the alternating pattern of public and private ownership of timber land in Douglas County and probably helped create some of the greatest changes of vegetation in the Rock Creek Region (USDI Bureau of Land Management, 1995a).

2.2.7. Transportation

Improvements in transportation were keys to the economic development and population growth of Douglas County during this time period. The period began with limited transportation options into and through Douglas County. Ships came into the Umpqua estuary and delivered goods destined for both the gold mines of California and the remainder of Douglas County. Goods moved from the estuary inland along the Scottsburg-Camp Stuart Wagon Road. Camp Stuart was a temporary military post occupied in 1851 in the Rogue River Valley. This route passed through Winchester and then into California following the Applegate Trail. Congress funded improvements to the Scottsburg-Camp Stuart Wagon Road and to the old Oregon-California Trail (Portland to Winchester) from 1853 through 1879. These road improvements led to the beginning of stage travel from Portland to Sacramento in 1860. The Oregon and California Stage Company began offering daily stages through Douglas County in July of 1860. A daily stage came through the Cow Creek area starting in 1862 (Chandler, 1981). The Coos Bay Wagon Road opened in 1873 allowing stage travel from Roseburg to Coos Bay.

Another form of transportation was attempted in 1870. A group of hopeful investors, *Merchants and Farmers Navigation Company*, financed a small sternwheel steamer, *Swan*, to navigate the Umpqua and South Umpqua Rivers from Gardiner to Roseburg. The voyage began February 10, 1870, and became a great social event as whole communities lined the riverbanks to watch the *Swan's* progress. Witness accounts recall the slowness of the trip upriver and the swiftness of the downriver journey. The *Swan* safely arrived in Roseburg with the captain, Nicholas Haun, very optimistic about vessel travel on the Umpqua. Captain Haun thought a minor clearing of the channel would allow a ship the size of the *Swan* to pass the rapids except in periods of very low water (Minter, 1967).

The U.S. Corps of Engineers surveyed the river and reported that it could be made navigable seven months of the year. Congress appropriated money for the removal of obstructions. Reports are sketchy about how much channel modification was actually carried out. One witness remembered some blasting in the Umpqua River channel near Tyee. In February, 1871, the *Enterprise* began a maiden voyage upriver but, because of low water, only reached Sawyers Rapids (downstream of Elkton). The cargo was subsequently dumped at the rapids, and no further attempt was made to navigate the upper Umpqua (Minter, 1967).

River travel on the Umpqua was soon forgotten when the Oregon California Railroad reached Roseburg in 1872. Financial problems stalled the southerly extension of the railroad for 10 years. Those 10 years proved to be an economic boon for Roseburg.

Travelers heading south took the train to Roseburg and then rode the stage into California. Travelers poured in and out of Roseburg creating a need for new hotels and warehouses and leading to rapid population growth. Finally, in 1887, the remaining tracks were completed, extending the railroad into California.

2.3. Onset of the modern era: early 1900s to the 1960s

2.3.1. Transportation

The first automobiles arrived in Oregon in 1899 and in Douglas County in the early 1900s. After 1910 automobile travel in western Oregon became a key motivation for road construction and improvements in Douglas County. One of the first major road construction projects in the state was the Pacific Highway (Highway 99) running from Portland to Sacramento and Los Angeles. Construction began in 1915 and by 1923 Oregon had a paved highway running the entire length of the state. In Douglas County the Pacific Highway passed through Drain, Yoncalla, Oakland, Sutherlin, Roseburg, Myrtle Creek, Canyonville, and Galesville for a total length of 97.7 miles.

Other major road construction projects completed before 1925 include routes between Roseburg and Coos Bay, Dixonville to Glide, Drain to Elkton, and Elkton to Reedsport. These roads were built to meet the expanding numbers of vehicles in the state. Registered vehicles in Oregon rose from 48,632 in 1917 to 193,000 in 1924. World War II slowed the road construction projects in the early 1940s but when the soldiers returned in 1945 road construction accelerated. The most important road-building project in the 1950s was Interstate Five (I-5), a four-lane, nonstop freeway, completed in 1966. I-5 was a windfall for cities along its path - Roseburg for example - but difficult for many bypassed cities including Drain, Yoncalla, Oakland, Riddle, Myrtle Creek, and Glendale.

The 1930s was an era of major road construction into rural areas of Douglas County especially on federal lands. The Civilian Conservation Corps worked thousands of hours during this decade building roads on both the Siuslaw and Umpqua national forests. By 1939 the North Umpqua Forest Highway had been extended east from Steamboat to Bradley Flats. A dirt and gravel road was constructed linking the Umpqua Basin with Highway 97 by 1940. This road however followed a narrow and circuitous route up Copeland Creek.[17] Between 1945 to about 1960 road building accelerated and proceeded at a high pace. Major lumber companies and both the Forest Service and Bureau of Land Management expanded forest access roads into the Western Cascades and Coast Range by hundreds of miles. The North Umpqua Hydroelectric Project was constructed in the late 1940s increasing the need for a transportation network up the North Umpqua corridor. The paved highway with its current alignment to the Cascade crest was completed in 1964 (USDI Bureau of Land Management, 2001).

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[17] Copeland Creek is a tributary to the North Umpqua River above Steamboat Creek west of this assessment area.

The Chamberlain-Ferris Act of 1916 revested to the federal government 2.3 million O&C acres (Oregon and California Railroad land) with an estimated 50 billion board feet of timber. This land was administered by the General Land Office and now the Bureau of Land Management.

2.3.2. Logging

Logging expanded in Douglas County in the early 1900s for two main reasons: the invention of the steam donkey engine and the use of logging railroads. The steam donkey engine was a power-driven spool with a rope or cable attached for yarding logs. It could be mounted on a log sled and yard itself, as well as logs, up and down extremely steep slopes. The logs were yarded with the steam donkey engine and then hauled to sawmills on logging railroads. In Douglas County more than 150 miles of logging railroads were used between 1905 and 1947.

Gyppo loggers came into prevalence in the 1920s. These were loggers and mill owners with limited capital trying to break into the market. The term "gyppo" related to the real possibility that these loggers would "gyp" or not pay their workers. Many of the gyppos operated on the edge, cutting corners and costs whenever possible. Equipment breakdowns, fuel leaks, and accidents were common occurrences. The gyppo loggers searched for valuable logs, such as cedar, left after the initial logging.

1890s to 1960s timeline

1900	Fish hatchery established near Glide
1903	Prunes major agricultural crop
1909	Flood
1916	Chamberlain-Ferris Act of 1916
1923	Pacific Highway (Highway 99) completed
1927	Flood
1929	Northwest Turkey Show in Oakland (Douglas County ranked 6th in U.S. turkey production)
1936	Kenneth Ford established Roseburg Lumber Company
1945	Returning soldiers (WWII) create a housing and timber boom
1947-1956	Eight dams are built in the headwaters of the North Umpqua River as part of the North Umpqua Hydroelectric Project
1950	Flood
1955	Flood
1962	Columbus Day storm
1964	Flood
1966	Interstate Five completed

Splash dams and log drives were still used in Douglas County into the 1940s (Markers, 2000). Waterways used to transport logs were scoured to bedrock, widened, and channelized. The large woody debris was removed and fish holding pools lost. Spawning gravels were removed or muddied (Markers, 2000). Log drives were phased out as more roads were built into the woods. In 1957 log drives in Oregon were made illegal; sport fishermen led the campaign against this form of log transport (Beckham, 1990).

Logging roads, built in increasing numbers from the 1950s, also had an impact on fish habitat. Landslides associated with logging roads added sediment to the waterways. Logging next to streams removed riparian vegetation which most likely resulted in higher summer stream temperatures and increased bank erosion. Fewer old-growth conifers were available as a new wood source in many Douglas County streams (Oregon Department of Fish and Wildlife, 1995).

Following World War II larger sawmills with increased capacity began to operate just in time to take advantage of the housing boom. Kenneth Ford established Roseburg Lumber Company in 1936 by taking over the operation of an existing sawmill in Roseburg. He built his own mill at Dillard in 1944.

Some logging began in the Rock Creek Region as early as the 1940s following the expansion of road construction into rural forest land. Harvest levels expanded in the 1960s (see Section 2.7.2) following the construction of the North Umpqua Highway in 1964 (USDI Bureau of Land Management, 2001). This provided a main transportation connection to mills and to the railroad located further down in the valley.

2.3.3. Hatcheries and commercial fishing

Douglas County's first fish hatchery was located northeast of Glide on the North Umpqua River near the mouth of Old Hatchery Creek (just over two miles below the mouth of Rock Creek). Built in 1900, the hatchery had an initial capacity for 1,000,000 eggs. In its first year of operations 200,000 salmon eggs were harvested. Another 600,000 chinook salmon eggs were brought in from a federal hatchery on Little White Salmon River.[18] These eggs produced approximately 700,000 fry that were released in the Umpqua river system. In 1901 a hatchery was constructed at the mouth of Steamboat Creek. A hatchery on Little Mill Creek at Scottsburg began operation in 1927 and operated for eight years (Bakken, 1970; Markers, 2000). In 1920 a trout hatchery was built on Rock Creek. In 1925, the salmon hatchery that was located on the North Umpqua River near Old Hatchery Creek was relocated to the Rock Creek Hatchery (USDI Bureau of Land Management, 1996). Except for several years in the 1970s, the hatchery has operated since then and is the single remaining hatchery in Douglas County.

The Rock Creek hatchery dam was built in the 1940s. Although there is a fish passageway, it was later discovered to be a partial barrier to fish movement upstream. Telemetry data showed that fish cannot find the passageway so they head back down to the North Umpqua River and continue back and forth between there and the Rock Creek dam (see Section 3.1.2), (Muck, 2005).

In the 1910s large numbers of fish eggs were taken from the Umpqua River system. "In 1910 the State took four million chinook eggs from the Umpqua; the harvest mounted to

[18] Little White Salmon River is located in south central Washington. It flows into Drano Lake located just up from the Bonneville Reservoir on the Columbia River.

seven million eggs in 1914. Over the next five years the State collected and shipped an estimated 24 million more eggs to hatcheries on other river systems" (Beckham, 1986, p. 208). The early hatcheries were focused on increasing salmon production for harvest. "Hatcheries have been essential in maintaining supplies of salmon, whose natural spawning grounds and migration routes have been severely disrupted in many areas by dams, agricultural reclamation and irrigation, and by timber operations" (Patton, 1976, p. 168). In recent years the effect of hatchery fish on the natural fish population has been examined. For instance, Flagg *et al.* (2000) have concluded that salmonids raised in an artificial hatchery environment do not respond the same as fish reared in a natural setting. However, they also felt current information was not sufficient to make concrete conclusions about how hatchery fish affect the survival of wild fish.

Commercial salmon fishing was an important element in the economy of Douglas County until about the 1940s. The fishing industry declined for many reasons including: overuse of the resource; logging practices that washed out spawning gravels and blocked fish migration; and possibly the egg harvest program mentioned above. By the late 1940s, the fishery was reduced to recreational or sport harvest rather than commercial.

2.3.4. Agriculture

Crop irrigation was introduced to Douglas County farmers in 1928. J.C. Leady, Douglas County Agent (predecessor of County Extension Agent) gave a demonstration of ditch blasting in 1928. In the demonstration one ditch in Melrose and one ditch in Smith River was created by blasting. The dimension of the resulting ditch was four feet deep by six feet wide. The report recommended this method of ditch creation in the low lands adjoining the Umpqua and Smith Rivers (Leedy, 1929).

In 1935 Douglas County Agent J. Roland Parker introduced crop irrigation using gas and electric pumps. "The lift necessary to place irrigation water upon most land, laying along the numerous streams throughout the county, ranges from 15 to 30 feet. Only in exceptional cases will a higher lift be necessary" (Parker, 1936, p.15). Parker predicted the applications for water rights and the installation of irrigation systems would double in 1936. In his 1935 Annual Report, Parker listed 21 farms and their proposed irrigation projects. The water sources included the South Umpqua River, Calapooya Creek, Little River, North Umpqua River, Tenmile Creek, Myrtle Creek, Hubbard Creek, and Cow Creek (Parker, 1936).

The appropriation of water rights for agriculture left less water in the streams for fish, especially in the critical late months of summer. In Oregon, water law follows the "prior appropriation" doctrine that is often described as "first come, first served." The first person to obtain a water right on a stream will be the last user shut off when the streamflows are low. Junior users have water rights obtained at a later date than higher priority users. Generally speaking, in periods of low water, the water right holder with the oldest priority date is entitled to the water specified in the senior water right regardless of the needs of junior users. There are exceptions to this prior appropriation doctrine including prioritization of water rights obtained prior to 1909 and domestic water rights (Oregon Water Resources Department, 2003).

Homesteading had begun near the mouth of Rock Creek by the early 1800s and would eventually result in the establishment of the community of Hoaglin. Hoaglin was located several miles up Rock Creek, centered between Kelly Creek and Taylor Creek. By 1896 there were 15 families reported in the community which stretched between McComas and Harrington Creek, and included a school and post office. These early settlements were based largely on subsistence farming, supplemented by hunting and trapping. Hoaglin eventually disappeared by the first decade of the twentieth century. Subsistence farming has continued, however, on a smaller scale, notably by the Rice and Taylor families (USDI Bureau of Land Management, 1996).

Although Euro American use of the Middle North Umpqua Watershed began in the mid 1800s, it was largely transitory until after World War I when the Biddle Ranch was established near the eastern edge of the watershed. In the 1930s, the Doyle brothers established homesteads in the upper reaches of Honey Creek. Subsequent residential locations have been concentrated between Honey Creek and Susan Creek (USDI Bureau of Land Management, 2001).

2.4. Modern era: 1970s to the present

2.4.1. Logging

In 1972 the Oregon Forest Practices Act became effective. Standards were set for road construction and maintenance, reforestation, and streamside buffer strips. New rules were added in 1974 to prevent soil, silt, and petroleum products from entering streams. Starting in 1978, forest operators were required to give a 15-day notification prior to a forest operation. New rules were also added relating to stream channel changes. In 1987 riparian protection was increased - specific numbers and sizes of trees to be left in the riparian areas were specified. New rules in 1994 were added to create the desired future condition of mature streamside stands. Landowner incentives were provided for stream enhancement and for hardwood conversion to conifer along certain streams (Oregon Department of Forestry, 2002).

<u>1970 to the present timeline</u>

1971	Flood
1972	Clean Water Act
1972	Oregon Forest Practices Act
1973	Endangered Species Act
1974, 1981, 1983	Floods
1994	Northwest Forest Plan results in reduced federal log supplies
1996	Flood
1999	International Paper Mill in Gardiner closed

In the 1970s, Roseburg Lumber's plant in Dillard became the world's largest wood products manufacturing facility. Key to the development of this facility was the availability of federal timber from both the U.S. Forest Service and the Bureau of Land

Management. A housing slump in the early 1980s and a decline in available federal timber in the 1990s resulted in the closure or reduced the size of many other manufacturing companies in the 1980s and 1990s (Oregon Labor Market Information System, 2002). In 2002 and 2003, increased wood products imports from foreign producers such as Canada and New Zealand resulted in a surplus of timber-based products in the US. This caused a depression in the local forest products manufacturing industry. In April, 2003, Roseburg Forest Products, the largest private employer in Douglas County, laid off approximately 400 workers.[19] However, by the second half of 2004 and on into 2005 the wood products industry experienced strong growth in Douglas County. Allyn Ford, chief executive officer of Roseburg Forest Products attributes this strong period to record prices, production, and demand created by low interest rates that caused a boom in housing and construction.[20] Although the market has continued to be strong in 2005, Sutherlin suffered a setback in employment when the Murphy Plywood plant burned down in July, 2005. The result of the fire was the loss of approximately 300 jobs in the community of around 7,000 people. It is still unknown whether the plywood plant will be rebuilt in Sutherlin.

Logging in the Rock Creek Region began by the 1940s. Harvest of federal land was in full swing by 1972 and peaked by the late 1970s to mid 1980s. The Canton Creek and Rock Creek watersheds experienced the bulk of their harvest on federal land between 1977 and 1984, while the Middle North Umpqua Watershed had its highest harvest levels occur from 1977 on into 1988 (see Section 2.7.2). Harvest records on private land were not available.

2.4.2. Dam construction

The North Umpqua Hydroelectric Project was constructed between 1947 and 1956 about 60 miles east of Roseburg. It uses water from the North Umpqua River and two main tributaries: Clearwater River and Fish Creek. The project, currently owned by PacifiCorp, includes eight developments; each typically consists of a dam, waterway (canals and flumes), penstock (a pipe used to carry water to a turbine), and powerhouse. In addition, three main reservoirs are associated with the dams. After exhausting its fifty year license, PacifiCorp was recently granted a new license in 2003 for an additional 35 years of operation (USA Federal Energy Regulatory Commission, 2003; PacifiCorp, 2005).

According to the 1998 North Umpqua River Cooperative Watershed Analysis, the project has affected downstream conditions on the North Umpqua River including the portion within the Rock Creek Region in a number of ways.[21] The dams have reduced the downstream transport of gravel, fine sediment, and large woody debris. These impacts from the dams, combined with the potential losses of large wood due to timber harvest

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[19] This information is based on conversations between Nancy Geyer from the UBWC, Umpqua Chapter Society of American Foresters past presidents Jake Gibbs and Eric Geyer, and Dick Beeby of Roseburg Forest Products.
[20] From the News Review article: *RFP Chief: Wood products industry riding 'perfect storm'* published online May 3, 2005. Available at: www.newsreview.info accessed March 14, 2006.
[21] Stillwater Sciences, 1998.

and road construction has most likely reduced instream habitat complexity, pool area and frequency, and cover in the downstream areas.

Both the Soda Springs and Slide Creek dams were constructed without fish passage thus blocking upstream migration of fish to historical habitat and downstream migration to varying degrees. Reductions in stream flows may decrease the ability of some animals such as fish and aquatic insects to use stream channels as migration corridors, due to inadequate depth and/or changes in water temperatures. Under the recent relicensing agreement, many of these concerns and more are being addressed through mitigation measures taken by PacifiCorp, in cooperation with the ODFW, US Forest Service, Bureau of Land Management, and private landowners. Some of the effects on fish cannot be eliminated such as the barrier at the Soda Springs dam; therefore additional off-site mitigation to improve fish habitat in tributaries below the dam are planned. Many of these are specifically targeted in the Rock Creek and Canton Creek watersheds (see Section 6.1 for more information on off-site mitigation planned in the Rock Creek Region).

During the late 1960s through 1980s several additional dams were constructed in Douglas County. The largest ones are included in Table 2-1 obtained from the Oregon Water Resources Department. Dams have both beneficial and detrimental influences on fish. Water release during periods of low flow in the late summer can assist fish survival. However, Galesville Dam and Berry Creek Dam are complete barriers to fish movement. Cooper Creek Dam and Plat I Dam may be barriers to juvenile fish.

Year completed	Dam name	Creek	Storage (acre feet)
1967	Plat I Dam	Sutherlin	870
1971	Cooper Creek Dam	Cooper	3,900
1980	Berry Creek Dam	Berry	11,250
1985	Galesville Dam	Cow	42,225

Table 2-1: Name, location, and storage capacity of Umpqua Basin dams built since 1960.

2.4.3. Tourism and recreation

The rapid expansion of tourism in Douglas County came after World War II. The improving economy left Americans with an increased standard of living and the mobility of automobile travel. The Umpqua Valley offers scenic attractions and good access roads. Interstate Five and the connecting State Highways 38, 42, and 138, provide access to Umpqua Valley's excellent tourist areas. Tourist destinations include Crater Lake National Park, Wildlife Safari, Salmon Harbor, and the Oregon Dunes National Recreation Area. Tourism is a growing industry in Douglas County.

The Rock Creek Region offers numerous popular recreation opportunities for both out of town visitors and local residents. In 1988 the North Umpqua River was designated a Wild and Scenic River from the Soda Springs Powerhouse to the river's confluence at Rock Creek (a total of 33.8 miles). The river is used for a variety of river-related recreational opportunities such as fly angling, bait fishing, swimming, rafting, and boating with drift boats. Use of the river by private boaters began in earnest by 1972. According to the USFS Middle North Umpqua Watershed Analysis (2001), private boating use has shown a steady increase since 1994. Outfitter guides for whitewater rafting began commercial use of the river in 1974. Permits issued by the USFS and the BLM for outfitter guides have fluctuated between two and twenty permits each year since 1992 (USDA Forest Service, 2001).

The Rock Creek Region is accessible for day-use by residents of Roseburg and the surrounding communities in Douglas County. In addition to the water recreation mentioned above, hunting, hiking, picnicking, wildlife viewing, biking, sight-seeing, and camping are all popular recreational uses. All of the developed recreational use facilities are managed by the Roseburg BLM, the USFS North Umpqua Ranger District, or Douglas County. The Millpond, Rock Creek, and Lone Pine campgrounds are found within the Rock Creek Watershed in the vicinity of Rock Creek. Together, these three campgrounds offer a total of 50 campsites that are regularly used. In the Canton Creek Watershed, the Canton Creek and Scaredman Creek campgrounds offer a total of 15 sites. The Middle North Umpqua Watershed has Susan Creek, Bogus Creek, and Williams Creek campgrounds for a total of 48 campsites. The Region also has 21.7 miles of maintained trails and two day use areas.

2.4.4. Settlement patterns and urbanization

Unlike many other Oregon counties, over 50 percent of Douglas County residents lived outside incorporated cities in 1980. Population density in 1980 was greatest in the central valley from Riddle to Roseburg to Sutherlin and lowest in the eastern and northwestern areas of the county (Cubic, 1987).

The population of Douglas County in 2000 was 100,399, which is an increase of almost 32,000 since 1960 (see Figure 2-1). Urban, industrial, and rural residential areas have developed along the South Umpqua River to the confluence with the North Umpqua River and around the Umpqua estuary. Water quality along these streams gained protection with the passage of the Clean Water Act in 1972. The Clean Water Act established pollution discharge levels on point sources such as sewage treatment and wood processing plants.

2.5. Population growth

Figure 2-1 shows population growth data for Douglas County during the settlement period (1840s-1890s), the onset of the modern era (1900-1960s), and the modern era (1970s-present). There are no population centers within the Rock Creek Region. The nearest communities of Idlyld Park and Glide are both small population areas of approximately 800 and 1,690 people respectively. Although there are no towns, there are residents living within the Rock Creek Region. The number of people within the Region has increased slightly over the years; however, the bulk of land is either owned by private timber companies, or the public (managed by the BLM and USFS), a factor which does not allow for much population expansion in the area. The residents in the Region and in the nearby towns generally commute to Roseburg or other cities for work, are self-employed, retired, or operate small stores that rely on recreation and tourism from use of the North Umpqua River corridor (see Section 1.3.2). Use of the Rock Creek Region, however is directly related to the increased growth of Douglas County since access is only about 30 minutes from Roseburg (see Sections 2.4.3 and 2.4.4).

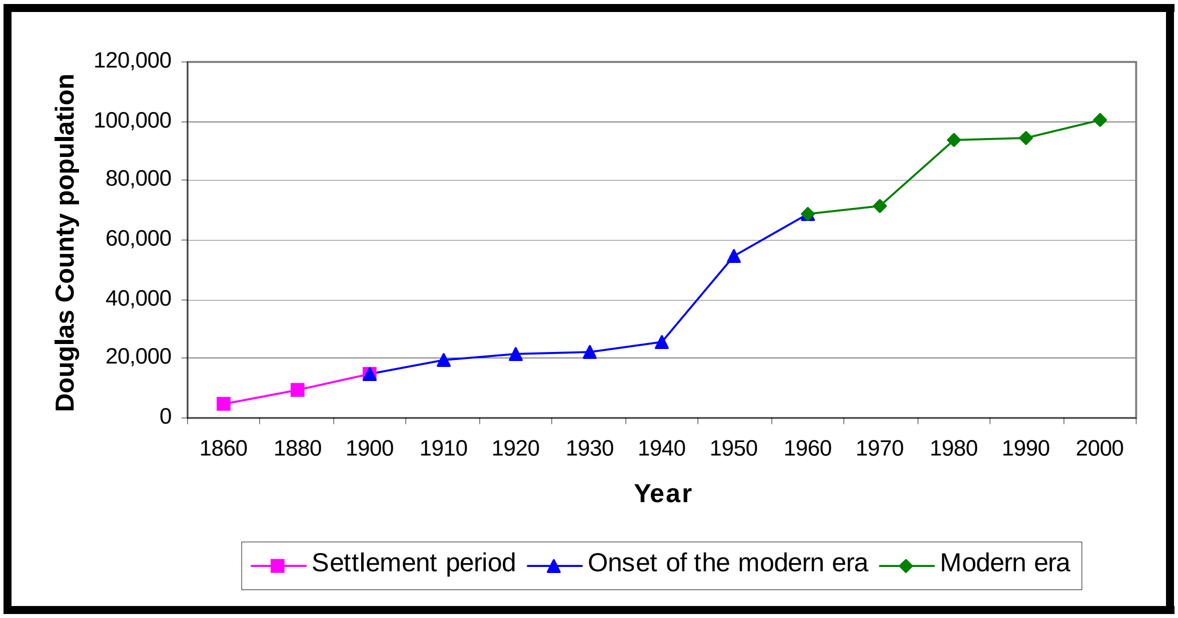

Figure 2-1: Population growth in Douglas County from 1860 through 2000.

2.6. Fish abundance and use[22]

The North Umpqua River's rich abundance of fish offers many recreational fishing opportunities. The river and its tributaries provide spawning and rearing habitat for many of the salmonid species that support commercial fisheries in the Umpqua Estuary and along the Oregon coast. Many of these populations depend on major tributaries to the North Umpqua River, such as Rock Creek and Canton Creek. Residents of Douglas County have fished the North Umpqua River and its tributaries for thousands of years. Fly fishing on the river became popular in the 1930s. This method of fishing has a dedicated following especially in a section of the North Umpqua River within and just below the Rock Creek Region where artificial fly fishing only is permitted.

2.6.1. Coho

Historically, coho salmon are thought to have been the most abundant anadromous salmonid in the coastal waterways of Oregon. In exceptional years they were estimated at one million returning adults. In 1924, an estimated 250,000 coho were harvested at the mouth of the Umpqua River. Over-harvesting from the commercial fishing industry initiated a decline in coho in the early 1900s.

[22] Fish count data used in this section is from the *North Umpqua River Fish Management Plan* (Andersen *et al.*, 1986) and the Winchester Dam counting station located on the lower North Umpqua River north of Roseburg.

Sharp declines in the Umpqua fishery began in the 1930s. From 1946 to 1980 wild runs of coho on the North Umpqua River fluctuated wildly from a high of 3,066 in 1952 to a low of 204 fish in 1970 recorded at the Winchester Dam. Fish counts averaged 1,350 through the 1960s. Runs generally declined coast-wide in the 1970s. The North Umpqua run reflected this decline with an average ten-year count (1970 to 1979) of 446 wild fish per year. Numbers of fish since 1980 have been increasing steadily with the most recent (2004) counts at 4,025 wild coho retuning.

Hatchery coho on the North Umpqua River began returning in large numbers in 1982. The higher total coho fish counts since 1982 are a direct result of these increased hatchery returns including 6,332 coho in 1985. A new hatchery program was started in the North Umpqua River in response to requests by fishermen and public officials for higher coho production on the southern Oregon coast and to establish a brood source for use on other Umpqua streams. In 1983, data on the distribution and catch of coho in the ocean that originated from the Rock Creek Hatchery showed that 71 percent of the offshore ocean catch was within Oregon and 29 percent in California. The ten-year average total coho fish count from 1995 to 2005 is 10,843 fish. The average of wild coho counted for this same ten years is 1,946 fish.

Sport harvest of coho in the North Umpqua was low prior to 1983. Most were caught incidentally while fishermen were trying for late summer steelhead. Between 1970 and 1980, in-river sport catch ranged from 12 to 159 fish annually with an average of 55 fish. Escapements in this same period ranged from 117 to 922 fish with an average of 446.[23] Escapements and fish caught increased dramatically in 1982 with higher numbers of fish in the river. In 1986, ODFW's coho policy in the North Umpqua River was to manage for both wild and hatchery fish with an emphasis on hatchery fish.

2.6.2. Summer steelhead

Summer steelhead runs between 1946 and 1985 averaged 3,385 wild adults returning to the North Umpqua River. Individual ten-year averages during this time fluctuated between 2,300 and 4,600 fish per year, reflecting the natural fluctuations expected with changing freshwater and ocean conditions. The wild run in 1986 was considered stable with no long-term trend up or down.

A hatchery program was initiated in Bandon with the first release of summer steelhead smolts in 1958. In 1979 the program was moved to the Rock Creek Hatchery. Returns of hatchery adults were modest until 1969 when over 10,000 summer steelhead hatchery adults were counted compared to just over 4,000 wild fish. The high numbers reflected large numbers of hatchery smolts released and favorable ocean conditions. The hatchery program was reduced in 1970 for fear that an extremely large artificial run could adversely influence wild summer steelhead or other species in the North Umpqua River

[23] Escapement measures the number of fish potentially available to spawn in the rivers. It is determined by fish counts minus fish caught. Fish caught is solely based on tags turned in by fishermen. It is expected that not all tags were turned in implying that more fish may have been caught. However, some fish caught where tags were turned in occurred below the Winchester Dam fish counting station. This would mean the escapement numbers could be higher.

sub-basin. Average summer steelhead hatchery and wild fish returns between 1975 and 1985 were 4,370 and 4,872 fish per year respectively.

The sport fish catch has been monitored since 1970. The annual harvest between 1970 and 1983 ranged from 2,100 to 8,300 with an average of 4,400 fish per year. Approximately 45 percent of the fish returns were caught by anglers, leaving between approximately 2,000 and 9,800 potentially available to spawn in the North Umpqua and its tributaries. Beginning in the mid 1970s there has been a steady increase in anglers releasing most or all of the summer steelhead they catch. By the mid 1980s, an estimated sixty-five percent of fly-caught summer steelhead was being released back into the river.[24] Assuming these released fish are caught again by other anglers, the amount of anglers supported by the summer steelhead sport fishery should be higher, increasing the value of the sport fishery. However, data were not available to determine how many anglers are fishing the North Umpqua River for summer steelhead.

2.6.3. Winter steelhead

Total annual winter steelhead runs between 1946 and 1985 ranged from 3,800 to 11,200 fish with an average of 7,188. Wild runs between 1972 and 1985 averaged about 6,400 fish per year (only slightly below the forty year average). The lowest returns of wild fish occurred in 1983 with 3,853 and the highest in 1985 with 8,404 fish (above the forty year average). Fluctuations of this magnitude within only two years probably more reflect ocean survival conditions rather than survival conditions in the North Umpqua River. More recent data on winter steelhead counts show an average between 1995 and 2004 of 8,168 fish per year, with the highest returns occurring in 2000 to 2004.

Stocking of hatchery-reared winter steelhead has occurred only a few times; however hatchery fish have been counted at the Winchester Dam every year from 1960 to 1981. According to ODFW, most of these hatchery fish are most likely summer steelhead crossing the dam during winter months. During this period the hatchery component comprised an average of 9 percent of the total return with the largest proportion from 1968 to 1973. Since 1982, the hatchery component has not been determined.

In 1986, the ODFW established a wild fish policy to manage the winter steelhead in the North Umpqua for wild fish only. The wild fish populations were considered healthy with no long-term up or down trend. The North Umpqua is the only totally wild winter steelhead system in the Umpqua Basin and one of only a few large rivers with this totally wild run.

The annual sport harvest between 1970 and 1983 ranged from about 700 to 2,300 with an average of about 1,500 fish per year. Annual counts averaged about 7,300 during this same period and estimated escapements averaged 5,900. The sport catch on the North Umpqua averaged about 19 percent of the population during this period. The runs were considered quite stable with healthy escapement levels.

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[24] Estimate of 65 percent of fly-caught steelhead being released back into the river was from the Steamboaters, a fly-fishing non-profit group located on the North Umpqua River.

2.6.4. Spring chinook

Spring chinook runs between 1946 and 1985 averaged over 5,500 wild adults returning to the North Umpqua. This number was slightly higher (6,109) from 1971 to 1986. Wild runs fluctuated over the forty years; however the numbers suggested no long-term trends..

A hatchery program was initiated to provide more fish to both the river and ocean fisheries and to insure an adequate spawning population. The first hatchery returns began in1952. Returns were modest until about 1969. Hatchery returns between 1969 and 1979 were large (high of 9,358 in 1969), reflecting a stabilized hatchery program and good ocean survival conditions. Hatchery returns from 1978 to 1984 experienced low levels every two to three years. This was attributed to higher water temperatures in Rock Creek affecting rearing conditions in conjunction with poor ocean conditions. While the number of smolts produced remained constant, their sizes were too small (attributed to hatchery rearing conditions of elevated water temperature) and survival was subsequently poor. These problems were largely solved with new hatchery techniques that could produce larger smolts and the number produced was increased from 140,000 to 200,000.

No hatchery smolts were released in any tributaries except Rock Creek to protect the wild stock. An angler use study in 1977 showed 76 percent of the total harvest of spring chinook in the North Umpqua was hatchery fish. These fish also contributed heavily to offshore sport and commercial fisheries. Approximately 71 percent of the North Umpqua spring chinook was harvested off Oregon shores in 1977.

Angling was restricted for spring chinook on the North Umpqua River between Rock Creek and the Winchester Dam. The sport catch in the river between 1970 and 1984 ranged from about 468 to almost 4,000 fish with an annual average of nearly 1,600. During these same years, escapement estimates ranged from about 3,500 to 14,400 (an unusually high count) with an average escapement of 5,900. These escapement numbers are conservative since an estimated 35 percent of the catch occurred below the Winchester Dam.

Spring chinook have been managed for both wild and hatchery fish. While it has been important to maintain the wild populations, the hatchery program proved to be vital to sport and commercial fisheries both in-river and off the Oregon coast.

2.6.5. Cutthroat trout

Cutthroat trout can be anadromous, stream-specific residents, or migratory within a basin. They are found throughout most of the North Umpqua system, but the populations have appeared relatively low. Since resident, migratory, and anadromous cutthroat cannot be differentiated, Winchester Dam counts may include all types. Wild cutthroat trout have been counted at the Winchester viewing chamber from 1946-47 to 1964-65 and the numbers have fluctuated wildly. Fish counts after 1965 were probably higher from the boost of hatchery cutthroat that were stocked just below the dam from 1961 to 1976. Fish counts of cutthroat trout at the dam did not differentiate between wild and hatchery fish; thus the actual number of hatchery cutthroat verses wild cutthroat returning through the dam is unknown. Stray rates on hatchery fish appeared high indicating that many fish counted at the dam during that period may have been hatchery fish. In later years, hatchery fish were also stocked in the Smith River and Scholfield Creek located nearer the mouth of the Umpqua River.

The total cutthroat trout population sharply declined in 1974 prior to discontinuing the hatchery stocking below the dam. In 1979-80 only 25 fish were counted while in 1966-1967, there were 2,364 fish counted, presumably due to hatchery stocking. The average over the entire 35 years was 750 fish. There were two periods of extremely low counts in 1957 to 1960 and 1978 to 1994. The cutthroat count was down to zero in 1992 and one in 1994. Numbers are still low but have increased slightly. The reasons for the low runs are unknown. There are a number of possible influences on the cutthroat trout population decline discussed in Section 3.5.2.

2.7. Forest vegetation history

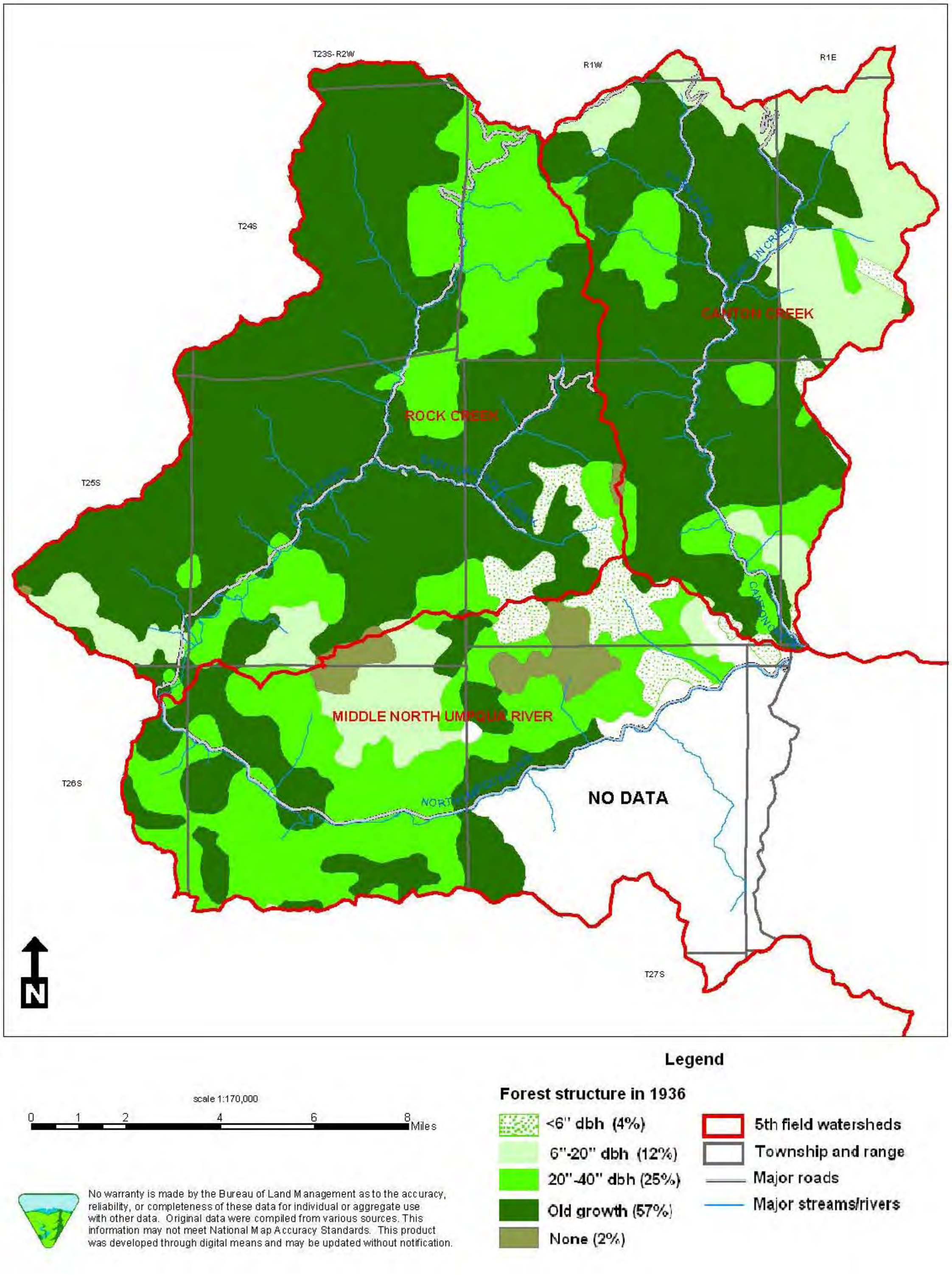
Forest vegetation has been shaped by different disturbances that occur throughout the landscape. Historically fire was the dominant force that shaped forest structure and species composition, although insects, disease, landslides, and stream-channel flooding and erosion have all contributed. In more recent times, industrial timber harvest has replaced fire as the major forest disturbance. Harvest in conjunction with fire suppression has altered the forest structure and composition to shape what we find there today.

Map 2-1 shows forest cover in 1936. No information was available for the southeast portion of the Middle North Umpqua Watershed. Although timber harvesting occurred in the Region as early as 1892, large scale timber harvesting had not become prevalent in the Rock Creek Region in the early 1930s. Therefore, this map provides the best indication of forest cover prior to wide-scale commercial logging. Fifty-seven percent of the mapped region was identified as old-growth forest. These are described as areas where the majority of the dominant trees were greater than 40 inches in diameter. Eighty-two percent of the area mapped contained forest where the majority of trees were greater than 20 inches in diameter.[25] Only two percent of the mapped area did not contain forest cover. Although the vast majority of the area was probably forested, non-forested areas are not uncommon but tend to be smaller in scale. It is possible that the non-forested area would be higher than two percent if the mapping scale were smaller.

2.7.1. Fire

Fire history is evident in nearly every naturally occurring forest stand in Oregon. Prior to logging and road building in more recent times, fire was the primary force responsible for creating the species composition and structural characteristics of forests in Western Oregon, including the Rock Creek Region. The intensity of fires and their frequency of occurrence help determine the resulting forest species mix and size distribution of trees.

[25] This includes the "old growth" and the "20- to 40-inch" categories displayed in Map 2-1.



Map 2-1: 1936 forest patterns for the Rock Creek Region.

More intense fires (hotter) tend to remove more (if not all) of the vegetation but occur less often. In the past, these stand-replacing fires resulted in new forests that established naturally over time. The resulting vegetation begins with pioneer shrub species leading to tree regeneration of species that occurred prior to the fire or are still prevalent in the surrounding areas. The more shade intolerant trees however will tend to dominate the site for many years. Although these stands regenerate over time, they contain no remaining larger trees and tend to develop a more uniform size component especially on better sites. Cooler fires typically occur more often but leave behind more trees and shrubs within the burned area. These residual trees and shrubs tend to be the more fire tolerant species, remain larger in size than the new regeneration that results, and continue to provide some shade to the understory that influences the composition of regeneration.

Middle North Umpqua Watershed

According to a Forest Service analysis of the Middle North Umpqua Watershed, this area had a high severity fire regime in the past (from around 1800 to 1946). This suggests that fires typically burned fairly hot and killed much of the vegetation within their boundaries, resulting in regenerated stands of the same age trees. Approximately 49 percent of the Forest Service land in this watershed was impacted by stand-replacing fires over the past 150 years.[26] The 1914 Oregon State Fire map shows that 43 percent of BLM lands in this watershed were classified as "burned, not re-stocking" indicating high severity fire damage. Many of these fires occurred in the mid to late 1800s and around the turn of the century during a time of little to no fire suppression and wide-spread large fires occurring across the Pacific Northwest.

Map 2-1 illustrates evidence of this high severity regime. Although not all of the data were available in the Middle North Umpqua Watershed, the map shows that in 1936, the watershed had less old growth and more area with smaller-sized trees which we would expect in areas dominated by hot, stand-replacing fires. A similar Forest Service map from 1946 of the entire Middle North Umpqua Watershed shows the unmapped portion dominated by early and mid-seral forests with much less late-seral forest that was concentrated along the North Umpqua River.

The more current regime for this area is considered moderate with signs of transition to high severity. Moderate regimes have a complex mix of low, medium, and high severity fires that occur infrequently (25 to 100 years). Generally more area is impacted by low and moderate severity fires than high. Analysis of recent fires that occurred in the watershed (Apple and Limpy fires in 2002) indicates that at least 90 percent of the area burned at low to moderate intensity.[27] High-severity fires do, however, remain an important disturbance agent in dry Douglas-fir forests, and aggressive fire suppression efforts have had an effect by reducing the intensity of these fires.

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[26] This includes the entire Middle North Umpqua 5th-field Watershed which extends east of the Rock Creek Region along the North Umpqua River just beyond Horseshoe Bend. See Section 1.2.1 for further description of the watershed boundaries.

[27] Both fires occurred within the portion of the Middle North Umpqua Watershed outside the Rock Creek Region assessment area.

Canton Creek Watershed

According to the 1914 Oregon state fire map, approximately 2,800 acres burned along the northwest boundary and in the very north of the watershed. In the BLM Canton Creek Watershed Analysis from 1995, this watershed is considered a moderate fire regime where approximately 67 percent of the area burned at low to moderate intensities resulting in a landscape of 10 to 40 percent early-seral vegetation, 10 to 15 percent mid-seral vegetation, and 45 to 75 percent late-seral vegetation. Large numbers of live and dead trees remained in the low to moderate intensity areas in part because few of these areas burned again. This resulted in multilayered forests (many ages and sizes) with large numbers of snags.

Rock Creek Watershed

Rock Creek can be divided into at least four distinct regions of forest development related to fire. The first in the northeast quarter of the watershed experienced a major fire in 1914 and has not received one since. This area is dominated by low productivity sites that had fairly open forest canopy with small diameter old trees even before the fire. The fire was predominantly not stand-replacing and left behind many residual trees resulting in an even more open forest with approximately ten percent canopy closure and poor understory vegetation.

The second distinct area is located along the south and southeast boundaries. Unlike the previous area, fires have been frequent and extensive along these ridges that separate the North Umpqua Watershed from the Rock Creek Watershed. Map 2-1 shows a deforested area that resulted from a fire in 1936. Shortly after, another large fire occurred prior to 1948. Uniform stands were created from many disturbance events indicating stand-replacing fires were common. Some older stands (over 200 years) survived these fires and have persisted as multi-canopy stands. An example of this is shown on Map 2-1 in the southeast portion of the watershed along the border with the Middle North Umpqua Watershed where a remaining area of old growth is surrounded by forest in the less than 6-inch category. These stands tend to be located in areas that used to be older seral forests predominantly on north facing slopes. Lightning strikes this area frequently and the fire return interval may have been as often as every twenty years. With fire suppression efforts in the 1950s until now, some mid-seral stands have begun to develop multi-canopy structure and understory vegetation indicative of less severe fires. One example is Pacific rhododendron which is a residual species following light fires but is generally very scarce after more severe fires that occur in the Western Cascades of Oregon (Dyrness 1973). The proportion of areas with different stages of forest development appears to have been relatively even at any given point in time with the older forest stages persisting in lower elevation sites along the riparian areas and on sheltered north facing slopes.

The third area located along the southwest border along the east and south slopes of Mt. Scott is somewhat similar to the second area discussed above. Even-aged stands are common and many ages are present throughout the area. More residual trees are found in the mid-seral stands indicating smaller fires or fewer stand-replacing fires. Although some stand-replacement fires have occurred, there is also evidence of partial burns and underburns. Some older stands have less than ten percent canopy closure, but many old growth stands (over 200 years old) appear to have not been impacted by fire in the foreseeable past. The area has a wide variety of stand types indicating a variety of fire intensity and frequency.

The fourth area is the remainder of the watershed and is the largest component of the Rock Creek Watershed. This area was once part of an uninterrupted section of old growth that extended from the Rock Creek Watershed through the eastern half of the Calapooya Watershed to the north. There is no recorded history of large fire events in this region and lightning strike activity is low. Natural stand regeneration from small areas of blowdown, small fires, forest pathogens, and small slumps and landslides created small patch openings within the old-growth forest. The old growth was characterized with a well developed multi-canopy structure and woody debris in all sizes. The forest was primarily Douglas-fir with a smaller component of western hemlock. Areas along the mainstem of Rock Creek were composed of younger, early-seral stands including mixed conifer and hardwood areas presumably due to meandering and stream course changes by Rock Creek over time.

2.7.2. Harvest

Wide-spread intensive timber management began in the late 1940s and accelerated through the mid 1960s with the rapid expansion of roads into rural areas of Douglas County. Noticeable timber harvest within the Rock Creek Region began in the 1940s but reached high levels in the 1960s. This began to dramatically change the vegetation on the landscape. Clearcuts removed entire stands of trees at once much like a high intensity fire. Regeneration of entire harvested stands occurred all at once, rather than slowly over decades. This change in regeneration pattern replaced many multi-canopy stands with even-aged uniform stands of fast growing mostly Douglas-fir trees. Harvest began at the lower elevations along the main stream channels where stands were typically made up of older seral multi-canopy trees.

Table 2-2 shows the BLM and Forest Service harvest in the region by decade. Harvest began in earnest in the Middle North Umpqua and Rock Creek watersheds on federal land in the 1950s while substantial harvest did not occur in the Canton Creek Watershed until the 1960s. However it continued at very high levels through the 1980s with over 91 percent of the harvested area in Canton Creek and 80 percent in Rock Creek occurring in these three decades (1960s through 1980s). Complete timber harvest records are not available for all landowners in the area; however Map 2-2, Map 2-3 and Map 2-4 show stand-replacing timber harvest on all ownerships from 1972 to 2002 for each watershed.[28] Table 2-3 shows the distribution of these acres by watershed.

These harvested stands are now at different ages and in different stages of forest development across the landscape. Assuming these were regenerated shortly after harvest, we can estimate the age and thus the approximate seral stage of these stands (see

[28] Harvest information for all ownerships was obtained from the Roseburg BLM, "change detection" GIS layer. These harvest areas were mapped on aerial photography taken over a series of years between 1972 and 2002. They include visible stand-replacing harvest on all ownerships since 1972.

Section 1.2.7 for more on seral stages). Intermediate stand treatments such as thinning that may or may not have occurred in these stands can adjust the rate of seral stage development by speeding the process of opening up the understory but also can create more uniform overstory conditions in the stand. Approximately 1,506 acres have been commercially thinned on public land throughout the entire Rock Creek Region.

Harvested areas from the 1940s to 1960s and some in the 1970s (see Table 2-2 and Table 2-3) are most likely showing mid-seral development, while the more recently harvested areas since the 1970s are in early-seral conditions. None of the areas harvested are probably showing late-seral conditions, therefore there has been a shift in forest structure from more late-seral (shown by old growth and some of the 20- to 40-inch diameters in Map 2-1) to more early and mid-seral stages of development. This is particularly evident in the Rock Creek and Canton Creek watersheds where larger diameter old-growth forest was most prevalent.

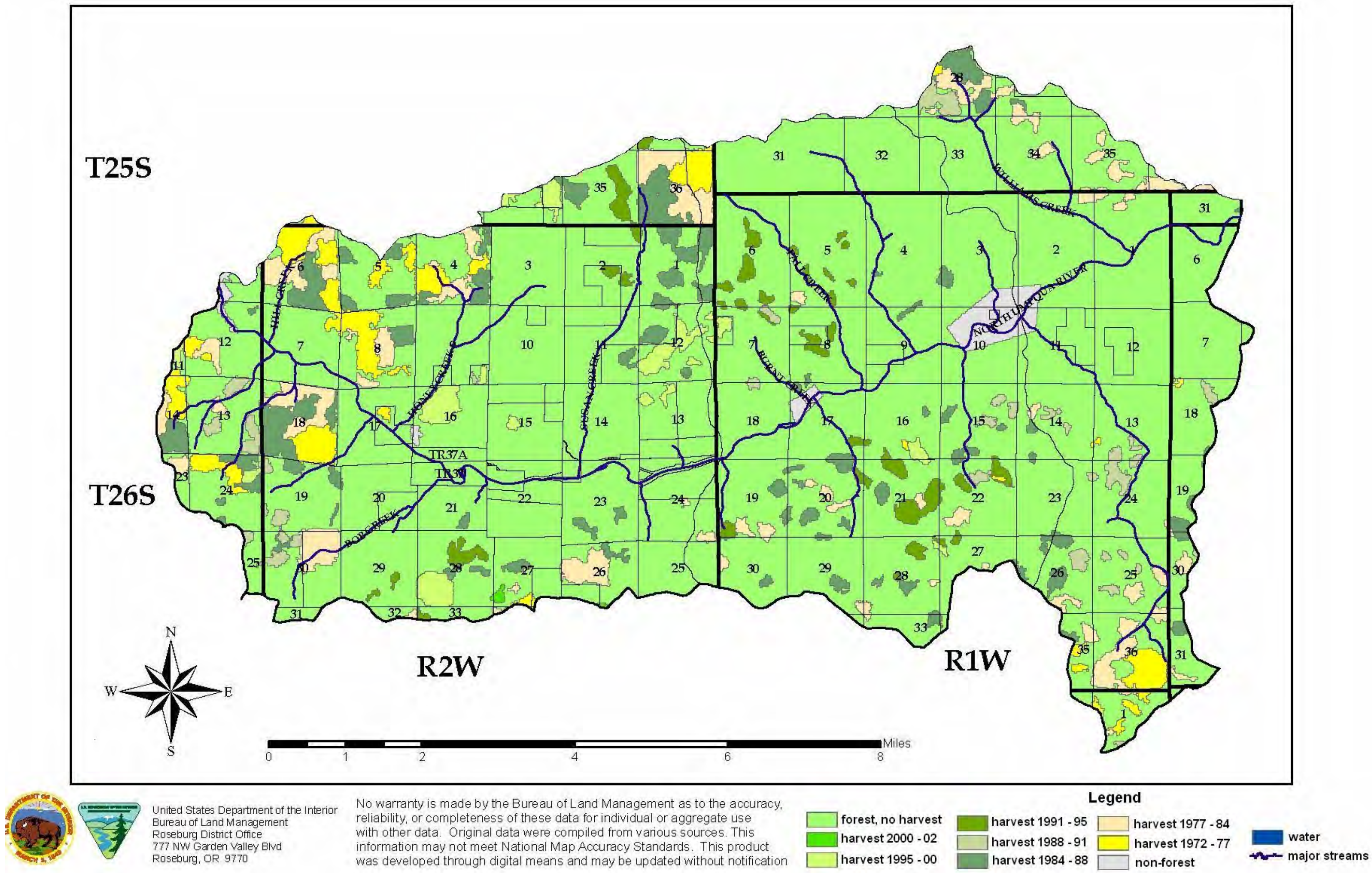
Harvest years	Middle North Umpqua	Canton Creek	Rock Creek	Total	Percent of Region	Seral stage
1940s	73	10	10	93	<0.1	mid
1950s	2,440	519	1,751	4,710	3.1	mid
1960s	1,503	1,957	3,883	7,343	4.8	mid
1970s	1,221	3,107	3,311	7,639	5.0	early to mid
1980s	2,906	3,330	3,679	9,915	6.4	early
1990s	1,786	308	876	2,970	1.9	early
2000s	47	0	82	129	<0.1	early
Total	**9,976**	**9,231**	**13,592**	**32,799**	**21.3**	**--**

Table 2-2: Harvested acres on Forest Service and BLM managed land by decade.

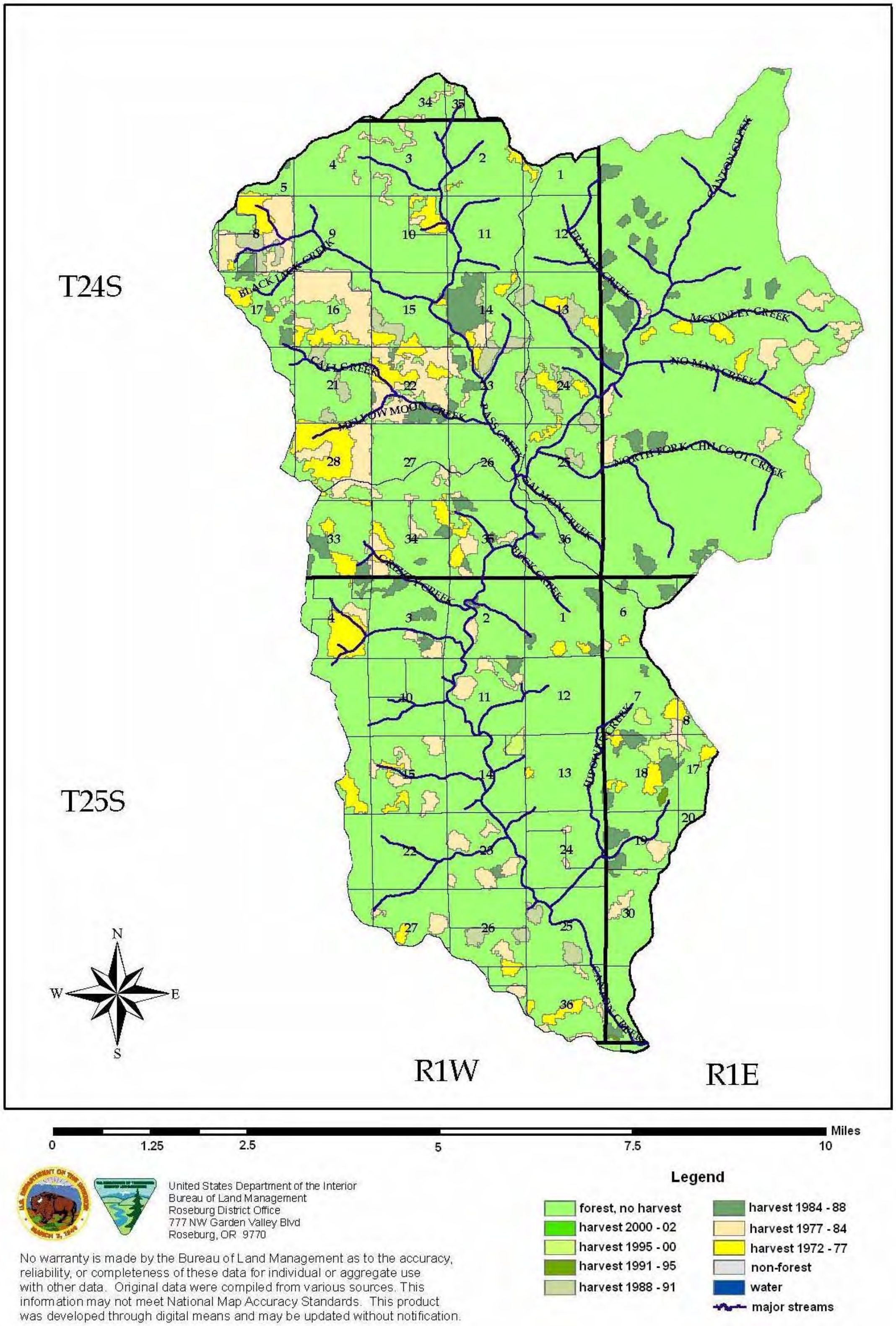
Harvest period	Middle North Umpqua	Canton Creek	Rock Creek	Total	Percent of Region	Seral stage
1972-77	1,519	1,965	4,157	7,641	5.0	mid
1977-84	2,306	2,616	6,597	11,519	7.5	early to mid
1984-88	2,338	1,381	4,787	8,506	5.5	early
1988-91	670	667	976	2,313	1.5	early
1991-95	816	25	358	1,199	0.8	early
1995-00	668	137	590	1,395	0.9	early
2000-02	23	0.0	105	128	<0.1	early
Total	**8,340**	**6,790**	**17,570**	**32,701**	**21.2**	**--**

* Colors are associated with Map 2-2, Map 2-3, and Map 2-4.

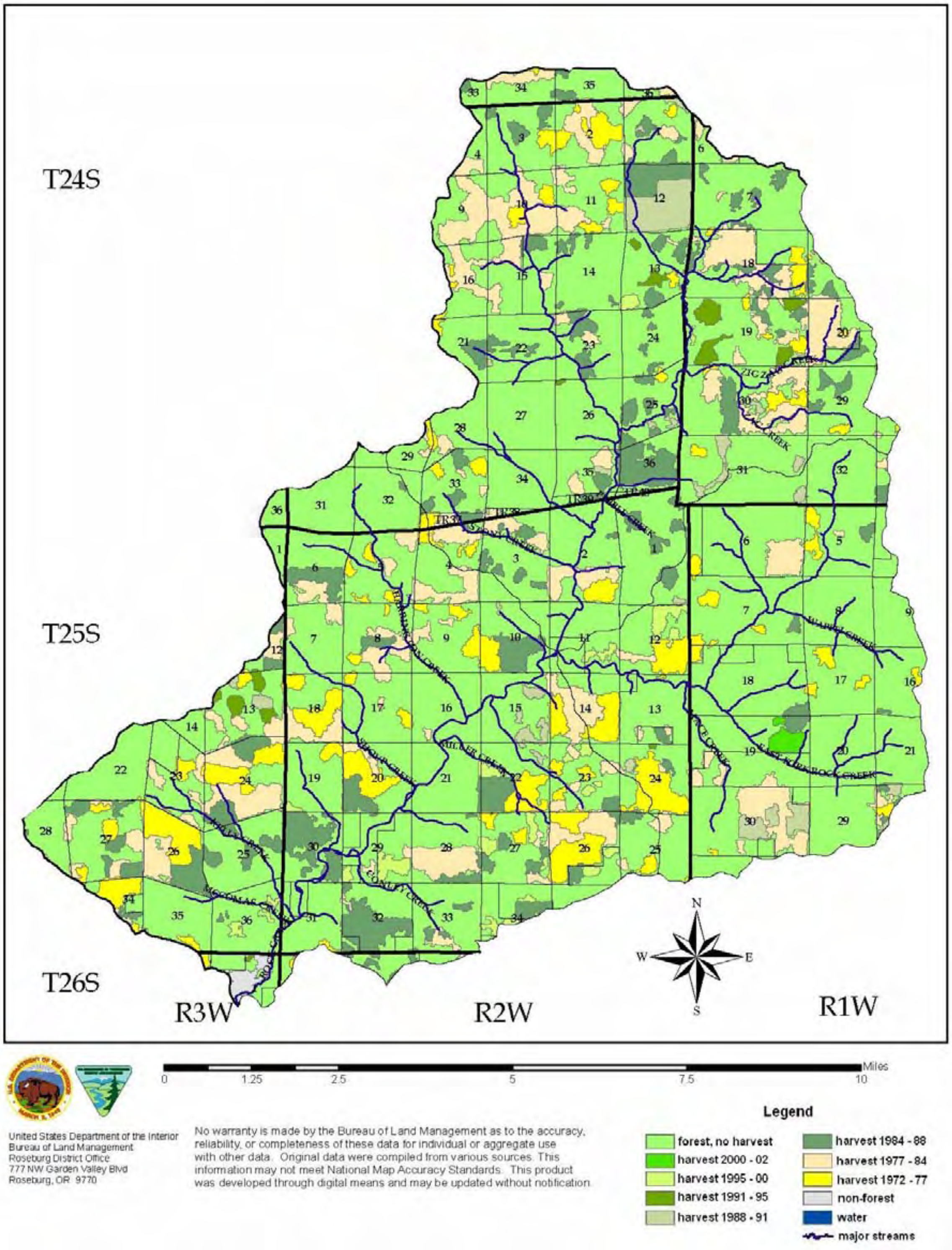
Table 2-3: Stand replacing harvest on all ownerships between 1972 and 2002.



Map 2-2: Areas harvested between 1972 and 2002 in the Middle North Umpqua Watershed.



Map 2-3: Areas harvested between 1972 and 2002 in the Canton Creek Watershed.



Map 2-4: Areas harvested between 1972 and 2002 in the Rock Creek Watershed.

3. Current Conditions

This chapter explores the current conditions of the Rock Creek Region in terms of instream, riparian, and wetland habitats, water quality, water quantity, and fish populations. Background information for this chapter was compiled from the following sources: the *Oregon Watershed Assessment Manual* (Watershed Professionals Network, 1999), the *Watershed Stewardship Handbook* (Oregon State University Extension Service, 2002), and the *Fish Passage Short Course Handbook* (Oregon State University Extension Service, 2000). Additional information and data are from the following groups' documents, websites, and specialists: the USDI Bureau of Land Management, the USDA Forest Service, the Oregon Department of Environmental Quality, the Oregon Department of Fish and Wildlife, the Douglas Soil and Water Conservation District, the US Geological Survey, and the Oregon Water Resources Department.

<u>Key Questions</u>

- In general how are the streams, riparian areas, and wetlands within the Rock Creek Region functioning?
- How is water quality in terms of temperature, surface water pH, dissolved oxygen, and other parameters?
- What are the consumptive uses and instream water rights in the region, and what are their impacts on water availability?
- What are the flood trends within each of the watersheds?
- What is the distribution and abundance of various fish species; what are the habitat conditions; and where are fish passage barriers?

3.1. Stream function

3.1.1. Stream morphology

Channel morphology[29]

Large disturbance events, such as floods, typically dominate stream channel morphology processes. The stream gradient and channel confinement govern the behavior of water flow through the channel in these peak flow events. These characteristics most significantly influence the character of the stream substrate, the stream's ability to maintain fish populations, and the effectiveness of riparian and in-channel enhancement projects. Narrow valleys and steep slopes force water through channels at high velocities, in which only large particles like gravel, cobbles, and boulders can be deposited. However, confined channels, though they have faster peak flows, maintain a more stable stream position than, for instance, the migrating meandering streams of a large floodplain. This section discusses the channel morphology within the Rock Creek Region. Information in this section has been summarized from the following documents: *Oregon Watershed Assessment Manual* (Watershed Professional Network, 1999) and

[29] Kristin Anderson and John Runyon of BioSystems, Inc., contributed to the text for this section.

Going with the Flow: Understanding Effects of Land Management on Rivers, Floods, and Floodplains (Ellis-Sugai and Godwin, 2002).

The Oregon Watershed Enhancement Board (OWEB) has developed a system for classifying streams based on their physical attributes that has implications for the ecology of these streams. This system, called the Channel Habitat Type system, uses features of stream gradient, valley shape, channel pattern, channel confinement, stream size, position in drainage, and substrate. Table 3-1 lists the channel habitat types that are found in the Rock Creek Region along with examples of streams that fall into each.

Channel Habitat Type	**Example within watershed**	**Restoration opportunities**
Low gradient medium floodplain	Portions of Rock Creek between Harrington and Kelly creeks	Because of the migrating nature of these channels, restoration opportunities such as shade and bank stability projects on small side channels may be the best option for improvement.
Low gradient small floodplain	Portions of Rock Creek between Harrington and Kelly creeks	Because of the migrating nature of these channels, restoration efforts may be challenging. However, because of their small size, projects at some locations would be successful.
Low gradient moderately confined	Canton Creek above the confluence of Hipower Creek	These channels can be very responsive to restoration efforts. Adding large wood to channels in forested areas may improve fish habitat, while stabilizing stream banks in non-forested areas may decrease erosion.
Low gradient confined	Lower reaches of East Fork Rock Creek	Though these channels are not often responsive, riparian planting projects may improve water temperature and erosion issues.
Moderate gradient moderately confined	Canton Creek below Pass Creek for about 0.8 miles	These channels are among the most responsive to restoration projects. Adding large wood to channels in forested areas may improve fish habitat, while stabilizing stream banks in non-forested areas may decrease erosion.
Moderate gradient confined	Lower Honey Creek	Though these channels are not often responsive, riparian planting projects may improve water temperature and erosion issues.
Moderately steep narrow valley	Wright Creek	Though these channels are not often responsive, riparian planting projects may improve water temperature and erosion issues.
Steep narrow valley Very steep headwater	Lower reaches of Hipower Creek Coon Creek	Though these channels are not often highly responsive, the establishment of riparian vegetation along stable banks may address water temperature problems.
Bedrock Canyon	Susan Creek at the headwaters	These areas are not conducive to restoration.

Table 3-1: Channel habitat types and examples within the Rock Creek Region.

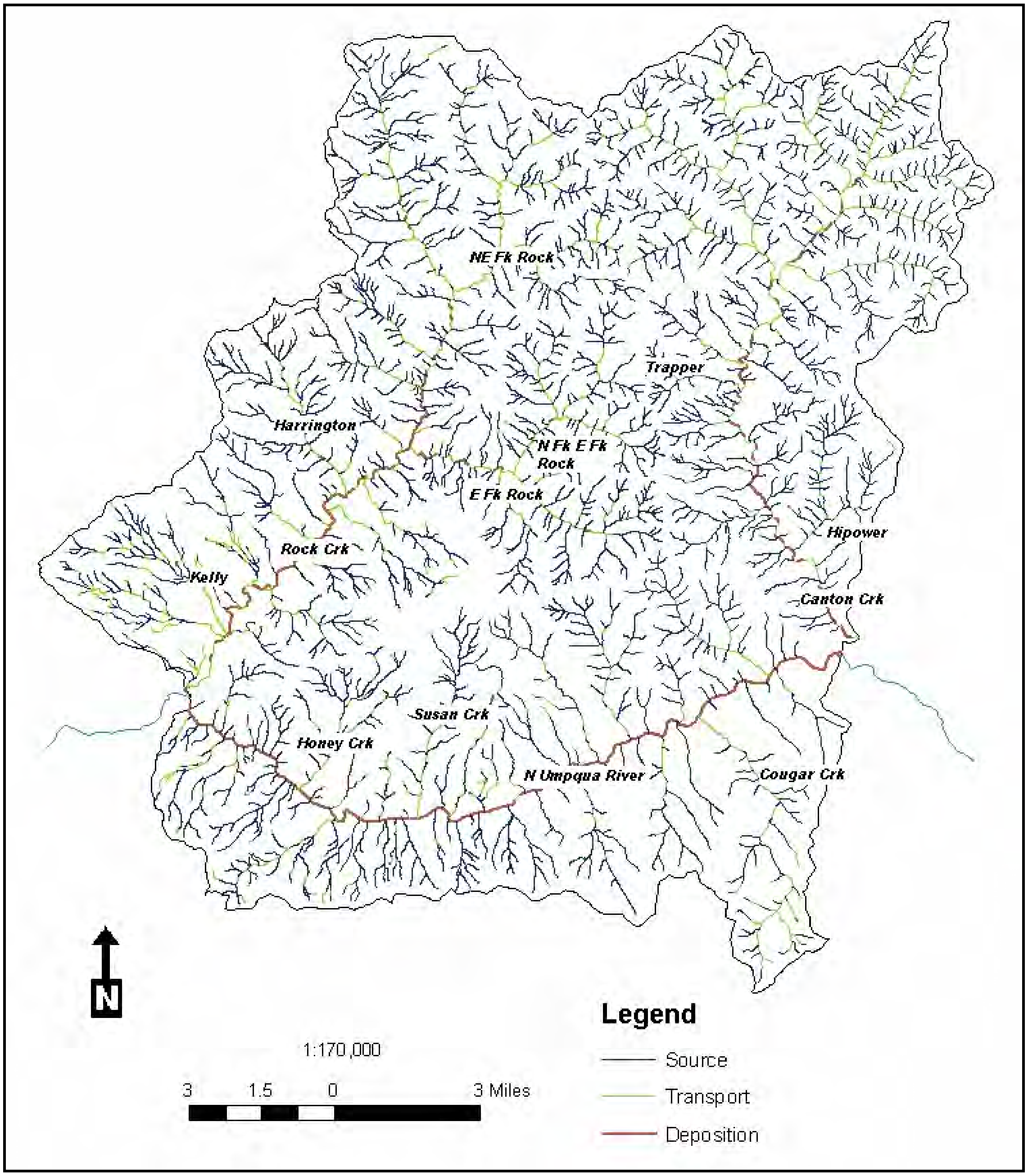
Ellis-Sugai and Godwin (2002) also look at streams in terms of their position in the watershed. Streams in steep headwaters (often 20 percent slope or greater) are source streams, adding sediment and wood to the stream system. They have high-energy flows, no floodplain, and are prone to landslides. Transport streams have medium gradients, often between 3 percent and 20 percent slopes. They often have small meanders and floodplains. They carry sediment and wood during times of large flows and store them during low flows. In the downstream reaches of watersheds lie depositional streams. The low gradients, large floodplains, and meanders of these streams dissipate the energy of flows and allow sediments and wood to settle out of low flows and be stored in these reaches of the streams for long periods. These depositional streams are the most sensitive to changes in the watershed. For instance, changes to sediment supply make the biggest impact in these lower reaches. Table 3-2 and Map 3-1 show the distribution and the percent of stream miles by gradient class within each watershed.

Gradient class	**Rock Creek**		**Canton Creek**		**Middle North Umpqua**	
	Stream miles	**% Total**	**Stream miles**	**% Total**	**Stream miles**	**% Total**
Source	304.3	77.98	227.9	80.8	203.6	77.3
Transport	74.8	19.1	47.0	16.7	41.5	15.8
Deposition	11.8	3.0	7.0	2.5	18.1	6.9
Total	390.9	100.0	281.9	100.0	263.2	100.0

Table 3-2: Stream miles within each gradient class by watershed.

Over 78 percent of the streams in the Rock Creek Region are young source streams on steep mountain terrain. The headwater areas are dominated by these streams. In addition, tributaries to Canton Creek in the lower half of the watershed below Trapper Creek and to the North Umpqua River on the south side of the river are mostly source streams. The primary exceptions are Hipower Creek and Cougar Creek that are somewhat larger channels with lower gradients that act as transport streams. The source streams provide sediment and wood to lower stream segments and are generally above anadromous fish areas. Most source streams south of the North Umpqua River have abrupt drops into the main channel making access impossible for anadromous fish (see Section 3.1.2). Shade and other riparian projects may help improve source stream reaches.

Larger tributary streams to Rock and Canton creeks and the upper reaches of these main channels are moderate gradient, confined channels that act as transport streams, both storing and moving sediment and wood downstream. Tributaries on the north side of the North Umpqua River are also transport streams. Many of these streams are in areas where the overall landscape is fairly steep, increasing debris flow potential. Harrington Creek is the location of perhaps the largest debris flow (over three miles long) to have occurred in recent history within the Region. Adding large wood, stabilizing banks by planting trees, and improving shade in these reaches may be helpful for the stream system.



Map 3-1: Stream gradients in the Rock Creek Region.

The North Umpqua is a low gradient depositional river. Although it is predominantly a confined channel, it has step-pool structure that dissipates energy and allows sediment to deposit out in the large slow moving pools. It also has wide sections with side channels used during higher flows. Although its gradient suggests its primary characteristics are depositional, it can also transport finer sediments, and somewhat larger material during peak flows.

Rock Creek is unconfined and mostly depositional from about Kelly Creek up to the confluence of Northeast Fork Rock Creek. This segment of Rock Creek and the lower portion of East Fork Rock Creek (to its junction with North Fork East Fork Rock Creek) are the only unconfined channels in the Region. They have relatively large meanders that regularly flood the riparian areas, as the streambank heights are minimal. Large overflow channels and gravel bars are common (see Photo 3-1). This type of alluvial habitat is relatively rare in the North Umpqua River sub-basin (Stillwater Sciences, 1998).

Canton Creek is a mostly confined depositional stream that moves water at higher velocity between step-pools. Water slows at the pools allowing deposition of material before again picking up speed to the next step-pool. There are a few small moderately confined segments on Canton Creek that allow some channel widening. Overall, it tends to move water at higher speeds than Rock Creek and the substrate that is deposited tends to be larger cobble rather than smaller gravels (see Photo 3-1).

Photo 3-1: Rock Creek (at left) is an unconfined channel with frequent gravel bars and wide meanders. Flooding of the riparian vegetation is not uncommon. Canton Creek (at right) is a confined channel with more cobble and boulder substrate. Riparian vegetation is more dominated by conifers.

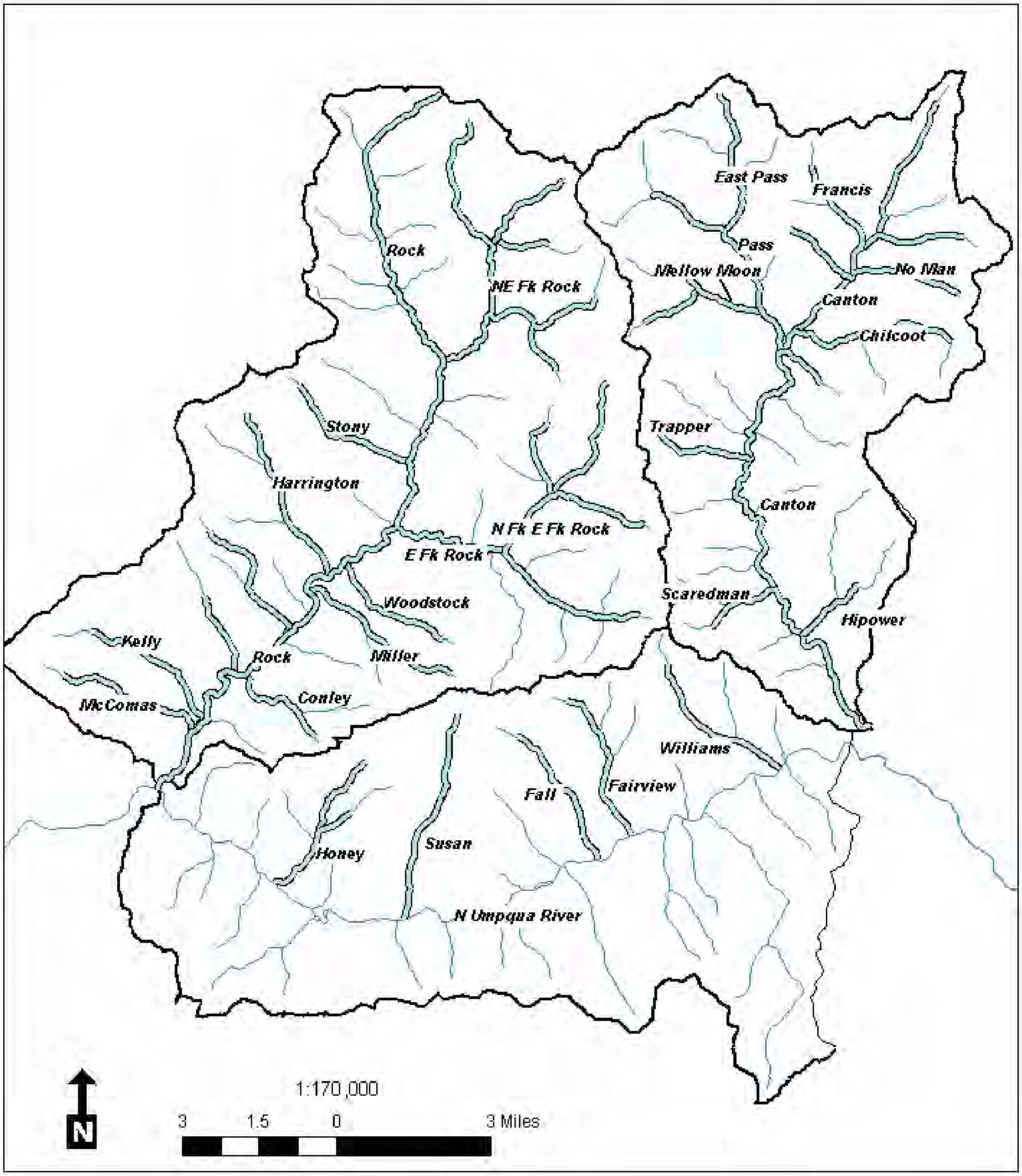
These broad, low-gradient reaches lend themselves to complex aquatic habitat with large wood, coarse sediment, pools, bars, and side channels. However, these reaches are difficult to enhance, as the meandering nature of the streams and the large volume of water flowing in wide channels can move rapidly especially during peak flows. This tends to dislodge large wood and debris as well as scour riparian areas of debris and vegetation. Special care should be given to project selection and planning in these areas. An adaptive management approach may be worthwhile to create roughness along the sides of these channels and in the riparian areas that may slowly add structure back into many segments where coarse wood is important but lacking.

Stream habitat surveys

Since 1992, the Oregon Department of Fish and Wildlife (ODFW) has conducted stream habitat surveys throughout the Umpqua Basin. The purpose of these surveys was to gather basic data about Umpqua Basin streams, and to compare current stream conditions to the habitat needs of salmonids and other fish. During the summers of 1992 through 1996, 132.6 stream miles were surveyed in the Rock Creek Region (see Map 3-2). For the survey work, ODFW used maps at a 1 to 100,000 scale where the smallest headwater streams are not visible. Since fish are not usually found in these small headwater streams, they are not necessary for surveys assessing fish habitat. At that scale, there are a total of 280.9 stream miles within the Region; therefore, approximately 47 percent of Rock Creek Region streams have been surveyed.[30] Each stream was divided into reaches based on channel and riparian habitat characteristics for a total of 121 reaches averaging 0.4 miles in length.

For each stream, surveyors measured a variety of pre-determined habitat variables. Since a primary purpose of the stream habitat surveys was to evaluate the stream's current condition relative to fish habitat needs, ODFW developed habitat benchmarks to interpret stream measurements that pertain to fish habitat. This assessment includes nine measurements that have been grouped into four categories: pools, riffles, riparian areas and large in-stream woody material. Table 3-3 provides the habitat measurements included in each category.

[30] Total stream miles in Sections 1.2.5 and in the discussion on channel morphology above were determined from a 1 to 24,000 scale map where the majority of small headwater streams are also seen.



Map 3-2: Streams surveyed for fish habitat in the Rock Creek Region.

Habitat characteristic	Measurements used for rating habitat quality	Benchmark values		
		Good	**Fair**	**Poor**
Pools	1. **Percent area in pools:** percentage of the creek area that has pools 2. **Residual pool depth:** depth of the pool (m), from the bottom of the pool to the bottom of the streambed below the pool a) small streams b) large streams	1. > 30 2a. > 0.5 2b. > 0.8	1. 16-30 2a. 0.5 - 0.3 2b. 0.8 - 0.5	1. <16 2a. < 0.3 2b. < 0.5
Riffles	1. **Width to depth ratio:** width of the active stream channel divided by the depth at that width 2. **Percent gravel in the riffles:** percentage of creek substrate in the riffle sections of the stream that are gravel 3. **Percent sediments** (silt, sand, and organics) **in the riffles:** percentage of creek substrate in the riffle sections of the stream that are sediments	1. ≤ 20.4 2. ≥ 30 3. ≤ 7	1. 20.5-29.4 2. 16-29 3. 8-14	1. ≥ 29.5 2. ≤ 15 3. ≥ 15
Riparian	1. **Dominant riparian species:** hardwoods or conifers 2. **Percent of the creek that is shaded** a) for a stream with width < 12m (39 feet) b) for a stream with width > 12m	1. large diameter conifers 2a. > 70 2b. > 60	1. medium diameter conifers and hardwds 2a. 60 – 70 2b. 50 – 60	1. small diameter hardwds 2a. < 60 2b. < 50
Large woody material in the creek	1. **Number of wood pieces**[31] per 100m (328 feet) of stream length 2. **Volume of wood** (cubic meters) per 100m of stream length	1. > 19.5 2. > 29.5	1. 10.5-19.5 2. 20.5-29.5	1. < 10.5 2. < 20.5

Table 3-3: Stream habitat survey benchmarks.

[31] Minimum size is six-inch diameter by ten-foot length or a root wad that has a diameter of six inches or more.

Stream habitat benchmarks rate the values of the components of the survey in four categories: “excellent,” “good,” “fair,” and “poor.” For the purpose of this watershed assessment, “excellent” and “good” have been combined into one “good” category. Table 3-3 provides parameters used to develop the benchmark values.

For this assessment, UBWC and ODFW staff simplified the stream data by rating the habitat categories by their most limiting factors. For example, there are two components that determine the “pools” rating; percent area in pools and residual pool depth. If a reach of a small stream had 50 percent of its area in pools, then according to Table 3-3, it would be classified as “good” for percent area in pools. If average pool depth on the same reach were 0.4 meters in depth, this reach would have “fair” residual pool depth. This reach’s classification for the “pools” habitat category would be “fair.” Most habitat categories need a combination of components to be effective, and therefore are rated by the most limiting factor, which is pool depth in this example.

The benchmark ratings should not be viewed as performance values, but as guides for interpretation and further investigation. Streams are dynamic systems that change over time, and the stream habitat surveys provide only a single picture of the stream. For each habitat variable, historical and current events must be considered to understand the significance of the benchmark rating. Take, for example, a stream reach with a “poor” rating for instream large wood. Closer investigation could uncover that this stream is located in an area that historically never had any large riparian trees. Failing to meet the benchmark for instream large wood might not be a concern because low instream wood levels might be the stream’s normal condition. On the other hand, meeting a benchmark might not mean all is well. A stream reach in a historically wooded area could meet its benchmark for large instream wood because a logging truck lost control and dumped its load in the stream. In this example, meeting the large wood benchmark is not sufficient if that stream reach has no natural sources of woody material other than logging truck accidents.

<u>Overview of conditions</u>
Looking at historical and recent conditions is necessary to fully understand the value of each reach’s benchmark rating. Conducting this type of study for every reach within the Rock Creek Region is beyond the scope of this assessment. Instead, we look for patterns within the whole watershed and along the stream length to provide a broad view and help determine trends that might be of concern.

Of the 121 surveyed stream reaches, only eleven rate as “fair” or “good” in all four categories (9.1 percent). Seventy-seven stream reaches (63.6 percent) have at least two categories rate as “poor.”[32] The Rock Creek Region has a high proportion of steep topography resulting in high gradient streams. These steeper streams are less conducive to development of pool and riffle characteristics. This helps to explain why over 57 percent of stream reaches rate as “poor” for pool attributes, and over half rate as “poor” for riffles. Map 3-3 shows that the majority of streams that rated “poor” for pools occur on upland streams that tend to have higher gradients than the mainstem channels. This is

[32] Appendix 2 shows the location and habitat survey rating for each characteristic by stream reach.

also the case for riffles as shown on Map 3-4. However, the lower mainstem of Rock Creek is also “poor” for riffles but is a low gradient unconfined section. This portion of Rock Creek is wide and contains very little large wood material as shown on Map 3-5. This may contribute to higher velocity stream flow and fewer small gravel deposits characteristic of riffles.

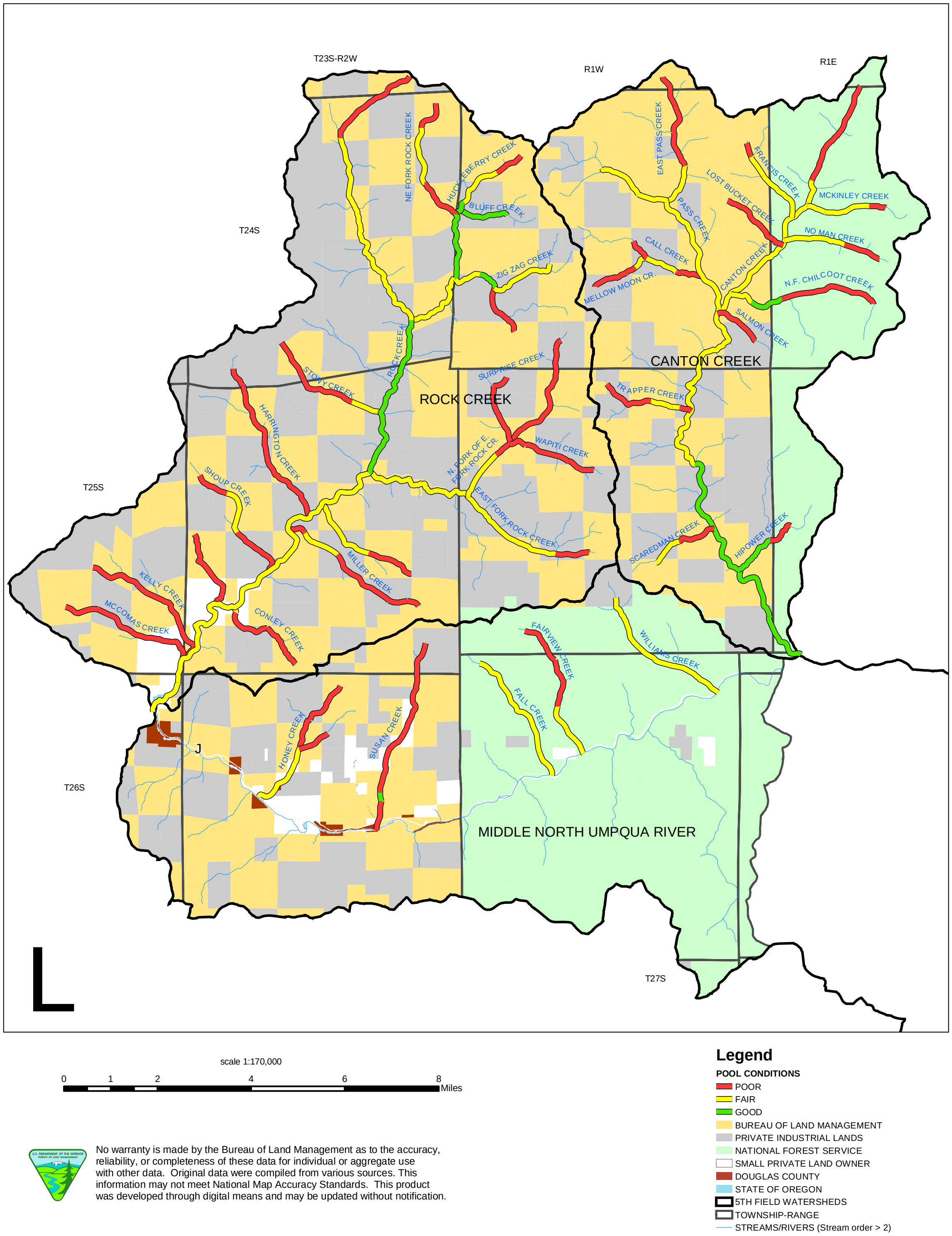
On Map 3-5 we also see that the majority of Canton Creek is lacking large wood material but is “fair” for riffles and “fair” or better for pools. Canton Creek tends to have a bedrock dominated channel with large boulders in the lower portions that may be contributing to pool development where large wood is lacking. Most streams in the Rock Creek Region are dependent on large wood for reducing flow velocity and providing roughness and diversity of habitat. However large wood is one of the most limiting attributes with over half the reaches rated “poor.”

It is important to think of large wood in terms of what is present in the stream and what will probably fall in from the riparian areas in the future. Map 3-6 shows that the upper reaches of Canton Creek and its tributaries are rated “good” for riparian which will help supply wood not only for these upper reaches but for the lower end of Canton Creek as the logs transport downstream. In contrast, on Map 3-5 we see that most of the upper reaches of Rock Creek are “good” for large wood but have a “poor” riparian rating on Map 3-6. This indicates that although current large wood levels are “good,” there may be a shortage of large wood in the future when the current pieces move out of the system.

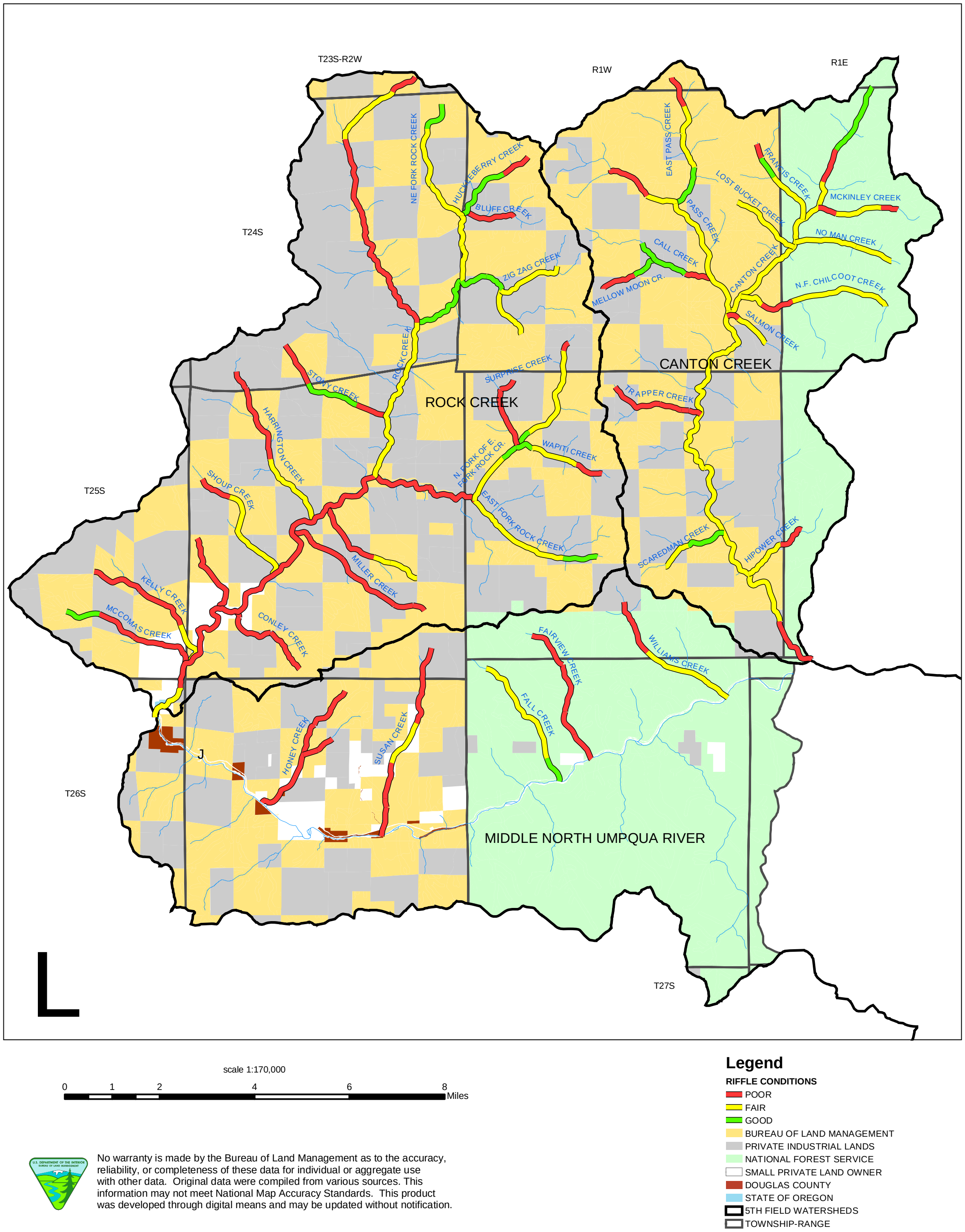
Riparian attributes tend to be the most favorable characteristic surveyed within the Region. Over 76 percent of the reaches have fair or good riparian conditions. The poor riparian ratings are most likely in many areas where timber harvest occurred prior to current harvest practices that require buffers on fish streams. Current forest practices also require reforestation of all harvested areas. Since nearly all of the area is managed for forestry or in reserve status, the riparian areas that were previously harvested are most likely to be in young, mostly conifer stands today.[33] These trees will provide large wood to streams in the future but are not large enough at present.

Planting trees in the riparian areas to provide cover and future large wood may benefit some areas by providing diversity of species and rehabilitating areas where restocking failed or was destroyed during rare peak flood events such as occurred in 1964. Thinning of trees in dense conifer stands may also be an important step to speed the development of large wood and wider crowns in these areas (see Section 3.2.1). Protecting those riparian sections that are already in good or excellent condition is also important. Riparian reserves on federal land provide for wide buffers of protection on most streams and the Forest Practices Act establishes protection on private land along salmonid streams. Conservation easements are another strategy to provide riparian protection on private land where riparian areas on upland streams are not currently protected, and where adding additional buffers may help prevent stream warming or maintain future large woody debris sources in key areas.

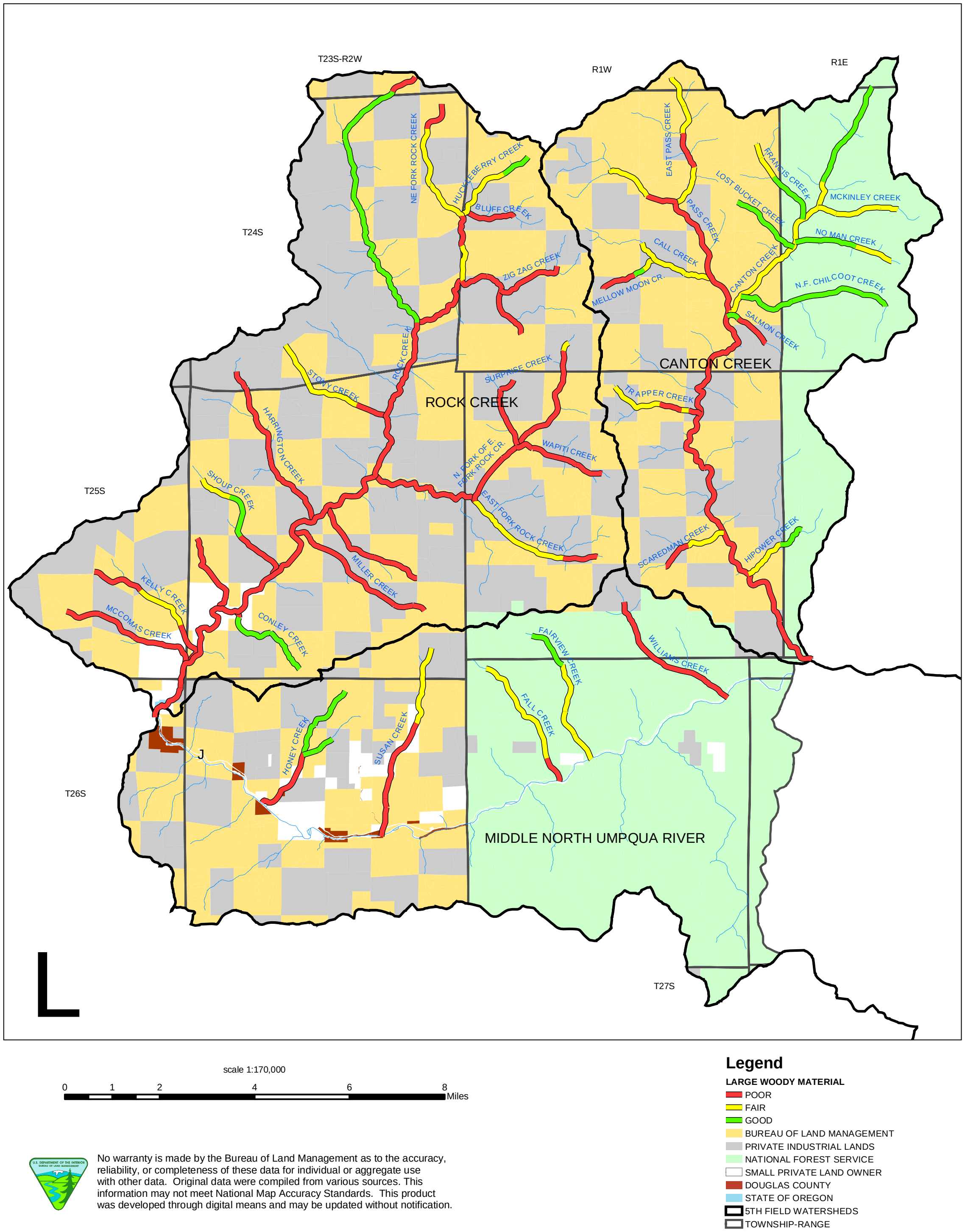
[33] Land uses that describe vegetation surrounding the stream by stream reach are provided in Appendix 2.



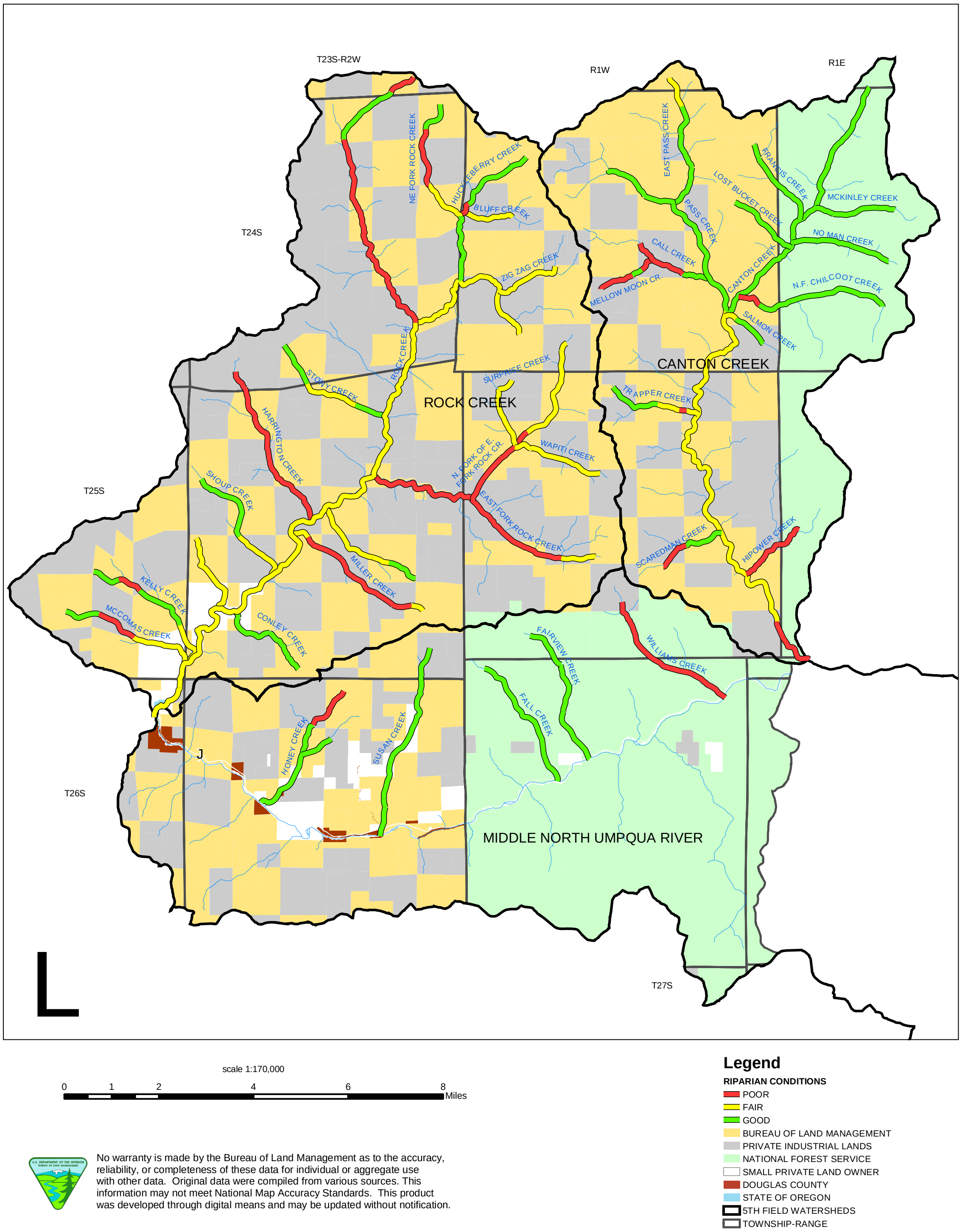
Map 3-3: Stream habitat survey pool ratings for the Rock Creek Region.



Map 3-4: Stream habitat survey riffle ratings for the Rock Creek Region.



Map 3-5: Stream habitat survey large wood ratings for the Rock Creek Region.



Map 3-6: Stream habitat survey riparian ratings for the Rock Creek Region.

Limiting factors affecting stream habitat[34]

In November, 2005 a multi-agency group of fish biologists, hydrologists, and other resource professionals developed a list of factors limiting fish habitat in streams within the Rock Creek Region. The list included the following eight limiting factors:

- Lack of winter habitat
- Elevated summer temperatures
- Lack of spawning gravels
- Fish passage barriers or obstacles
- Hatchery influence on genetics of fish populations
- Elevated peak flows
- Nutrient additions related to fish carcasses added to streams
- Lack of adult holding pools and harassment of fish in existing pools

Two limiting factors will be discussed here: lack of winter habitat and lack of spawning gravels. (See Sections, 3.1.2, 3.2.1, 3.3.2, 3.4.3, and 3.5.2 for more discussion of restoration activities related to fish passage, riparian areas, elevated summer temperatures, peak flows, and hatchery influence.) The effectiveness of different restoration activities in addressing these limiting factors was then evaluated. Some restoration activities address many factors while others are very specific.

Lack of winter habitat and spawning gravels

Deep pools where water moves slowly are an important habitat feature for salmonids especially in the winter. When streamflows are high and the current is swift, many salmonids are washed out of the streams. Areas with complex structures created by woody debris and/or boulders provide places of refuge where the current is slow during these events. Fish can also use these areas to feed while under cover of debris structures that offer protection from predators. High swift flows can move gravels downstream. Woody debris that builds up behind these structures also traps gravels and other sediment, providing more spawning grounds for salmonids. Thus the most effective restoration activity that addresses lack of winter habitat or lack of spawning gravels is the placement of instream woody debris or boulders.

Placing these structures within the streams provides immediate benefit to salmonid habitat. However, it is also important to insure long-term benefit which is accomplished through improving or protecting riparian areas that are a valuable source of large woody debris. Some roads may also limit habitat complexity where the stream is restricted from its floodplain area. This restriction reduces stream meandering, which then can increase streamflow velocity causing loss of winter habitat. Thus removal of certain roads, often those located in the valley bottoms, may also improve winter habitat and spawning gravels. This action is more difficult as there are management needs for maintaining

[34] The UBWC and Roseburg BLM sponsored a meeting on 11/1/05 to set priorities for restoration work that would improve fish habitat within the Rock Creek Region. The meeting included fish biologists, hydrologists and other resource specialists familiar with the Rock Creek Region from the UBWC, Forest Service, BLM, ODFW, PacifiCorp, and Stillwater Sciences. Refer to Appendix 7 for a complete summary of limiting factors, restoration activities, and specific locations recommended for treatments.

many of these roads and rerouting the road is often not an option. Table 3-4 lists the streams where instream structure placement, riparian improvement, riparian protection or road obliteration would improve winter habitat and /or increase spawning gravels.

Restoration treatment	**Limiting factor**	
	Lack of winter habitat	**Lack of spawning gravels**
Instream wood/boulder placement	East Fork Rock Creek Canton Creek Rock Creek Harrington Creek Pass Creek McComas Creek Miller Creek Shoup Creek Kelly Creek	Rock Creek Canton Creek Rock Creek upper tribs Canton Creek upper tribs
Riparian improvement	Rock Creek Canton Creek Pass Creek East Fork Rock Creek Harrington Creek Shoup Creek	
Riparian protection	Rock Creek Canton Creek East Fork Rock Creek	
Road obliteration	Rock Creek East Fork Rock Creek Harrington Creek North Fork East Fork Rock Canton Creek Pass Creek Mellow Moon Creek	Rock Creek (above E. Fork) East Fork Rock Creek North Fork East Fork Rock Harrington Creek Mellow Moon Creek

Table 3-4: Streams recommended for restoration treatments to address lack of winter habitat and spawning gravels in the Rock Creek Region.

Large woody debris placement

PacifiCorp and ODFW have begun a restoration project on East Fork Rock Creek as part of a settlement agreement that includes off-site mitigation related to the North Umpqua Hydroelectric Project relicensing (see Section 6.1). The Settlement Agreement describes the present conditions and the intended benefits in East Fork Rock Creek:

> "East Fork Rock Creek is a low-gradient stream channel that lacks habitat complexity due to past management activities in the basin. Because of its low gradient, large woody debris enhancement efforts may have a relatively high potential for increasing production of coho salmon,

> steelhead, cutthroat trout, and Pacific lamprey. ...Large woody debris enhancement in the Rock Creek basin will result in both direct and indirect benefits for anadromous fish. Direct benefits will include increased aquatic habitat complexity, and increased pool frequency and depths. Indirect benefits may include increased ability of the channel to capture and store large woody debris and sediment, increased retention of fine and coarse organic material, improved nutrient cycling, and reduced stream power, potentially reducing scour of channel bed and banks (PacifiCorp *et al*., 2001)."

Sampling of fish and habitat conditions began several years ago to establish baseline information on East Fork Rock Creek. Woody debris placement should begin within the next few years. Initial sampling showed large fry populations (over 80,000) were reduced to about 2,000 by September and to 400 during high flows in December. Most were lost in the first high flow event. This result, coupled with the fact that temperatures are cool in East Fork Rock Creek and spawning gravels appear adequate, indicated a shortage of over-winter habitat was primarily responsible for lower salmonid numbers.

Large woody debris will be placed into the stream at different densities to determine the maximum benefit to fish that can be obtained from adding these structures. This information can then be used in other areas where PacifiCorp intends to add instream woody debris for enhancement purposes related to the off-site mitigation discussed in Section 6.1.

Upper Canton Creek and East Fork Pass Creek have both been identified in the Settlement Agreement as additional areas to receive instream large woody debris placement. These areas will be located upstream of natural fish barriers to anadromous fish with the intention of providing benefits to resident trout. Areas will be selected where conservation easements on the riparian corridors may also be established. (See Section 3.2.1 for more on conservation easements.)

3.1.2. Stream connectivity

Stream connectivity refers to the ability of resident and anadromous fish, as well as other aquatic organisms, to navigate the stream network. The stream system becomes disconnected when natural and human-made structures such as waterfalls, log jams, and dams, inhibit fish passage. Although some stream disconnect is normal, a high degree of disconnect can reduce the amount of suitable spawning habitat available to salmonids. This, in turn, reduces the stream system's salmonid productivity potential. Poor stream connectivity can increase juvenile and resident fish mortality by blocking access to other critical habitat, such as rearing grounds and cool tributaries during the summer months.[35]

For this assessment, fish passage barriers are structures that completely block all fish passage. A juvenile fish passage barrier permits adult passage but blocks all young fish. Structures that allow some adults or some juvenile fish to pass are referred to as obstacles. Although a single obstacle does not prevent passage, when there are multiple

[35] See Section 3.3.2 for more information about stream temperature.

obstacles, fish can expend so much energy in their passage efforts that they may die or be unable to spawn or feed. This assessment reviews the known distribution and abundance of two common human-made fish passage barriers and obstacles: dams and culverts.

Dams

Dams can be barriers or obstacles to fish passage if the distance from the downstream water surface to the top of the dam (the "drop") is too far for fish to jump. Whether or not a fish can overcome this distance depends on three factors; the size of the fish, the height of the drop, and the size of the pool at the base of the dam, which is where fish gain momentum to jump. If the pool is two feet deep, it is generally believed that adult fish can surmount a two-foot high dam or less, while juvenile fish can overcome a height of 0.5 feet or less. As pool depth decreases or height increases, fish have difficulty jumping high enough to pass over.

A diversion dam constructed for the Rock Creek fish hatchery located just up from the confluence of Rock Creek with the North Umpqua River is a fish obstacle during low flows on Rock Creek. There is a fish bypass located to one side that many fish during upstream migration are unable to navigate especially during low flows making it ineffective in the summer months. Based on radio telemetry studies and observations at the facility, the ladder currently prevents upstream passage by over 90 percent of coastal cutthroat trout, 10 to 30 percent of adult spring chinook salmon, 30 to 50 percent of adult summer steelhead, 10 percent of adult winter steelhead, 30 to 50 percent of adult coho salmon, and all juvenile salmonids (PacifiCorp *et al*., 2001). The ODFW is currently in the process of securing final engineering plans and funding for the construction of a new fish ladder to alleviate this problem.

PacifiCorp owns and operates the North Umpqua Hydroelectric Project located further up the North Umpqua corridor. Although dams associated with this project are not within the Rock Creek Region, they do have an effect on the Region. During the recent relicensing process, PacifiCorp and ODFW signed a "…Memorandum of Understanding (MOU) to improve access and enhance historically available spawning and rearing habitat for native anadromous and resident fish in the North Umpqua River Basin." The agreement includes providing off-site mitigation in Rock and Canton creeks for loss of fish habitat due to five dams that are fish barriers located within the North Umpqua Hydroelectric Project further up the North Umpqua River. PacifiCorp will provide half of the funding necessary to construct the new fish ladder at the Rock Creek Hatchery diversion dam as one part of the agreement. ODFW is currently seeking additional match-funding to pay for redesign and construction of the new fish ladder. (See Section 6.1 for more on off-site mitigation related to riparian and instream habitat.) Improving fish passage through the diversion dam has been identified as a significant restoration priority within the Rock Creek Region.[36]

[36] Improving fish passage at the diversion dam was identified by numerous fish biologists as a top priority at the Rock Creek Region fish summit meeting for prioritizing fish habitat restoration (see Appendix 7).

The Oregon Water Resources Department, the Douglas Soil and Water Conservation District, and the UBWC are not aware of any other dams in the Rock Creek Region that are barriers or obstacles to adult or juvenile fish passage.

Culverts

Culverts can be a barrier or obstacle to fish passage if the distance from the downstream water surface to the culvert outfall is too far for fish to jump. Just as with dams, it is generally believed that adult fish can reach a culvert outlet that is two feet or less from the downstream water, while juvenile fish overcome a height of 0.5 feet or less, if there is a two-foot deep pool at the outfall.

Unlike dams, water velocity within the culvert poses another potential fish passage barrier. In natural stream systems, fish are able to navigate high velocity waters by periodically resting behind rocks and logs or in pools. Smooth-bottomed culverts offer no such protection, and water velocities can prevent some or all fish from passing through the pipe. Fish may face an additional velocity barrier at the upstream end of a culvert if it has been placed so that the stream flows sharply downward into the culvert entrance. In general, smooth-bottomed culverts at a one percent gradient or more are obstacles to fish passage. Culverts that are partially buried underground or built to mimic a natural streambed provide greater protection and allow fish passage at steeper gradients and higher water velocities.

Culverts may be fish passage obstacles or barriers for only part of the year. As water levels change, so do pool depth, drop distance, and water velocity. A culvert with a five-foot drop in the summer may be easily navigated in the winter. High water flows in winter can increase pool size and reduce jumping distance. However, high flows can also increase water velocities, making culverts impassable.

Fish passage barrier inventory

The Umpqua Basin Fish Access Team (UBFAT), surveyed culverts on potential fish-bearing streams throughout the entire Rock Creek Region.[37] They identified and prioritized potential fish passage-limiting culverts on all ownerships. The passage barriers were characterized as barriers to both adult and juvenile fish or only to juvenile fish. The Roseburg BLM also has a fish passage barrier inventory; however differences in barriers between adult and juvenile fish passage are not specified.[38] The UBFAT and Roseburg BLM inventory of man-made fish passage barriers are shown in Map 3-7. The Umpqua National Forest inventory has no known man-made fish barriers in the Rock Creek Region. In addition to the barriers shown in Map 3-7, there are many natural barriers to fish access. These are unlikely to be modified and are not presented here.

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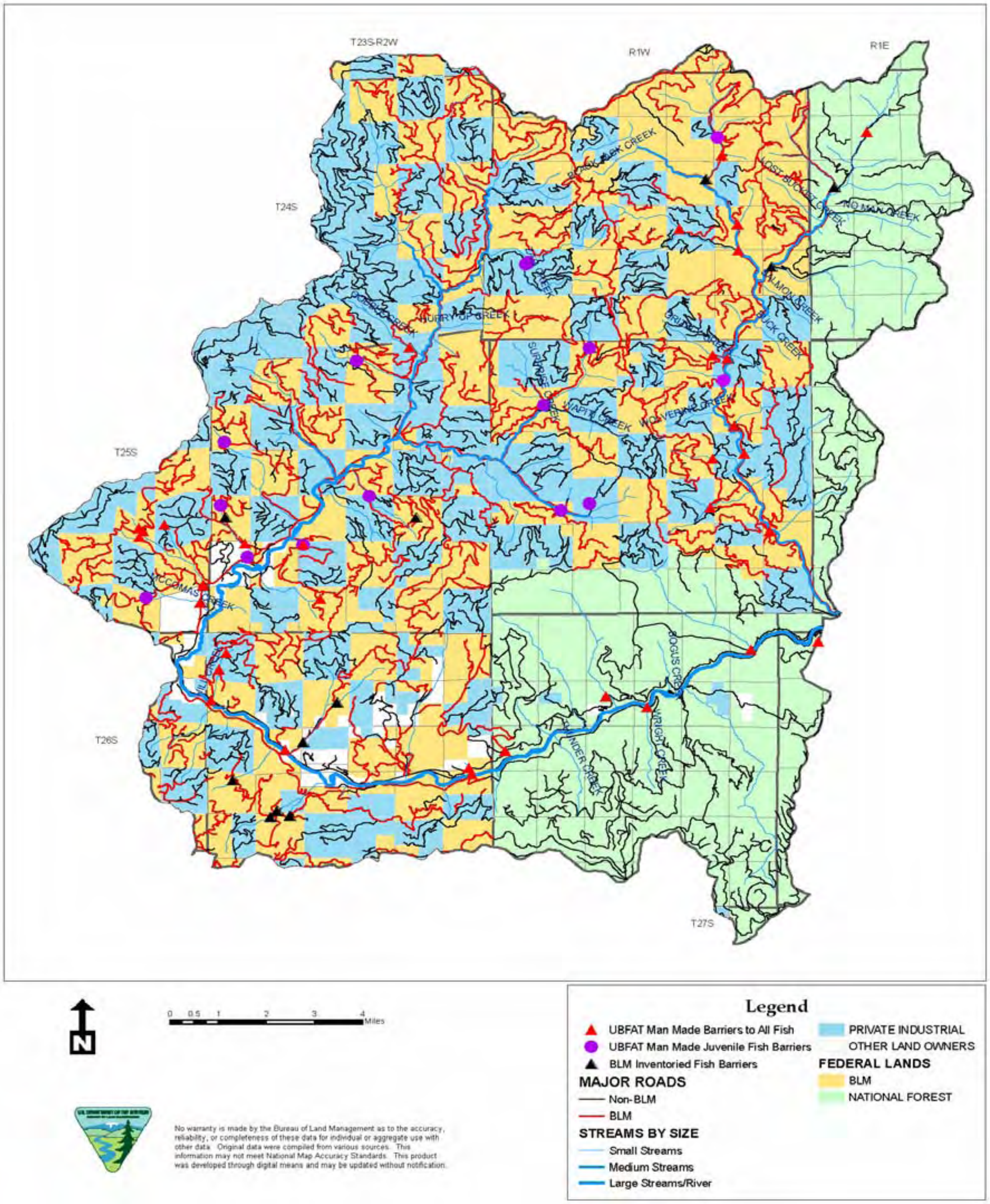
[37] UBFAT is a cooperative multi-agency/organization effort implemented by the Douglas Soil and Water Conservation District to survey culverts throughout the Umpqua Basin across all ownerships for fish passage problems, and prioritize those passage barriers for replacement.

[38] Several of the BLM-inventoried passage barriers were also inventoried more recently by UBFAT at which time they were specified as barriers to all fish or juveniles only.



Map 3-7: Man-made fish passage barriers by ownership within the Rock Creek Region.

Based on the current inventories, there are 58 man-made fish passage barriers in the Rock Creek Region (see Table 3-5). Thirty-three of these are barriers to adult and juvenile fish, while 14 are barriers to only juvenile fish. The remaining 11 barriers inventoried did not distinguish between adult and juvenile fish. As shown in Table 3-5, the majority of man-made fish passage barriers (23 barriers) are located in the Rock Creek Watershed, where roughly half (12 barriers) affect juvenile fish only. The Canton Creek Watershed has 17 passage barriers where at least 12 block upstream access to both adult and juvenile fish. At least 12 of the 18 fish passage barriers in the Middle North Umpqua Watershed affect both juvenile and adult fish.

Fish unable to pass through barrier	Rock Creek Watershed	Canton Creek Watershed	Middle North Umpqua Watershed
Adult and juvenile	9	12	12
Juvenile only	12	2	0
Unspecified	2	3	6
Total	23	17	18

Table 3-5: Fish passage barriers by type of fish affected in the Rock Creek Region watersheds.

Prioritizing barriers for replacement

The UBFAT inventory assigns a score to each inventoried culvert based on its significance to fish production. For example, if a barrier blocks access to several miles of anadromous fish habitat as opposed to only 50 feet, it would be scored higher, giving it higher priority for replacement if all other factors are equal. Attributes considered in determining priority scores include the following:

- Amount of additional habitat by species that could be accessed (including coho, cutthroat, chinook, and steelhead)
- Quality of upstream habitat
- Downstream barriers
- Seasonality of stream (goes dry, retains pools, perennial)
- Natural or man-made structure
- Severity of barrier to fish

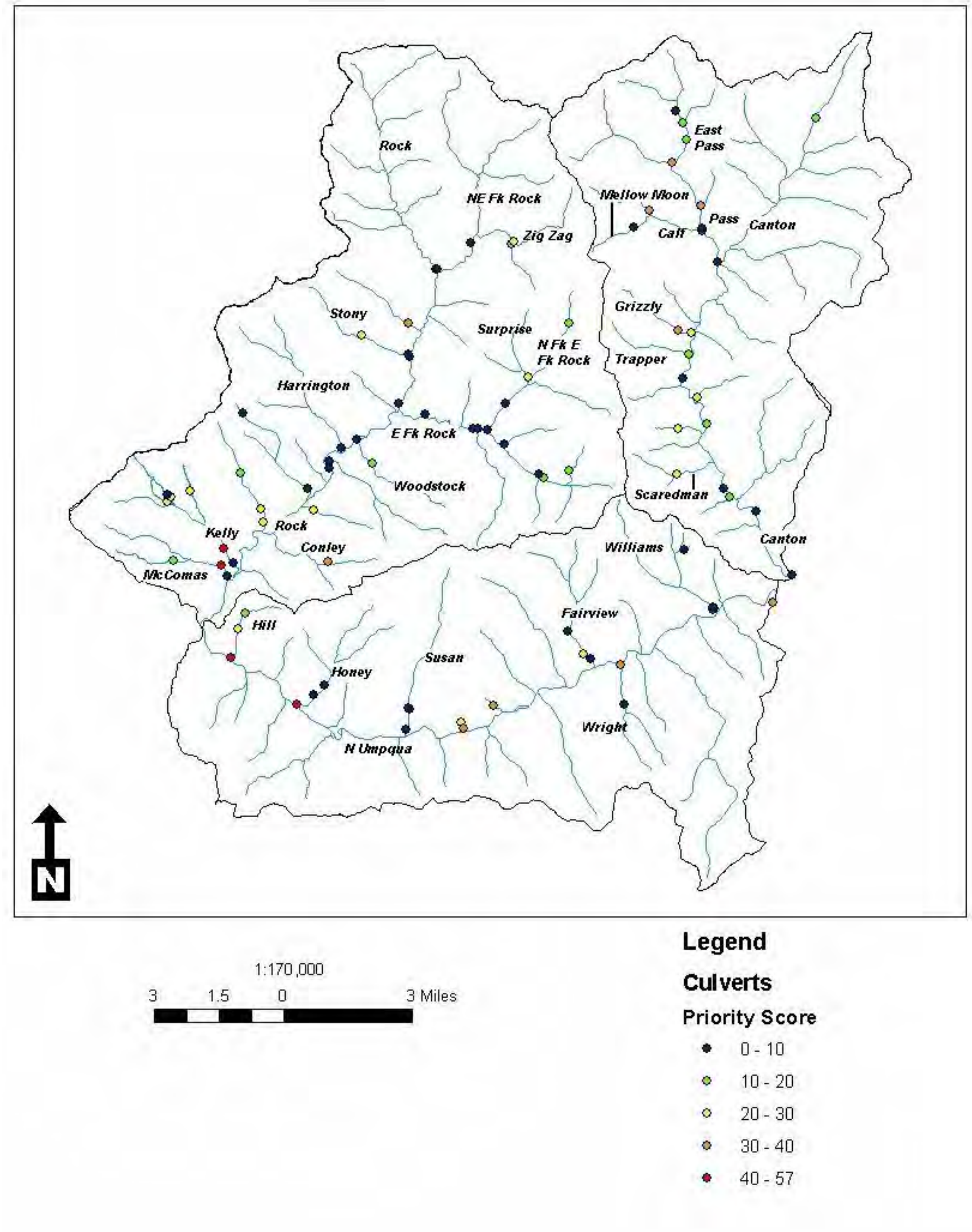
Appendix 3 shows the criteria, their associated values, and the process used to determine scores. Priority scores from the UBFAT process are shown in Map 3-8 where the higher scores indicate a higher replacement priority. Not all of these are barriers or obstacles, as some are in areas where fish are not present. However, barriers located in areas without fish would score lower in priority. Others may be natural barriers where providing fish passage is unlikely; therefore they are given the lowest scores.

Scores will be used to prioritize efforts to fix these passage barriers both within the assessment area and within the Umpqua Basin. Map 3-8 shows the replacement priority scores for culverts within the Rock Creek Region. Although we know there are some higher-priority culverts in the Umpqua Basin, the Rock Creek Region is the first area to have complete watershed inventories of culverts by UBFAT; therefore we cannot compare these watersheds as a whole to other watersheds around the Basin for relative fish passage restoration priorities.

The highest priority culverts for replacement on Map 3-8 are located near the mouths of Hill Creek, Honey Creek, and Williams Creek just above their intersections with the North Umpqua River, and near the bottom of Kelly and McComas creeks just above Rock Creek. All five of these culvert locations received scores between 40 and 57.

Hill Creek, Honey Creek, and Williams Creek are associated with Highway 138. The Honey Creek site has two adjacent culverts that are currently being replaced with a bridge by ODOT. This is a multi-year project; the bridge is now under construction and the culverts will be removed in 2006. The Kelly and McComas creeks culverts are associated with the Rock Creek Road (BLM Road 26-3-1). The Roseburg BLM considers them high priority for replacement. Both of these culverts as well culverts on Taylor Creek and Surprise Creek were also identified by fish biologists as high priority fish restoration projects at the Rock Creek Region fish summit meeting for prioritizing fish habitat restoration (see Appendix 7). The Roseburg BLM and the UBWC are in the process of replacing a fish barrier culvert on Honey Creek just above the ODOT bridge site.

There are no culverts in the Canton Creek Watershed with ratings above 40. Culverts with a score of 30 to 40 are scattered throughout the Region with four in each of the Canton Creek and Middle North Umpqua watersheds, and two in the Rock Creek Watershed (see Map 3-8).



Map 3-8: **UBFAT inventoried culverts with priority replacement scores for the Rock Creek Region.**

3.1.3. Channel modification[39]

For the purpose of this assessment, "channel modification" is defined as any human activity designed to alter a stream's flow or its movement within the floodplain, such as building riprap, dredging, or vegetative bank stabilization. Although placing structures like boulders or logs in a stream alters the channel, this type of work is done to improve aquatic habitat conditions and is not intended to alter the stream's path. As such, instream structure placement projects are not considered channel modification activities for this assessment.

In Oregon, the state has the authority to regulate all activities that modify a stream's active channel. The active channel is all the area along a stream that is submerged during normal high waters. Even if the entire stream is within a landowner's property, the active channel, like the water within it, is regulated by public agencies, and channel modification projects can only be done with a permit.[40] History has shown that channel modification activities are often detrimental to aquatic ecosystems and to other reaches of the same stream. Streams naturally meander; attempts to halt meandering can alter aquatic habitats in localized areas and cause serious erosion or sedimentation problems further downstream. Although channel modification projects can still be done with a permit, obtaining a permit can be a lengthy process.

Historical channel modification projects

Quantifying historical channel modification activities is difficult because no permits were issued, and the evidence is hidden or non-existent. Many of the past channel modification activities were probably related to removal of gravel bars from streams and bank stabilization. According to the Douglas Soil and Water Conservation District, property owners removed gravel bars to sell the gravel as aggregate, to reduce water velocities, and "to put the creek where it belongs," in many areas of the Umpqua Basin. Gravel bars are not stationary, and during every flood event gravel is washed away and replaced by upstream materials.[41] Consequently, a gravel bar in the same location was often removed every year.

According to some long-time residents along the North Umpqua, large quantities of gravel were removed from the North Umpqua River below the Mott Bridge for the construction of a new Forest Service building (see Section 5.1.1). Other gravel bars were removed to support road construction. Exploratory mining was extensive up the Steamboat drainage and probably also occurred up the Canton Creek drainage.

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[39] Information in Section 3.1.3 is primarily from personal communications between the UBWC and Douglas Soil and Water Conservation District staff, and resource specialists from the BLM and Forest Service.

[40] Under the Oregon Removal/Fill Law (ORS 196.800-196.990), removing, filling, or altering 50 cubic yards or more of material within the bed or banks of the waters of the state or any amount of material within Essential Habitat streams or State Scenic Waterways requires a permit from the Division of State Lands. Waters of the state include the Pacific Ocean, rivers, lakes, most ponds and wetlands, and other natural bodies of water. Tree planting in the active stream channel, and timber harvesting in some circumstances, can be done without a permit.

[41] In general, a gravel bar that has no grass or other vegetation is very unstable.

The Rock Creek Mill had a log pond that was located on the west side of Rock Creek where the BLM Millpond campsite is currently located. A side channel of Rock Creek was diverted and dammed to flood the pond.

Bank stabilization concerns any material added to the stream's bank to prevent erosion and stream meandering. The term "riprap" refers to bank stabilization done with any handy material including tires, car bodies, railroad ties, rocks, and cement. Frequently, riprap becomes buried by sediment only to be exposed years later when a stream alters its path. During the 1996 Douglas County area floods, many past bank stabilization projects were exposed as sediment was washed away. In some cases, entire car bodies used for riprap were found stranded in the middle of streams that had drastically changed course.

The Millpond and Rock Creek campgrounds, located along the west bank of Rock Creek, have riprap retaining walls along portions of the channel presumably to prevent Rock Creek from wearing down the streambank and encroaching on campground development. These campgrounds were constructed in 1964; however there are no available records indicating when the retaining wall was constructed.

Current channel modification projects

Most known current channel modification projects in the Region are related to road crossings with culverts, and channel confinement from previously constructed roads. Culverts are usually constructed with riprap along the sides to prevent erosion around the structure and flow is channeled through the culvert. However, most current structures are built using wider culverts with minimal constriction of the channel whenever possible. Wider crossings over unconfined stream segments such as lower Rock Creek are most often bridges that allow movement of the channel. The ODOT bridge installation on Honey Creek (mentioned above) will allow Honey Creek's flow to widen from its currently restricted flow at the culverts that feed into the North Umpqua River.

Existing mainline roads along Rock Creek, Canton Creek and the highway along the North Umpqua River constrain these channels to varying degrees. In particular, the Rock Creek Road from just above the hatchery to East Fork Rock follows a section of Rock Creek that is an unconfined channel that naturally wants to meander. There are portions of this road that restrict its movement.

The Douglas Soil and Water Conservation District, OWRD, UBWC, Roseburg BLM, and the Umpqua National Forest are not aware of any additional channel modification projects in the Rock Creek Region. Landowners and stream restoration professionals report that non-permitted channel modification activities still occur throughout the Umpqua Basin. In many cases, the people involved are unaware of the regulations and fines associated with non-permitted channel modification projects and the effects on aquatic systems.

3.1.4. Stream function key findings and action recommendations

Stream morphology key findings

- Many transport streams are in areas where the landscape is fairly steep, increasing debris flow potential. Adding channel and riparian roughness from large wood and vegetation may help slow debris flows and help trap sediment in these streams.
- Rock Creek from Kelly Creek up to the confluence of Northeast Fork Rock Creek and the lower segment of East Fork Rock Creek are the only unconfined channels in the Region. They have relatively large meanders that regularly flood the riparian areas as the streambank heights are minimal. Large overflow channels and gravel bars are common.
- Canton Creek is a mostly confined depositional stream that moves water at high velocity between step-pools. There are a few small moderately confined segments on Canton that allow some channel widening. Overall, it tends to move water at higher speeds than Rock Creek; therefore the deposited substrate tends to be larger cobble rather than smaller gravels.
- The broad, low-gradient reaches (including Rock Creek, Canton Creek and the North Umpqua River) lend themselves to complex aquatic habitat with large wood, coarse sediment, pools, bars, and side channels. However, these reaches are difficult to enhance, as the meandering nature of the streams and the large volume of water flowing in wide channels can move rapidly especially during peak flows. This tends to dislodge large wood and debris as well as scour riparian areas of debris and vegetation.
- The Rock Creek Region is dominated by high gradient source streams that typically provide large wood and debris to lower stream segments. Although these segments tend to be above the anadromous fish areas, riparian projects along these streams may help provide a future large wood source to lower stream segments.
- Stream habitat surveys suggest that lack of large woody material, and poor riffles and pools limit fish habitat in surveyed streams. The Region tends to contain high gradient streams which are not as conducive to pool and riffle development. Most streams in the Region are dependent on large wood for reducing flow velocity and providing roughness and diversity of habitat.
- Lack of winter habitat and spawning gravels are two limiting factors affecting fish habitat in the Region.
- Instream wood or boulder placement, riparian improvement and protection, and road obliteration are all restoration strategies that can increase winter habitat and spawning gravels.
- East Fork Rock Creek has been found to be limited by insufficient over-winter habitat related to a shortage of large woody debris structures and pool habitat. A large woody debris placement project is currently underway on East Fork Rock Creek by PacifiCorp in cooperation with ODFW.
- PacifiCorp and ODFW will also be identifying areas in upper Canton Creek and East Fork Pass Creek for large woody debris placement projects to benefit resident trout.
- Riparian survey ratings tend to be the most favorable, indicating that although the current levels of large woody material in the streams are limited the future large wood source from riparian areas may be better. Exceptions include the upper reaches of

Rock Creek, where current large wood levels are good but riparian attributes are limited, indicating a potential future problem to those streams.

Stream connectivity key findings

- The diversion dam at Rock Creek and fish passage barrier culverts reduce stream connectivity, affecting anadromous and resident fish productivity in the Region.
- Culverts are common obstacles or barriers to fish migration. They can be complete barriers to fish or obstacles that can wear fish out if too many have to be crossed during migration. They can also be partial barriers blocking only some fish or juveniles.
- Replacing problem culverts and redesign of the diversion dam fish ladder may be the quickest way to increase fish habitat for a number of different salmonid species by providing access to streams that meet habitat requirements.
- Culverts rated with the highest priority for replacement by UBFAT are in the Rock Creek and Middle North Umpqua watersheds on Kelly, McComas, Hill, Honey, and Williams creeks.
- Fish passage barriers on Kelly Creek and McComas Creek are also identified as high priority for replacement by the BLM and by a multi-agency group of fish biologists during a meeting to prioritize restoration within the Region. Fish passage barriers on Taylor Creek and Surprise Creek were identified during this same meeting as well.

Channel modification key findings

- There are no known permitted channel modification projects in the Rock Creek Region.
- Historical modifications include the construction and use of the Rock Creek Mill log pond diverting water from Rock Creek by use of a push up dam, and riprap placed along Rock Creek to prevent erosion into campgrounds and associated trails.
- Most modifications are related to culvert structures associated with road construction, and to roads that prevent stream meandering in portions along Rock Creek.

Stream function action recommendations

- Select and plan projects carefully in the broad, low-gradient reaches of Rock Creek, Canton Creek and the North Umpqua River. An adaptive management approach may be worthwhile to create roughness along the sides of these channels and in the riparian areas that may slowly add structure back into many segments where coarse wood is important but lacking.
- Where appropriate, improve pools and riffles while increasing instream large woody material by placing large wood and/or boulders in streams with channel types that are responsive to restoration activities and have an active channel less than 30 feet wide.[42] Adding large wood, stabilizing banks by planting trees, and improving shade along moderate gradient transport streams may be helpful in restoring some attributes of stream function such as winter habitat and spawning gravels.

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[42] Thirty feet is the maximum stream width for which instream log and boulder placement projects are permitted.

- Work with landowners, ODFW, and PacifiCorp to identify riparian areas that should be protected and/or improved to insure future large woody debris to channels.
- Encourage land use practices that enhance or protect riparian areas:
  - Plant native riparian trees, shrubs, and understory vegetation in areas with poor or fair riparian areas.
  - Manage riparian zones for uneven-aged stands with large diameter trees and younger understory trees.
  - Maintain areas with good native riparian vegetation through easements on private land and education of small private landowners.
- Work with ODFW to obtain match funding to money already obtained for use in redesign and construction of a new fish ladder at the diversion dam.
- Encourage landowner participation in restoring stream connectivity by eliminating barriers and obstacles to fish passage. Restoration projects should focus on barriers that, when removed or repaired, create access to the greatest amount of fish habitat.
  - UBFAT scoring can be used to determine those of highest priority.
  - In addition to the UBFAT scoring, culverts on Kelly Creek, McComas Creek, Taylor Creek, and Surprise Creek have already been identified as high priority for replacement by fish biologists working in the area.
- Increase landowner awareness and understanding of the effects and implications of channel modification activities through public outreach and education.

3.2. Riparian zones and wetlands

3.2.1. Riparian zones

For the purpose of this assessment, the vegetation immediately adjacent to a stream is the stream's riparian zone. These areas and their associated streams have direct influence on each other. Riparian zones influence stream conditions in many ways. Aboveground vegetation can provide shade, reduce water velocity during peak flows, and add nutrients to the stream. Roots help prevent bank erosion and stream meandering. Trees and limbs that fall into streams can increase fish habitat complexity and create pools. Insects that thrive in streamside vegetation are an important food source for fish. Streams affect riparian areas through flooding, scouring, and sediment deposition, all of which influence the types of vegetation that grow.

What constitutes a "healthy" riparian area is dependent on many factors. Although many large diameter conifers and hardwoods provide the greatest amount of shade and material, many streams flow through areas that do not support large trees or forests. In some areas, current land uses may not permit the growth of "ideal" vegetation types. Conclusions about stream riparian zone conditions should take into consideration location, known historical conditions, and current land uses. Therefore, this assessment's riparian zone findings should be viewed as a guide for interpretation and further investigation and not as an attempt to qualify riparian conditions.

The ultimate source of stream heat is the sun, either by direct solar radiation or by ambient air and ground temperature around the stream.[43] Blocking the amount of direct solar energy reaching the stream surface reduces warming rates. Streams with complete cover receive the least direct solar radiation, and are therefore preferred in the Umpqua Basin, where many streams are 303(d) listed for high temperature.[44] Cover is dependent on stream width and riparian vegetation. Shrubs and grasses can provide substantial cover for small, narrow streams. Larger streams can be partially shaded by vegetation and completely shaded by infrastructure. In very wide streams, only bridges provide complete coverage.

The Rock Creek Region is dominated by forest land and the predominant land use is forest management (see Section 1.3). This includes both federal and private forest lands that require various levels of tree retention and buffers in riparian areas. Most of the riparian areas that have been altered in the Region are the result of past timber harvest and road construction, although peak flood events have caused or exacerbated the changes to some riparian areas. Landslides, windthrow, insects, fire, invasive plants, and land development have all contributed to riparian changes as well.

Timber harvest changes to riparian zones

Timber harvest has impacted the most riparian acres. Although impacts from harvest can be significant in terms of tree removal, soil disturbance, and change in hydrologic function, it is important to note that effects of these changes can recover over time. Removal of vegetation has a long-term effect, compared to road construction or development that can be a more permanent effect.

Timber harvest in the Region began in earnest by the 1950s. Although complete records of these earliest units are not available, federal timber harvest records indicate that almost eight percent of the Region was harvested prior to 1970 (Table 2-2). The greatest effect to the function of these harvested riparian areas occurred at the time of harvest. Although this early harvest was extensive, forest development in these areas today is much more advanced than in the recent harvest areas. Older harvested riparian areas are still affected by these past changes; however significant recovery of vegetation, shade, and coarse wood is contributing again to riparian function.

Riparian areas with wide bands of trees provide habitat and migration corridors for wildlife. As the number of trees in close proximity to the stream increases, so does the likelihood that some trees will fall into the stream, forming pools and creating fish habitat. Wide tree buffers also increase stream shading, creating a microclimate with cooler summer temperatures compared to other reaches within the same stream that lack tree cover.

Current timber harvest on private land is regulated by the Oregon Forest Practices Act which took effect in 1972. When first enacted, reforestation and some buffers on streams were required. This Act has been modified over time with increasing protection to

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[43] See Section 3.3.2 for more information about stream temperature.
[44] See Section 3.3.1 for more information about 303(d) listed streams.

riparian areas. Harvest prior to 1972 had no restrictions on riparian harvest. Federal land harvest regulation followed suit in 1976 with the Forest Management Act. Current protection of riparian zones during timber harvest is variable by ownership and specific stream characteristics. For these reasons, a buffer of 200 feet (approximately one "site-potential" tree length) was used in this analysis on all streams. Since actual buffers necessary to protect riparian zones are variable, this assessment is a guide to further investigation where riparian protection or restoration may be warranted.

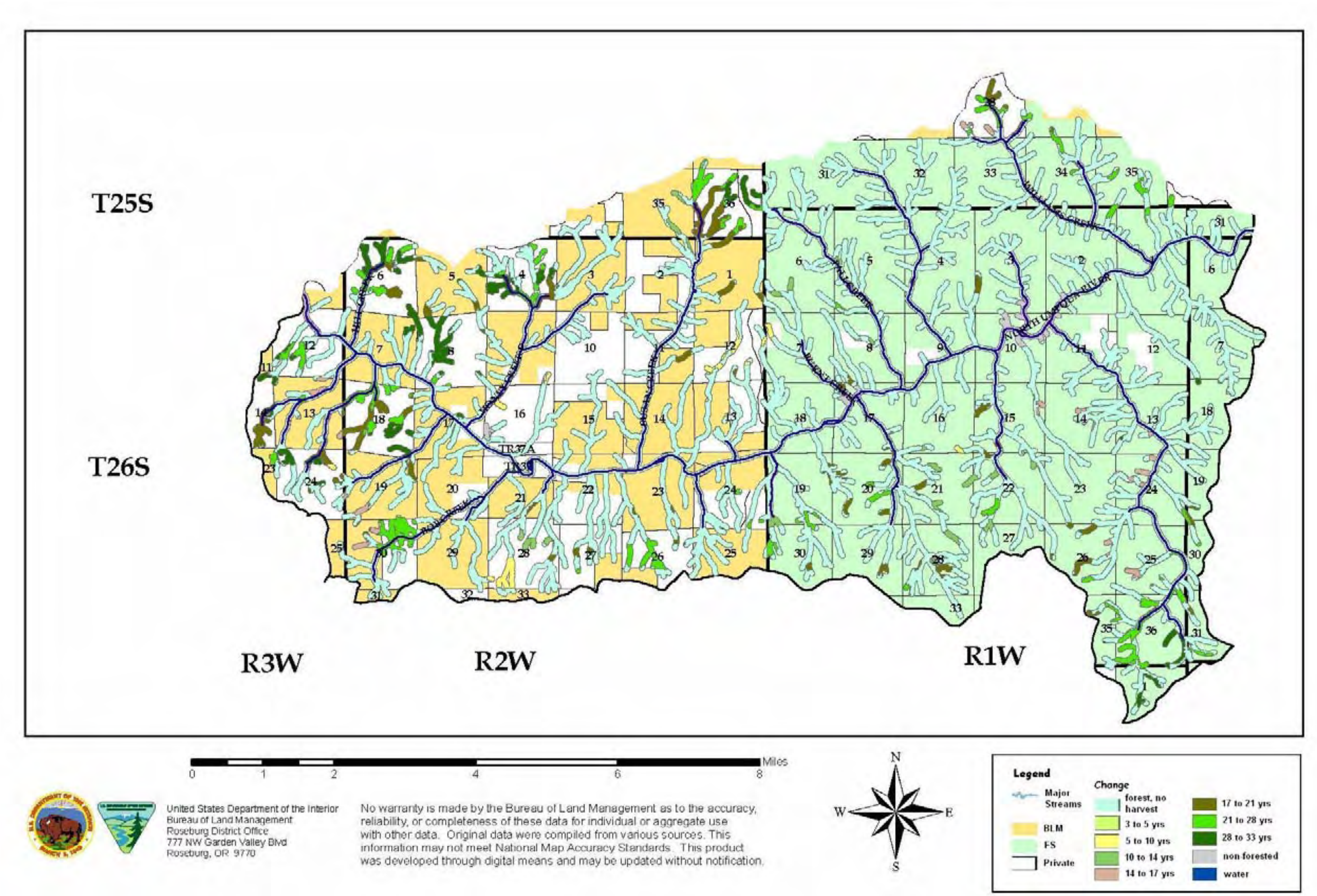
The Roseburg BLM mapped non-forest and harvest areas across all ownerships from 1972 to 2002.[45] These mapped areas that are within 200 feet of streams for each watershed are shown in Map 3-9, Map 3-10, and Map 3-11 and listed in Table 3-6.

Period harvested or condition	Years since harvest	Middle N Umpqua (acres)	Canton Creek (acres)	Rock Creek (acres)	Total (acres)
1972 - 77	28 - 33	535	909	1,290	2,734
1977 - 84	21 - 28	847	979	2,389	4,215
1984 - 88	17 - 21	626	435	1,395	2,456
1988 - 91	14 - 17	144	234	210	588
1991 - 95	10 - 14	191	9	50	250
1995 - 2000	5 - 10	126	20	111	257
2000 - 02	3 - 5	0	0	46	46
non-forested	---	247	0	64	311
forested*	---	12,300	13,080	15,541	40,921

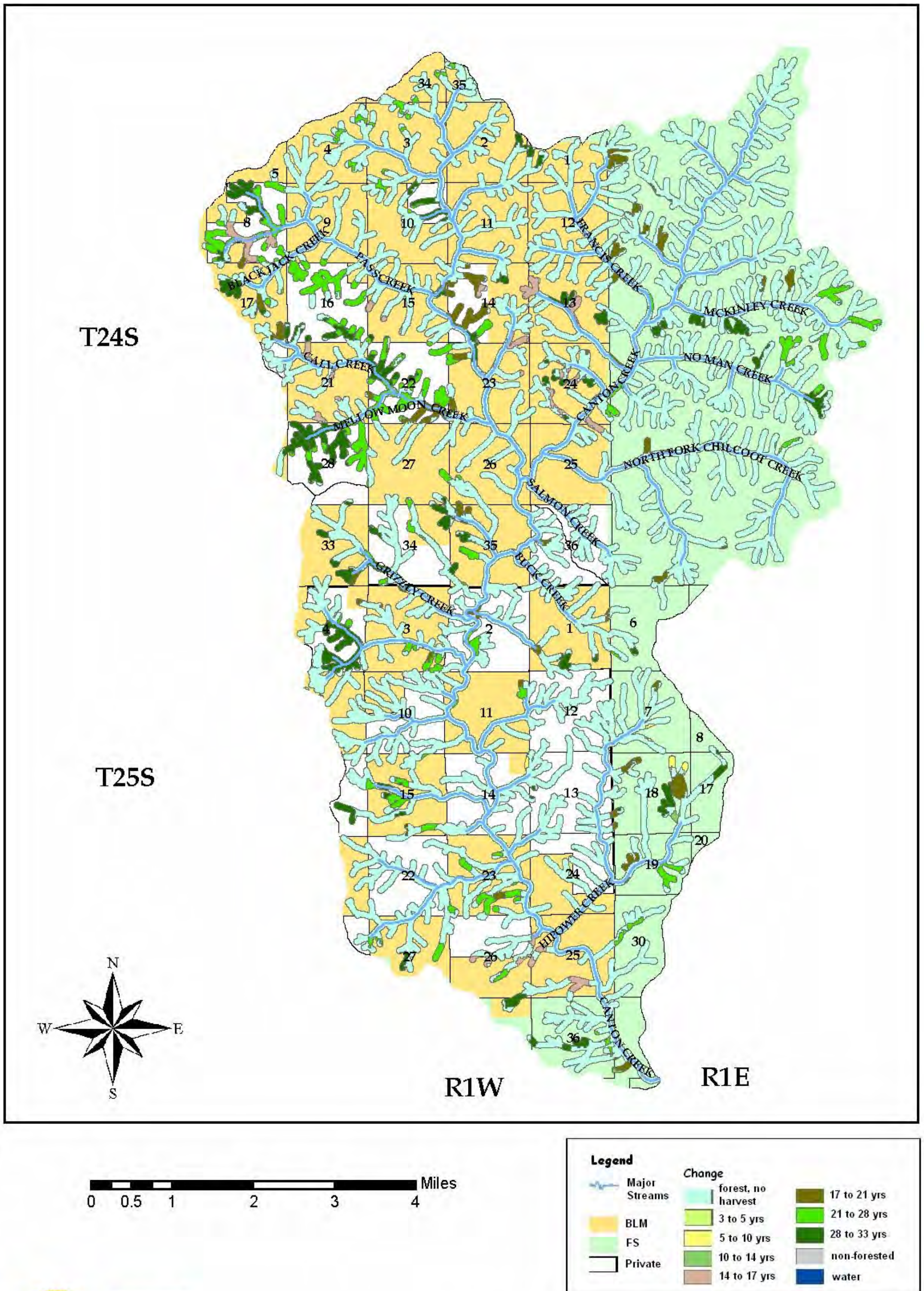
* Forested areas with no visible harvest since 1972. Some areas were harvested prior to 1972 and now contain older forest.

Table 3-6: Harvested acres over time; non-forested acres; and forested acres (not harvested since 1972) within 200 feet of streams in the Region.

[45] Areas were mapped on aerial photography taken over a series of years between 1972 and 2002. They include visible stand-replacing harvest on all ownerships, non-forest areas, and forested no harvest areas.



Map 3-9: Harvested areas over time within 200 feet of streams in the Middle North Umpqua Watershed.



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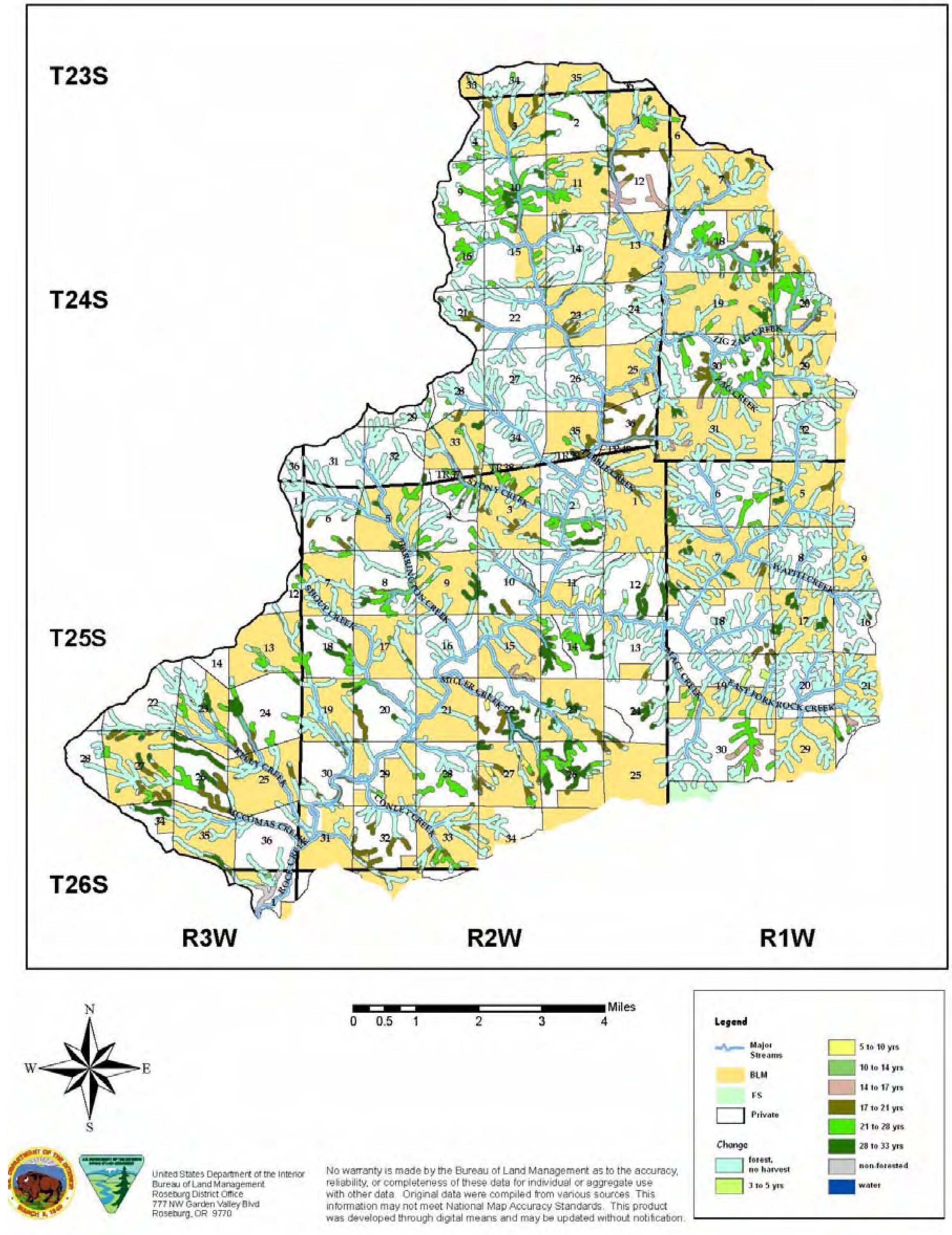
Map 3-10: Harvested areas over time within 200 feet of streams in the Canton Creek Watershed.



Map 3-11: Harvested areas over time within 200 feet of streams in the Rock Creek Watershed.

Figure 3-1 shows that over 80 percent of the riparian areas in the Middle North Umpqua and Canton Creek watersheds and 74 percent in the Rock Creek Watershed have not been harvested in the last 33 years. However, approximately 21 percent of the riparian areas in the entire Rock Creek Region have been harvested since 1972.

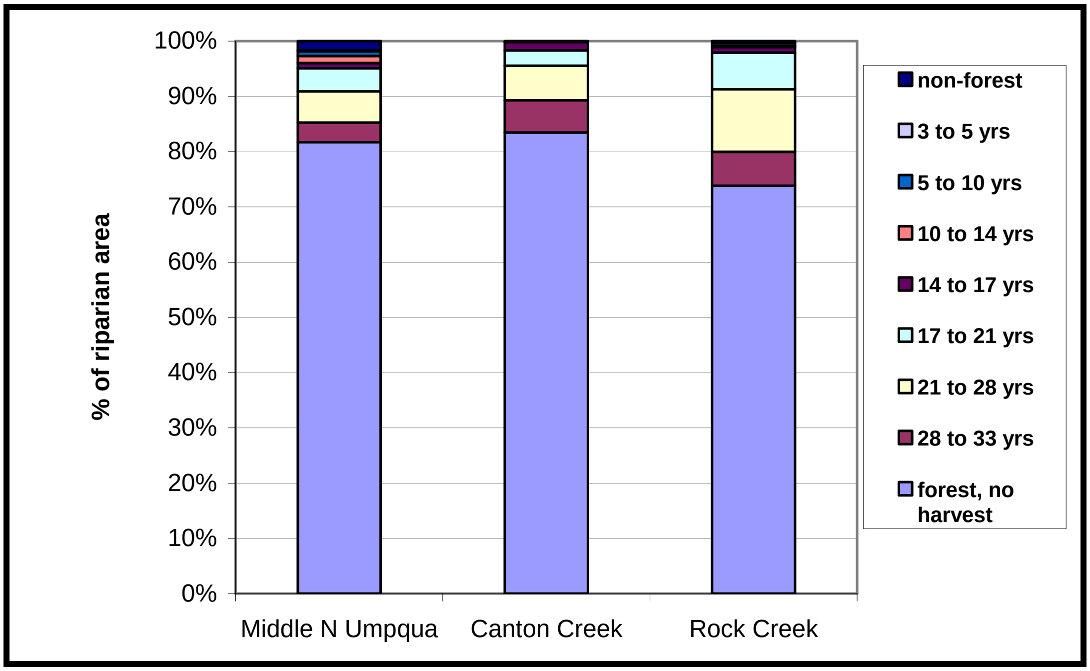


Figure 3-1: Timber harvest, non-forest, and forest, no harvest acres between 1972 and 2002 for all ownership within 200 feet of streams in the Region.

Figure 3-2 shows the distribution of ages for the portion harvested is mostly 21 to 28 years old. These forests are starting to show mid-seral stage development where some trees are dying making room for more dominant trees to grow larger.[46] This promotes larger tree crowns and diameters to aid in creating shade and large wood necessary for riparian function. Most of the older harvested areas between 28 and 33 years should be in mid-seral stages already. Forests younger than 21 years are still in an early-seral stage with little understory, smaller crowns, shorter trees, and a more even-sized canopy. Many of these are starting to provide some shade but need more time to provide optimum shade and large wood characteristics.

[46] See Section 0 for a complete description of the different seral stages of forests.

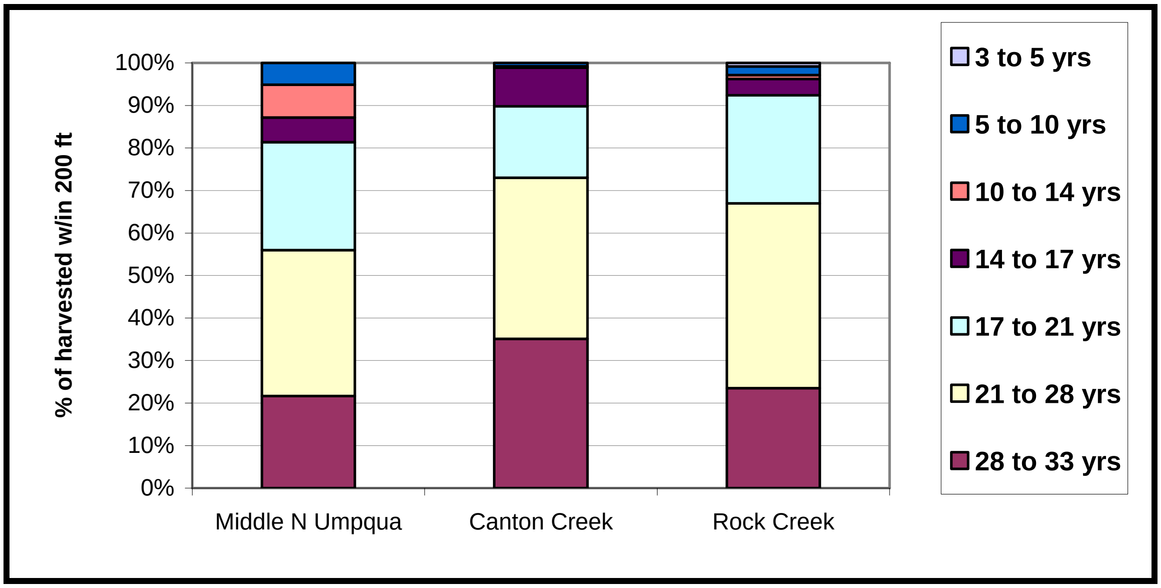


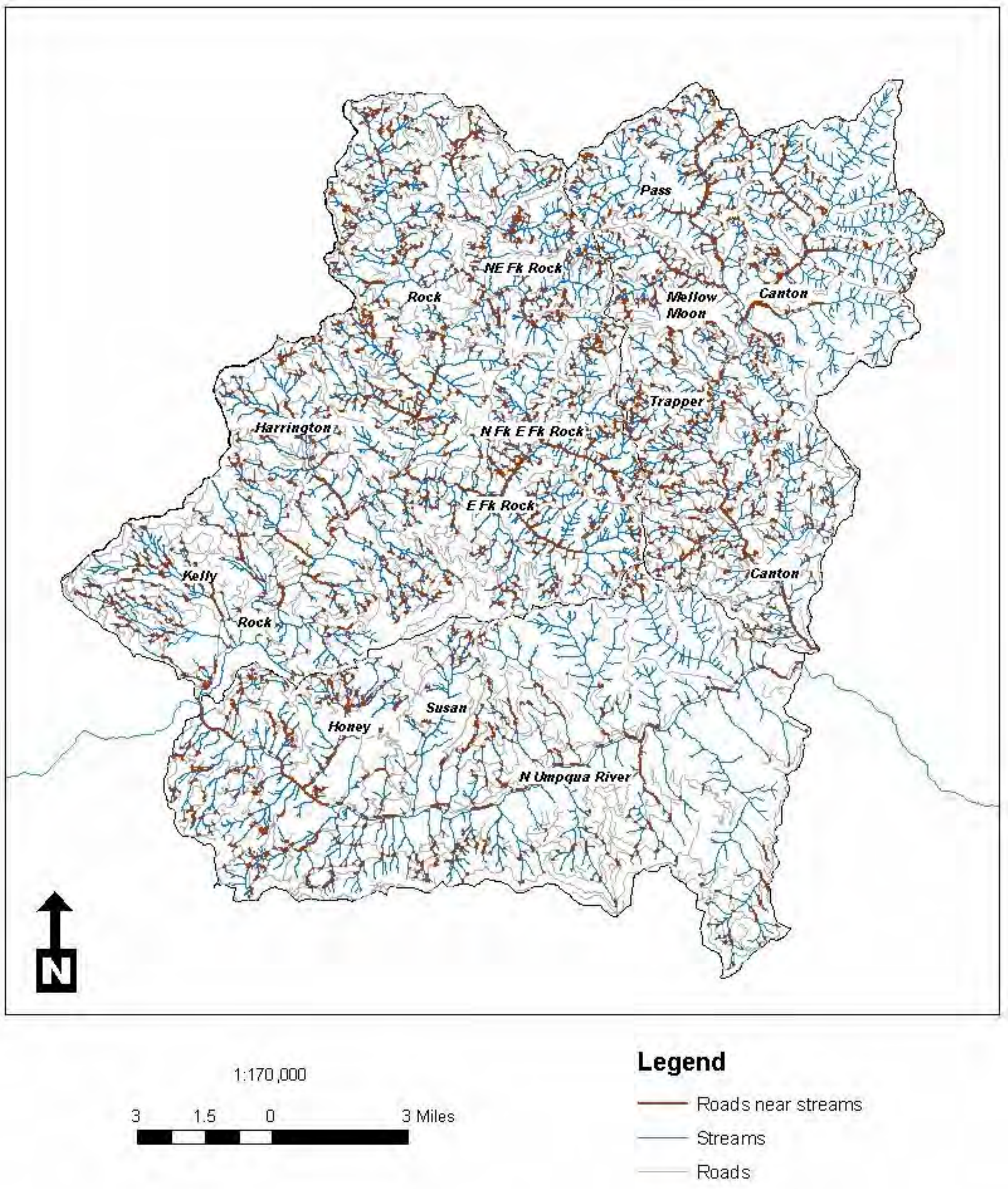
Figure 3-2: Distribution of ages for harvested riparian areas between 1972 and 2002 in the Rock Creek Region.

Road construction changes to riparian areas

Roads can have a long-term to permanent effect on riparian areas in several ways. Clearing of vegetation for the road removes shade and potential large wood sources from the area. Compaction of the roadbed and the continued use of the road make the loss of vegetation permanent. Roads that are not necessary for continued use can be decommissioned and vegetation can be reestablished. Roads can also restrict channel meandering, especially along the larger streams where the mainline roads were built. This not only affects stream flow characteristics but also how the stream recruits large wood into the channel.

Construction of roads in the Rock Creek Region was underway in the 1940s and 1950s. Roads were constructed to access timber with the earliest mainline roads established along Rock Creek, Canton Creek and the Middle North Umpqua River. These followed the streams along the valley floor and led the way to additional construction up many of the tributaries.

Map 3-12 shows the portions of streams that are within 200 feet of a road. Not all of these streams are impacted by the roads since the size of riparian areas vary depending on the stream. Larger streams and those with anadromous fish typically require greater riparian protection than the highest reaches of many headwater streams. However streams with large portions within 200 feet of roads are more likely impacted by loss of riparian zone. In the Canton Creek Watershed, large portions of Canton Creek, Pass Creek, Francis Creek, and Mellow Moon Creek are within 200 feet of roads. In the Middle North Umpqua Watershed most of the area is along the lower end of the North Umpqua River where the highway runs closer to the river. Honey Creek also has a large portion of the stream within 200 feet. The concentrations of streams near roads in the Rock Creek Watershed occur along East Fork Rock Creek, North Fork East Fork Rock Creek, Wapiti Creek, and in the lower portions of Shoup, Harrington, and Stony creeks.



Map 3-12: Roads within 200 feet of streams in the Rock Creek Region.

Table 3-7 shows the Rock Creek Watershed has about 154 miles of road and over 39 percent of the stream miles within 200 feet. The Middle North Umpqua Watershed has the least with 27.5 percent and Canton Creek Watershed has 34.7 percent of the stream miles within 200 feet.

	Middle N Umpqua	Canton Creek	Rock Creek
Road miles within 200 feet of streams	72.5	97.9	153.9
Percent of stream miles within 200 feet of roads	27.5	34.7	39.4

Table 3-7: Road miles and percent of stream miles within 200 feet by watershed.

Development effects on riparian areas

The Rock Creek Region has little development compared to lower elevation watersheds in the Umpqua Basin. There are some small landowners with houses and associated buildings such as barns and driveways that are impermeable surfaces. Some of these residences have also cleared trees or other vegetation within the riparian areas for access or views. These private residences are mostly located along the lower reaches of Rock Creek, Honey Creek, and along the North Umpqua River (see Map 1-10). Not all of these residences have development or clearing within the riparian zone.

Other types of development include the Rock Creek Hatchery, much of which is constructed within the riparian area along Rock Creek. It has several large buildings, roads, parking areas and ponds. Campgrounds and day use recreation sites have also been created in all three watersheds. Two campgrounds are located along Rock Creek several miles up from the hatchery. More campgrounds are along the North Umpqua River at Susan Creek, near Williams Creek and Bogus Creek, and two smaller ones on Canton and Scaredman creeks. Day use parking and picnic areas are located along the North Umpqua River at the Swiftwater Bridge, and Susan Creek. These developments include parking areas and road access that have removed riparian vegetation. Large trees and down logs are usually retained in the camp and day use sites, but much of the understory vegetation is removed.

Invasive plants effect on riparian areas

Invasive plants are a problem throughout the Umpqua Basin. Non-native, invasive plants that have established themselves spread rapidly and thrive in many areas by out-competing the native plants that were there. This not only creates less diverse areas, but often the invasive plants do not provide all of the same function of the native plants in keeping healthy riparian areas. Invasive plants often shade out shrubs used by animals and insects that supply a food source to wildlife and fish. They also can inhibit establishment and growth of seedlings, eventually causing canopies to open up as larger trees die with few young trees to replace them.

The Oregon Department of Agriculture developed a list of these plant species that are a particular problem. Plants identified on this list are referred to as noxious weeds. These plants are often targeted for removal or control to reduce their effect in an area. Riparian areas and roads are primary passageways for the spread of these plants. Many of the seeds are spread on vehicles traveling along roadways. Water transports seeds to riparian areas where growing conditions are often favorable.

The Rock Creek and Canton Creek watersheds were some of the first areas that the Roseburg BLM surveyed for noxious weeds beginning in 1995. These surveys are ongoing as spread of noxious weeds is rapid. BLM continues to treat many of these areas by removing or killing these weeds to help control their spread. Herbicides are commonly used to kill noxious weeds along roadways. In riparian areas, mechanical methods are more typical to protect the waterway.

The DSWCD, Roseburg BLM, and Umpqua National Forest are just beginning a project to remove French, Spanish, and Scotch broom species along the highway from Glide to the Soda Springs reservoir, with some additional work up Rock Creek.

Other effects on riparian areas

Flooding during peak storms has had significant effects on the riparian areas, particularly in Rock Creek. The 1964 rain-on-snow flood caused massive flooding, scouring, and deposition of material in the riparian areas. In some cases, new overflow channels were established. These peak flow events continue to affect riparian areas today.

Landslides have always affected riparian areas by removing vegetation, scouring areas along steeper tributaries, and depositing wood and sediment in flatter riparian zones. Landslide frequency has increased from historic times (see Section 3.3.7). Landslides that trigger debris flows often extend beyond streambanks; scouring riparian vegetation and eventually depositing material in the lower riparian zones. However, roads that follow streams along the valley bottoms intercept some landslides before they reach riparian areas.

Windthrow, insects and fire all continue to affect riparian areas. The effects of fire have been reduced with the onset of active fire suppression. However riparian areas can act as fire corridors during intense burns. Buffers that are often left untreated from past harvest can have dense fuel loads that connect to one another throughout the watershed. These same untreated areas can also increase the probability of windthrow and insect damage. Fuel load management is important in minimizing this risk.

Riparian treatment options

Riparian improvement

Thinning forests can change the rate at which forests develop older characteristics. Riparian areas that have harvest restrictions are not typically thinned. Areas outside riparian corridors often receive pre-commercial thinning at about 15 years of age and can be commercially thinned at about 40 years. Younger stands in riparian areas should be considered for thinning to speed up the large wood and large tree crown development for riparian function. Large trees located in riparian areas are the source of large woody debris in streams, a key component to fish habitat. In some of the smaller tree stands, thinning can be done through girdling rather than tree removal where the ground is sensitive to disturbance.

Planting trees and other riparian plants can be done in areas that have not regenerated with native species. These plants not only provide shade, but during peak flows, they trap sediment, provide nutrients, and add roughness that slows water movement. This may be necessary in areas where noxious weeds dominate the understory and outcompete native vegetation. Removal of noxious weeds and continued maintenance of plantings in these areas would be required until native plants have fully occupied the sites. Some areas that have regenerated to all hardwoods, may benefit from inter-planting conifers. This would add diversity to riparian areas as well as a potentially larger future wood source (see **Error! Reference source not found.**). Large wood can also be placed in the floodplain riparian areas to add structure to the stream, trap sediment, and slow water movement during flood events.

Photo 3-2: Hardwood dominated riparian area in the background and dense blackberry in the foreground along Rock Creek.

Riparian protection

Improving riparian areas can improve stream conditions, but it is just as important to protect riparian areas that are functioning well, especially along streams that have had their riparian function greatly reduced. The Northwest Forest Plan provides substantial protection to riparian areas on federal land and the Oregon Forest Practices Act provides some protection on private land forest land. However, some streams may benefit from additional protection where functioning riparian areas have been substantially reduced from past activities.

Riparian conservation easements[47]

Conservation easements are a tool that can be used to add permanent protection to riparian areas that are currently functioning well. They typically involve an agreement between the landowner and the implementing agency or group to manage a specific area such as a riparian corridor to maximize conservation and natural function of the property in perpetuity. PacifiCorp, as part of the off-site mitigation agreed upon to meet their relicensing requirements, is in the process of determining the location of riparian corridors on private land primarily along mainstem Rock Creek, in upper Canton Creek,

[47] PacifiCorp *et al.,* 2001.

and East Fork Pass Creek where conservation easements can be established to manage these areas to benefit the associated streams in perpetuity. Selected areas will be approved by the ODFW, and designed to increase stream channel shading and reduce temperatures in mainstem Rock Creek to benefit anadromous species and in upper Canton Creek and East Fork Pass Creek to benefit resident trout. The easements established in the Canton Creek Watershed will coincide with instream placement of large woody debris (see Section 3.1.1 for a description of large woody debris placement). Provided there are interested landowners, the benefits of these easements, as stated in the Settlement Agreement and described in Section 6.1 are as follows:

> "This measure, in combination with management guidelines included in the Northwest Forest Plan and overall enhancement efforts in the Rock Creek basin should function to substantially increase protection for riparian and aquatic habitats in the basin, resulting in improved habitat conditions for anadromous and resident fish. In addition, riparian conservation easements will be expected to increase recruitment of large woody debris to stream channels in the long term in the affected reaches."

Location of treatments

Riparian area improvement and protection can improve many of the limiting factors of streams. They are the best management tools for reducing the rate of stream warming during peak summer temperatures by providing shade and wood to streams. Bedrock channels heat up faster than those with gravel or cobble substrates. Instream wood can trap these gravels and provide additional cover to the stream. Improving or protecting riparian areas along the streams listed in Table 3-8 would reduce the rate of stream warming during high summer temperatures, and help reduce the impact of peak flows. Improving riparian areas along other streams may address limiting factors to fish production in the Region such as improving winter habitat. Refer to Sections 3.1.1 and 3.4.3 for more discussion on winter habitat and peak flows.

Limiting factor	Riparian improvement	Riparian protection
Elevated stream temperatures in summer	Pass Creek Canton Creek Rock Creek Harrington Creek Miller Creek	Canton Creek East Fork Rock Creek Rock Creek
High velocity peak flows	Miller Creek Pass Creek Harrington Creek	

Table 3-8: Streams where improving or protecting riparian areas would help reduce stream warming during high summer temperatures.

3.2.2. Wetlands[48]

The hydrology of wetlands and stream-associated wetlands is often complex and interconnected. A watershed-based approach to wetlands assessment is critical to ensure that the whole ecosystem is reviewed. The purpose of this section is to review current wetlands locations and attributes, historical wetlands, and opportunities for restoration. Background information for this section was compiled from the following groups' documents, websites, and specialists: the Oregon Division of State Lands, US Environmental Protection Agency, US Fish and Wildlife Service, and Wetlands Conservancy. Additional information was compiled from *Wetland Plants of Oregon and Washington* (Guard, 1995).

Overview of wetland ecology

When discussing wetlands, it is helpful to clarify terms and review ecological functions in order to facilitate a mutual understanding. The following section provides a brief description of wetland ecology.

What is a wetland?

In general, wetlands are a transitional area between terrestrial and aquatic ecosystems, where the water table is usually at or near the surface of the land, or the land is covered by shallow water. The following three attributes must be found together to establish the existence of a regulated wetland:

1. Under normal circumstances there is inundation or saturation with water for two weeks or more during the growing season;[49]
2. The substrate is predominantly undrained hydric soil as indicated by the presence of features such as dull colored or gleyed (gray colors) soils, soft iron masses, oxidized root channels, or manganese dioxide nodules; and
3. At least periodically, the land supports predominantly hydrophytic (water-loving) vegetation.

Function and values

In the past, wetlands were regarded as wastelands and considered nuisances. As early as 1849 with the enactment of the Swamp Act, wetlands removal was encouraged. Wetlands were feared as the cause of malaria and malignant fever. However, research over the years has led to a greater appreciation of the many important ecological functions that wetlands perform.

Of the many functions and benefits of wetlands, different ones will be important to different communities depending upon their goals for wetland protection and restoration. Some of the many functions and benefits of wetlands include:

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[48] Much of this section is from the Wetlands section by Jeanine Lum of Barnes and Associates, Inc. produced for the UBWC South Umpqua Watershed Assessment.
[49] The growing season in Douglas County is from March 1 through October 31.

- Flood prevention - wetlands are able to absorb water from runoff during storms and gradually release the water that would otherwise flow quickly downstream.
- Water filtration - wetlands improve water quality by acting as sediment basins. Wetland vegetation is able to filter and reduce excess nutrients such as phosphorous and nitrogen.
- Ground water recharge - water that is held in wetlands can move into the subsurface soil, thus recharging the groundwater.
- Stream bank stabilization - wetlands and associated vegetation slow the movement of water and help slow erosion of stream banks.
- Fish and wildlife habitat - many species depend on wetlands for food, spawning and rearing.

Background of the Clean Water Act and National Wetlands Inventory

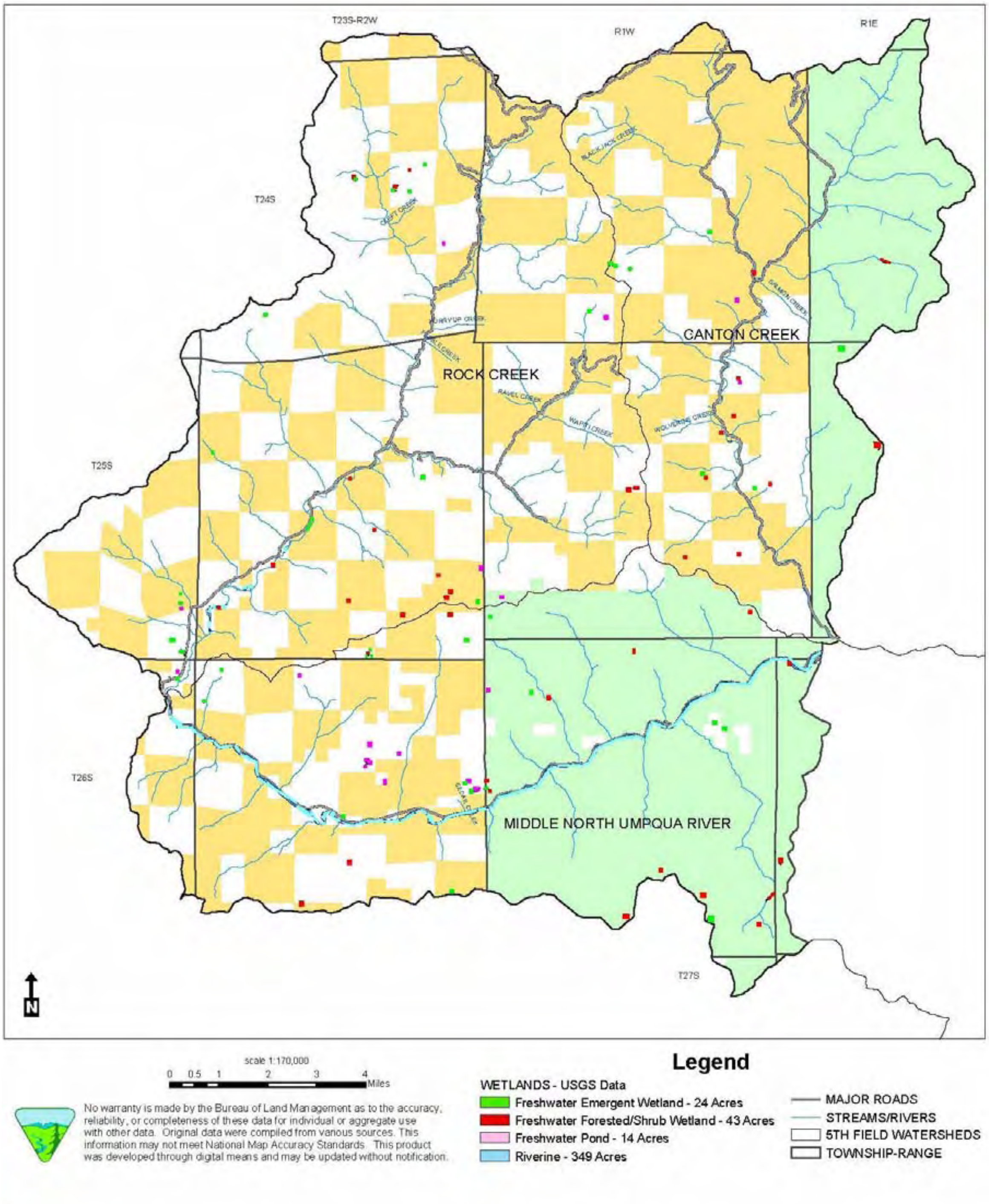
Section 404 of the federal Clean Water Act requires that anyone planning to place dredged or fill material into waters of the United States, including wetlands, must first obtain a permit from the U.S. Army Corp of Engineers. Established (ongoing) and normal farming, ranching, and forestry activities are exempt. The Emergency Wetlands Resources Act of 1986 requires the U.S. Fish and Wildlife Service (USFWS) to inventory and map wetlands in the United States. This mapped inventory is called the National Wetlands Inventory (NWI).

Nationally, an estimated 46 million acres, or 50 percent of the original wetlands area, have been lost to clearing, filling, draining and flood control since the 1600s. In 1997, the USFWS reported an 80 percent reduction in wetlands loss during the period 1986 to 1996, as compared to the decade prior. Although the nation has not met the goal of no net loss of wetlands, it has slowed the rate of wetlands loss.

Types of wetlands

A wetland that holds water all year round is the easiest wetland to recognize and the one most people understand as a wetland. Another type of wetland is the ephemeral wetland, or a wetland that holds water for only a few days, weeks, or months during the year. The timing and duration of water are important factors that dictate which plants and wildlife will use a particular wetland.

NWI classifies wetlands based on guidelines established by Cowardin and others (1979). The “palustrine” system classification includes all non-tidal wetlands dominated by trees, shrubs, emergents (erect, rooted, non-woody plants), mosses or lichens. It groups the vegetated wetlands traditionally called by such names as marsh, swamp, bog, fen, and prairie potholes. The palustrine wetland also includes the small, shallow, permanent or intermittent water bodies often called ponds. Bodies of water that are lacking such vegetation and are less than 20 acres in size are included in this category. Palustrine wetlands locations within the Region are shown on Map 3-13 with forested and scrub-shrub wetlands combined.



Map 3-13: Rock Creek Region wetlands from the National Wetlands Inventory.

The "riverine" system classification includes wetlands within a channel, except those dominated by trees, shrubs, and persistent emergents. Wetlands within a channel that are dominated by vegetation are classified as "palustrine". Table 3-9 is a summary of codes and descriptions used in the NWI. Riverine wetlands locations are displayed in Map 3-13.

System	Class	Brief description
P=Palustrine	EM=emergent	Dominated by rooted herbaceous plants, such as cattails and grass.
	SS=scrub-shrub	Dominated by shrubs and saplings less than 20 feet in height.
	FO=forested	Dominated by trees taller than 20 feet in height.
	UB=unconsolidated bottom	No vegetation evident at the water surface, with mud or exposed soils.
R=Riverine	R3=upper perennial	Channels that flow throughout the year, characterized by high gradient and fast water velocity.
	R4=intermittent	Channels that contain flowing water only part of the year.

Table 3-9: National Wetlands Inventory wetlands codes and descriptions.

Description of current wetlands in the Rock Creek Region

A review of the NWI data shows the main channel of the North Umpqua River and portions of Rock Creek between Kelly Creek and Shoup Creek are classified as riverine systems which periodically or continuously contain flowing water. Portions of land adjacent to the North Umpqua River, designated primarily as beach bars, are seasonally flooded. Here surface water is present for an extended period, especially early in the growing season, but is absent by the end of the growing season in most years. The water table can vary from saturation at the surface to well below the ground surface after flooding ceases.

Most of the wetlands in the Region are considered riverine and are located primarily along the North Umpqua River. They occur primarily on public land managed by the Forest Service and BLM, with some located on Rosboro Lumber Company and small private landowner property. Most of these areas are managed as forest land in a Wild and Scenic land use designation where there is extra protection from disturbance on public land. The private land holdings are all classified as empty rural lands. Some riverine wetlands also occur along the lower segments of Rock Creek mostly on small private landowner property.

Most of the palustrine wetlands are dominated by forest or shrub vegetation. These are found throughout the Region including far up near the ridges to just adjacent to many of the streams. Those concentrated near streams are located along Canton Creek and several tributaries between Scaredman Creek and Pass Creek, as well as along the lower portions of Rock Creek near the riverine wetlands. Emergent wetlands are also found throughout but tend to be closer to streams. The largest concentration is along Rock Creek where the old Rock Creek Mill used to have a log pond. Portions of this wetland are being affected by the spread of noxious weeds and beavers have been active in a small stream running through the area (see Photo 3-3). Blackberry and broom species are both spreading within this emergent wetland. This is common especially on the raised microsites of emergent wetlands and throughout forest and shrub wetlands, especially those near roads and streams that spread seed of these invasive species.

Photo 3-3: Emergent wetland adjacent to Rock Creek with blackberry and scotch broom invading.

The vast majority of the pond wetlands are located on small private landowner property. These were probably developed mostly for irrigation, livestock and fire prevention.

Historical wetlands and changes in the Rock Creek Region

There is little specific reference in historical records to wetlands in the Rock Creek Region. However, approximately 38 percent by area of Oregon's wetlands have been drained, diked or filled since Euro-American settlement. In western Oregon specifically, 53 percent of the original wetlands acreage has been lost to development or converted to other uses (Wetlands Conservancy, 2003).

One indicator of possible historical wetlands is the area of hydric soils adjacent to existing wetlands. Hydric soils are formed under conditions of saturation, flooding or ponding of sufficient duration during the growing season to develop anaerobic conditions in the upper part of the soil profile. In general, hydric soils are described as clayey, poorly-drained, with low permeability and a high water table present during late fall, winter, and spring.

There are no hydric soils mapped in the NRCS mapping of the Region. However, hydric soils are known to be present in the Region indicating that these areas probably contain combinations of many soils where mapping did not select out hydric as the dominant soil type. Records of hydric soils and wetlands that existed prior to early road construction in the Region do not exist. Mainline roads that follow the larger streams up the valleys probably were built through wetlands where the hydrology has been changed by the road construction.

Restoration opportunities in the Rock Creek Region

Wetlands loss and degradation is caused by human activities that change wetland water quality, quantity, and flow rates; increase pollutant inputs; and change species composition as a result of disturbance and introduction of non-native species. Although one of the functions of wetlands is to absorb pollutants and sediments from the water, there is a limit to their capacity to do so.

The primary impacts to wetlands in the Rock Creek Region are from the invasion of noxious weeds and probably road construction. Removing and controlling noxious weeds in the remaining wetland areas is imperative to maintaining continued function of these areas. New road location can avoid wetlands, and older roads that are deemed unnecessary to current and future management of these lands may be decommissioned and rehabilitated, although restoring hydrologic function to these areas is very difficult.

There is opportunity for enhancement and protection of wetlands including forested alder stands and emergent and forested wetlands along the lower to middle segments of Rock Creek, on Canton Creek below Wolverine Creek, along the bottom of Pass Creek, near the upper reaches of Cougar and North Fork Chilcoot creeks, and many areas along the North Umpqua River. Bank stabilization and riparian planting can increase habitat value along the targeted creek. Landowner interest, land use, current condition, and threats to the site are considerations in deciding which sites have merit as a wetland project.

Opportunities exist for landowners to participate in incentive, cost-share, and/or grant awarding programs that encourage good land stewardship and benefit wetlands. Although each program varies with its incentives and eligibility, landowners share these common concerns:

- Lack of awareness of available programs.
- Overwhelming program choices: "which one is best for me?"
- Concern about hidden agendas and "fine print."
- Anxiety over bureaucracy and contracts: "not worth the effort."
- Fear of the loss of privacy on land or the discovery of threatened or endangered species on the property.

Some wetland projects are undertaken for the specific purpose of compensating for the damage or destruction to another wetland area. Recent reports show that nearly two-thirds of all mitigation projects fail to meet performance standards (Mockler, 2003). Planning, monitoring, and long-term management, important for all wetland activities, are especially important for wetland mitigation projects. Lack of measurable goals, monitoring and corrective adaptive management have been identified as some problems with mitigation wetlands in Douglas County.

Recommendations

Nearly all of the wetlands in the Rock Creek Watershed are found on private land with the exception of a few along Rock Creek and several at higher elevations in the south of the watershed that are on public BLM managed land. Wetlands in the west half of the Middle North Umpqua Watershed are all on private land while most in the east are on public Forest Service land. In the Canton Creek Watershed they are on a mix of public and private ownership. Much of the private ownership is managed industrial forest land or small private forest land, in some cases near residential development. Wetlands are not productive for forest management and many are located in buffers along streams where harvest is prohibited. However, noxious weed invasion may be inhibiting their function. Landowner "buy-in" and voluntary participation must be fostered if wetland conservation is to be successful in the watershed. The following recommendations can help realize this goal.

Increase awareness of wetland conservation

Develop opportunities to increase awareness of what defines a wetland, its functions and benefits. This is a fundamental step in creating landowner interest and developing landowner appreciation for wetland conservation. Identify or establish various peer related demonstration projects as opportunities to educate stakeholders.

Address landowner concerns

Establish an approachable "one-stop shop" or clearinghouse to assist landowners in enrolling in programs that can benefit wetlands and meet landowner goals. A friendly and "non-governmental" atmosphere can reduce some of the previously identified landowner concerns. A central site can identify and coordinate partners, streamline landowner paperwork, and facilitate leveraging of money and in-kind services often needed for a successful project. Combining local programs with national programs gives flexibility and maximizes dollars. For example, a landowner could receive a tax exemption under the local Wildlife Habitat Conservation and Management Program, receive technical assistance in planning and cost share from the Natural Resources Conservation Service, and receive grant monies from Partners for Wildlife and Ducks Unlimited.

3.2.3. Riparian zones and wetlands key findings and action recommendations

Riparian zones key findings

- Most effects to riparian areas are from past timber harvest, road construction, and noxious weed invasion. Peak flood events have also caused scouring away of vegetation along streambanks and within riparian areas exacerbating disturbance in these areas.
- Buffers established primarily along fish-bearing streams are currently reducing the impact of harvest near streams. Past harvest prior to buffer establishment (which began in 1972) commonly occurred up to the streambank in the more productive valley bottom lands. These lands have recovered some of their riparian function of shade, cover, and some larger wood pieces.
- Approximately 21 percent of the riparian areas within the Region were harvested since 1972. Most of this harvest today has trees 17 to 33 years old. The majority of these areas are beginning to develop larger crowns and wider spaced trees as some die out from competition. Approximately 34 percent of these acres are probably still in

an early seral stage with shorter trees, and smaller tree crowns and diameters. They most likely have little understory vegetation and structure.

- Roads have limited the riparian areas along many stream sections. Road construction creates a more permanent loss of riparian function relative to other effects such as timber harvest.
- Roads exist within 200 feet for extended distances along several streams. Riparian functions along these streams are more likely impacted by the road. This occurs in the Canton Creek Watershed along Canton, Pass, Francis, and Mellow Moon creeks. In the Rock Creek Watershed, East Fork Rock, North Fork East Fork Rock, Wapiti, and the lower reaches of Shoup, Harrington, and Stony creeks are affected.
- Noxious weeds are an increasing problem in riparian areas. They out-compete native plants and do not provide all of the same functions.
- Noxious weeds often thrive in riparian areas since riparian zones tend to be highly productive areas where seed is readily spread from nearby road and waterways.
- Several streams would benefit from riparian improvement or protection by reducing the rate of stream warming during peak summer temperatures or reducing the effects of peak flows. Improvement may include thinning, noxious weed removal, planting, or large wood placement in flood plain areas. The streams include Canton, Pass, Rock, Harrington, Miller, and East Fork Rock creeks.
- PacifiCorp and the ODFW are in the process of identifying riparian areas that would benefit mainstem Rock Creek, upper Canton Creek, and East Fork Pass Creek by establishing conservation easements on private land. These areas would be managed to enhance shading of these creeks to reduce stream warming and to provide a future source of large woody debris.

Wetlands key findings[50]

- Road development, noxious weed invasion and spread, and some settlement and development have probably changed the original wetland hydrology in the Region.
- Most of the remaining wetlands mapped in the Rock Creek and west half of the Middle North Umpqua watersheds are found on private land with a few exceptions. The rest occur on a mix of private and public land.
- Landowner “buy-in” and voluntary participation must be fostered if wetland conservation is to be successful in the Region.
- Road construction probably occurred through wetlands in the 1940s to 1960s changing their hydrology.
- Noxious weed invasion is a problem in changing the vegetation of remaining wetlands decreasing their wetland function.
- There is opportunity for enhancement and protection of wetlands including forested alder stands and emergent and forested wetlands along the lower to middle segments of Rock Creek, on Canton Creek below Wolverine Creek, along the bottom of Pass Creek, the upper reaches of Cougar and North Fork Chilcoot creeks, and many areas along the North Umpqua River.

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[50] Jeanine Lum of Barnes and Associates, Inc., contributed to the wetlands key findings and action recommendations.

Riparian zones and wetlands action recommendations

- Ensure riparian areas harvested prior to 1972 are regenerated and fully stocked. Incorporate a mix of appropriate riparian species to enhance diversity.
- Review younger stands for thinning options to expedite growth of tree crowns and diameters. Consider tree girdling especially right near the stream edge where areas may be sensitive to disturbance.
- Remove or control noxious weeds in recently harvested riparian areas and along roads adjacent to riparian areas. This will speed up forest establishment and growth, and maintain plant diversity in the riparian areas.
- Prioritize efforts on smaller streams with anadromous fish presence where channel widths can be more heavily shaded by riparian cover. Target areas at the junctions of tributaries with the main channels where anadromous fish use is heavy and channel width and water velocity is lower than in the main streams such as Rock Creek.
- On larger streams with unconfined sections such as Rock Creek, consider adding coarse wood within the floodplain riparian zone. Consider planting to add diversity of species including conifer back into alder dominated areas. Combine riparian work with areas where instream work may be warranted.
- Identify areas along Canton, Pass, Rock, Harrington, Miller, and East Fork Rock creeks that would benefit from riparian improvement or protection to reduce stream warming in the summer months, and reduce erosion and water velocity during peak flows.
- Work with ODFW and PacifiCorp to find matching sources of funds to help pay for conservation easements and work with landowners to develop interest in the program.
- Encourage private landowners to maintain healthy riparian and wetland sections through education and promoting land easements.
- Inventory wetlands for noxious weed problems that can be included in the programs for noxious weed control.
- Plant wetland species into areas where invasive plants have been removed to promote wetland species establishment.
- Avoid wetlands with new road construction.
- Develop opportunities to increase awareness of what defines a wetland, its functions and benefits. This is a fundamental step in creating landowner interest and developing landowner appreciation for wetland conservation.
- Identify or establish various peer-related demonstration projects as opportunities to educate stakeholders.
- Establish an approachable "one-stop shop" or clearinghouse to assist landowners in enrolling in programs that can benefit wetlands and meet landowner goals.

3.3. Water quality

3.3.1. Stream beneficial uses and water quality impairments

The Oregon Water Resources Department (OWRD) has established a list of designated beneficial uses for surface waters, including streams, rivers, ponds, and lakes. Beneficial uses are based on human, fish, and wildlife activities associated with water. This assessment focuses on the designated beneficial uses for flowing water, i.e. streams and rivers. Table 3-10 lists all beneficial uses for streams and rivers within the Umpqua Basin.

Beneficial uses	
Public domestic water supply*	Private domestic water supply*
Industrial water supply	Irrigation
Livestock watering	Fish and aquatic life
Wildlife and hunting	Fishing
Boating	Water contact recreation
Aesthetic quality	Hydropower

* With adequate pretreatment (filtration & disinfection) of natural quality to meet drinking water standards.

Table 3-10: Beneficial uses for surface water in the Umpqua Basin.

The Oregon Department of Environmental Quality (ODEQ) has established water quality standards for the designated beneficial uses. These standards determine the acceptable levels or ranges for water quality parameters, including temperature, dissolved oxygen, and pH. Water quality standards set by ODEQ are reviewed and updated every three years. ODEQ monitors streams and stream reaches throughout Oregon, and streams or reaches that are not within the standards are listed as "water quality impaired."[51] The list of impaired streams is called the "303(d) list," after Section 303(d) of the 1972 Clean Water Act. For each stream on the 303(d) list, ODEQ determines the total maximum daily load (TMDL) allowable for each parameter as part of a plan for bringing the stream up to standard.[52] Streams can be de-listed once TMDL plans are complete, when monitoring shows that the stream is meeting water quality standards, or if evidence suggests that a 303(d) listing was in error.

* Canton Creek has been delisted for sediment since this report (see Section 3.3.7).

Table 3-11 shows the Rock Creek Region streams included in the 2002 final 303(d) list that require TMDL plans.[53] This table is not a comprehensive evaluation of all water quality concerns in the Rock Creek Region. There are many streams and stream segments that have not been monitored by ODEQ, or for which additional information is needed to evaluate water quality.

To evaluate water quality in the Rock Creek Region, seven water quality parameters are reviewed in this section. These parameters are temperature, pH, dissolved oxygen, nutrients, bacteria, sedimentation and turbidity, and toxics. ODEQ monitoring data and state and federal agency data that meet ODEQ standards were used and evaluated using ODEQ water quality standards or OWEB recommended levels.

[51] ODEQ can also use data collected by other agencies and organizations to evaluate water quality.
[52] Total maximum daily load plans are limits on pollution developed when streams and other water bodies do not meet water quality standards. TMDL plans consider human-related and natural pollution sources.
[53] Streams that are water quality limited for habitat modification and flow modification do not require TMDL plans. In the Rock Creek Region, these streams are: Canton Creek (habitat), Pass Creek (flow and habitat), and the North Umpqua River (flow).

Stream or stream segment	Parameter(s)	Year listed	Stream miles listed	Season
Canton Creek	Temperature Sedimentation Temperature	1998 1998 2002	0 - 10 0 - 10 10 – 12.5	Summer **delisted in 2005* Summer
East Fork Rock Creek	Temperature	2002	0 – 5.9	Sept 15 – May 31
East Pass Creek	Temperature	2002	0 - 3	Sept 15 – May 31
Harrington Creek	Temperature Temperature	1998 2002	0 – 3.8 0 – 3.8	Summer Sept 15 – May 31
Honey Creek	Temperature Temperature	2002 2002	0 – 3.2 0 – 3.2	Summer Sept 15 – May 31
Mellow Moon Creek	Temperature	2002	0 – 3.1	Sept 15 – May 31
Miller Creek	Temperature	2002	0 – 3.6	Sept 15 – May 31
North Umpqua River	Temperature Arsenic Temperature	1998 2002 2002	34.8 – 65.9 35 - 52 0 – 47.7	Spring/Summer All year Summer
Rock Creek	Temperature Temperature	1998 2002	0 – 12.4 12.4 – 19.1	Summer Sept 15 – May 31
Scaredman Creek	Temperature	2002	0 – 2.1	Sept 15 – May 31
Susan Creek	Temperature Temperature	2002 2002	0 – 4.3 0 – 4.3	Summer Sept 15 – May 31

* Canton Creek has been delisted for sediment since this report (see Section 3.3.7).

Table 3-11: ODEQ water quality limited streams in the Rock Creek Region. [54]

3.3.2. Temperature

Importance of stream temperature

Aquatic life is temperature-sensitive frequently requiring water that is within certain temperature ranges. The Umpqua Basin provides important habitat for many cold-water species, including salmonids. When temperature exceeds tolerance levels, cold-water organisms such as salmonids become physically stressed and have difficulty obtaining enough oxygen.[55] Stressed fish are more susceptible to predation, disease, and competition by species more tolerant of warm temperatures, which in the case of salmonids might be bass. For all aquatic life, prolonged exposure to temperatures outside tolerance ranges will cause death. Therefore, the beneficial use affected by temperature is fish and aquatic life.

[54] 303(d) listing information is from the ODEQ website *www.deq.state.or.us*. Select “water quality,” “303(d) list,” “review the final 2002 303(d) list,” and “search 303(d) List from a Map of Oregon Watersheds,” select “North Umpqua” from map, select “All Waterbodies” and “All Parameters” and “Query.”

[55] Cold water holds more oxygen than warm water; as water becomes warmer, the concentration of oxygen decreases.

Temperature limits vary depending upon species and life cycle stage. Salmonids are among the most sensitive fish, so ODEQ standards have been set based on salmonid temperature tolerance levels. These standards were updated in 2003, creating biologically based temperature standards specific to the habitat area and the species that use that area. The temperature standard is based on a seven-day average maximum (7DAM).[56] It is believed that very high spikes of short duration have little impact on aquatic life. Therefore, maximum stream temperatures are averaged over one week so that only persistently high temperatures are considered when streams are evaluated for water quality impairment. From the time of salmon and steelhead spawning until fry emerge, 55.4°F (13.0°C) is the maximum temperature criterion. For all other life stages, the 7DAM temperature in the Rock Creek Region is set at 60.8°F (16.0°C).

In most parts of the Umpqua Basin, ODEQ stream temperature standards during the summer months are 64.4°F (18.0°C) or greater. However, the Rock Creek Region is considered core cold water habitat thereby requiring lower summer maximum temperatures than many other areas.[57] Historical data suggest the North Umpqua River's natural condition is cooler than 60.8°F. Therefore, ODEQ set the 7DAM temperature standard lower in this area in an effort to maintain historical conditions. Adult spring chinook and summer-run steelhead hold in these waters during the summer. Maintaining low stream temperature reduces the risk of fungal infections and temperature-related stressors, thereby providing a safe and healthy environment for these fish.

Since it is important to keep the North Umpqua River cold, tributary streams should also be kept cool to reduce the rate of warming they may have on the main river. Hence the tributaries, including streams in the Rock Creek and Canton Creek watersheds, also have the same core cold water habitat designation (Heberling, 2005). There is some evidence that tributaries do not affect downstream temperatures; even so, cold tributaries are essential for the cold water habitat that they provide during warm stressful periods. The mouths of these tributaries are particularly important where salmonids can find refuge from the warmer main channel conditions (Smith, 2005).

These core cold water habitat areas are intended to provide assurance that optimal salmon and steelhead rearing temperatures are available all summer long in portions of the North Umpqua River sub-basin, and to provide some areas of colder holding waters for pre-spawning adults Oregon Department of Environmental Quality, 2003a). Although there is some question as to how much upstream conditions affect downstream temperatures, ODEQ believes that in order to attain the required 64.4°F (18.0°C) in the lower portions of the Umpqua Basin, most upstream waters must be colder(Oregon Department of Environmental Quality, 2003b).

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[56] The seven-day average maximum (7DAM) is an average of the maximum temperature of a given day, the three preceding days, and the three days that follow.
[57] Core cold water habitat in the Umpqua Basin includes the North Umpqua River sub-basin below Soda Springs Dam.

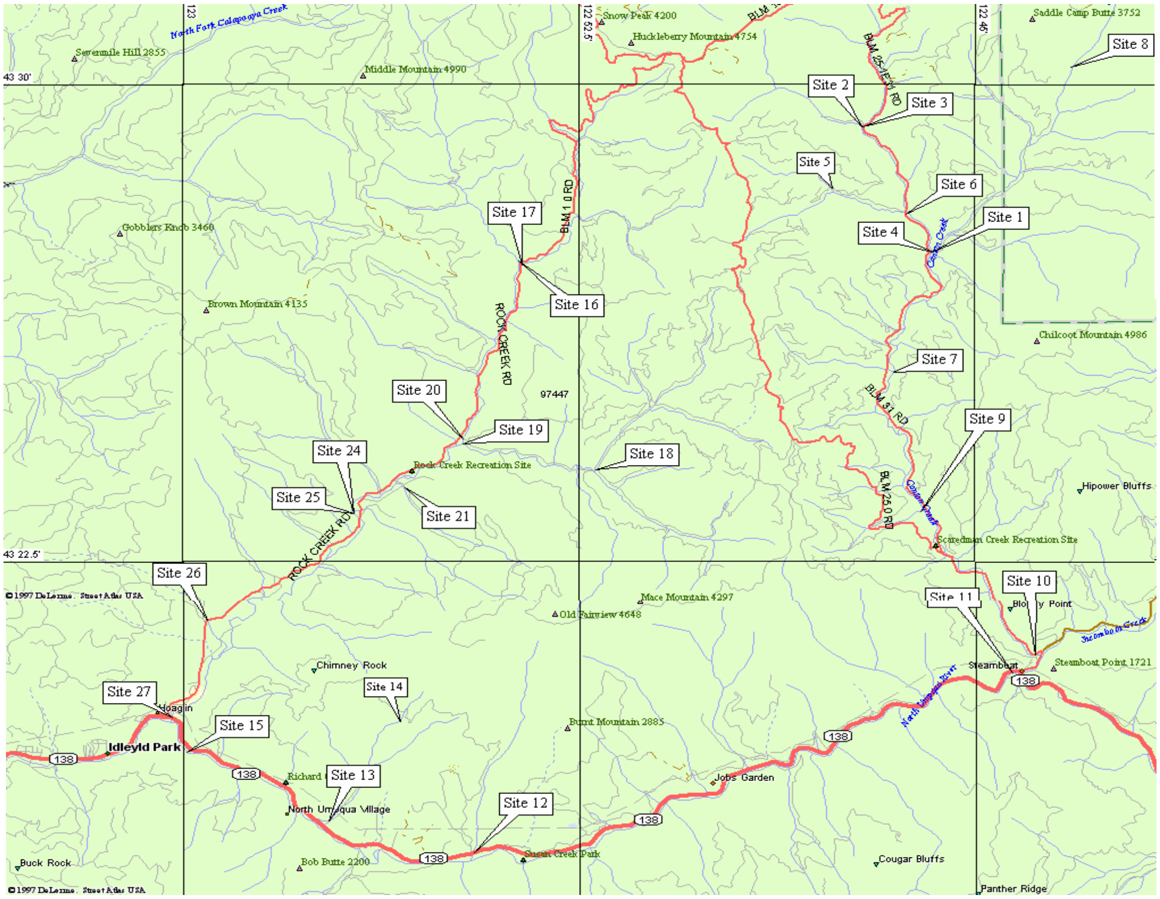
Stream temperature fluctuates by time of year and time of day. In the Rock Creek Region, eleven streams are 303(d) listed for temperature at various times of year (* Canton Creek has been delisted for sediment since this report (see Section 3.3.7).
Table 3-11). Three of these stream segments exceed temperature standards in both the summer and winter months, while most other segments exceed standards only in either the summer or winter months but not both.

The Roseburg BLM has temperature data from 23 sites in the Rock Creek Region. Data was collected from 1991 through 2004. However not every site has data for every year, and the data is generally only for the summer months. The sites range from one to ten years of data collected between the end of May and the middle of October. See Appendix 4 for a summary of all the BLM temperature data collected over the entire ten years. Douglas County operates three continuous monitoring stations located at the mouths of Canton Creek, Rock Creek, and on the North Umpqua River just below Steamboat Creek. These data are available through the Oregon Water Resources Department. The USGS also manages a continuous monitoring station on the North Umpqua River located above the mouth of Rock Creek. Table 3-12 and Map 3-14 show the locations of the monitoring sites within the watershed.

Site name	Site	Years	Site name	Site	Years
Canton Cr above Pass Cr	1	10	N Umpqua above Rock Cr*	15	8
Pass Cr above East Fork	2	7	Rock Cr above NE Fork	16	7
East Fork Pass Creek	3	9	Northeast Fork Rock Creek	17	6
Pass Creek	4	5	N Fork E Fork Rock Cr	18	2
Call Creek	5	3	East Fork Rock Creek	19	7
Mellow Moon Creek	6	4	Rock Cr above E Fork Rock	20	5
Trapper Creek	7	4	Woodstock Creek	21	4
Middle Canton Creek	8	7	Harrington Cr above slide	22	3
Scaredman Creek	9	5	Harrington Cr below slide	23	3
Canton Creek near mouth	10	14	Rock Creek above Miller	24	4
N Umpqua below Steamboat Creek	11	22	Miller Creek	25	5
Susan Creek	12	3	Kelly Creek	26	4
Honey Creek	13	2	Rock Creek near mouth	27	23
Honey Creek upper	14	1			

* Data obtained through USGS website request at *www.or.water.usgs.gov*. Archived data sent by Susan J. Miller on 3/10/2005.

Table 3-12: Temperature monitoring locations, site numbers, and years of data collection for the Rock Creek Region.



Map 3-14: Temperature monitoring sites within the Rock Creek Region.

The US Forest Service also has temperature data collected for use in its *Middle North Umpqua Watershed Analysis*. Data were collected on six sites in 1999 and 2000 only. Since the raw data were not available nor were data collected for 2004 or 2005, it was not incorporated into this analysis. However, the 7DAM temperatures collected by the Forest Service for the six monitoring sites will be included here.

Figure 3-3 shows the moving 7DAM temperatures in 2003 for the mouth of Rock Creek (site 27), Canton Creek (site 10) and the two North Umpqua River sites (sites 11 and 15). All four of these stream segments are considered water quality impaired for stream temperature in the summer. The data show that the moving 7DAM temperatures exceed the current standard for much of the summer. The temperature of the North Umpqua River is much warmer by the time it reaches the mouth of Rock Creek compared to below Steamboat Creek, especially in the middle of the summer. This is a distance of about 18 river miles, and changes in the local environment, channel configuration and inflows result in a different temperature pattern. Canton Creek is similar to Rock Creek until about the middle of August when the temperatures in Canton Creek cool down more than in Rock Creek. By the middle of September there is a substantial difference in temperature between the two creeks. Both sites on Canton and Rock creeks remain warmer than both the North Umpqua sites throughout the summer, with the greatest difference of 4°F to 6°F in late July and continuing through August.

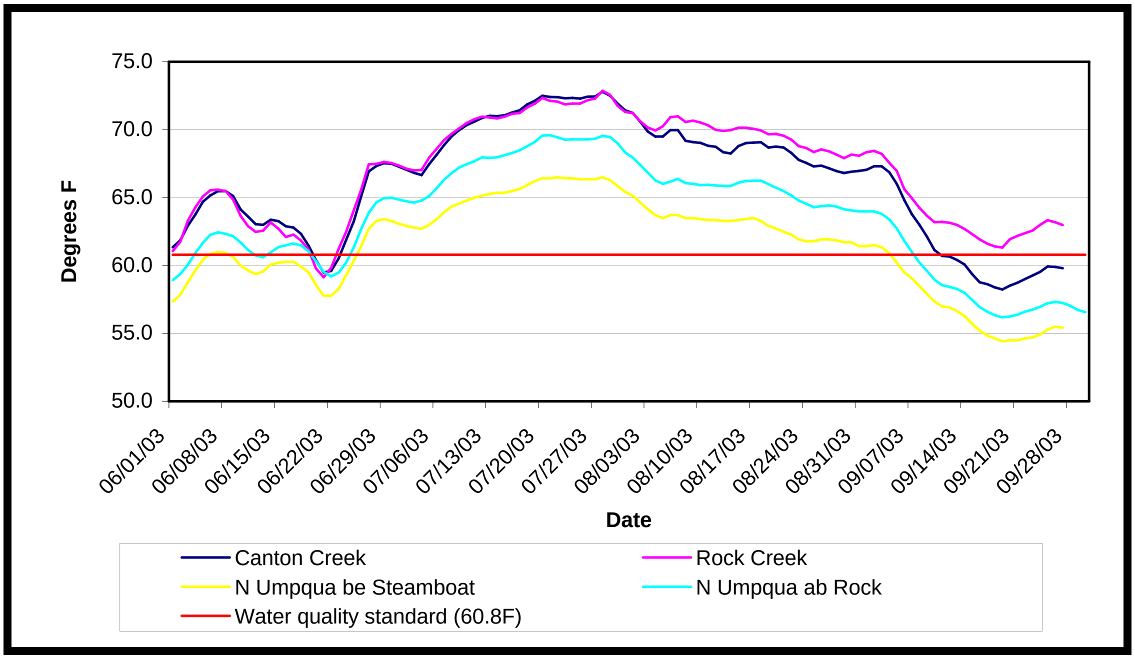


Figure 3-3: Seven day moving average maximum stream temperatures in 2003 for the main channels in the Rock Creek Region.

Although daily maximum temperatures exceed the water quality standard for much of the summer, it is also important to recognize the fluctuation of temperature within any given day. Figure 3-4 shows the relationship of the 7DAM to the daily mean temperature and the fluctuation of temperature in each day for the mouth of Rock Creek, North Umpqua below Steamboat, and Canton Creek above Pass Creek[58] in 2004. On both the North Umpqua and Canton Creek there are significant portions of each day that are cooler than the standard. We can expect that at peak temperatures in the day, fish will try to avoid the warmest water by finding deeper pools with good cover, and cool spots where groundwater is entering the system. When the temperatures cool down at night, the fish will again have access to the entire stream. Deep pools with good cover and groundwater inflow zones are important features of warmer streams. Rock Creek however had temperatures that mostly exceed the standard from about mid-July to mid-August. During this time, 7DAM temperatures are often especially high so that groundwater refuge and deeper pools are even more important to fish use.

[58] Summer data was not complete for this site, and no data for the mouth of Canton was available in 2004. We can expect that temperatures at the mouth of Canton Creek would be warmer than above Pass Creek.

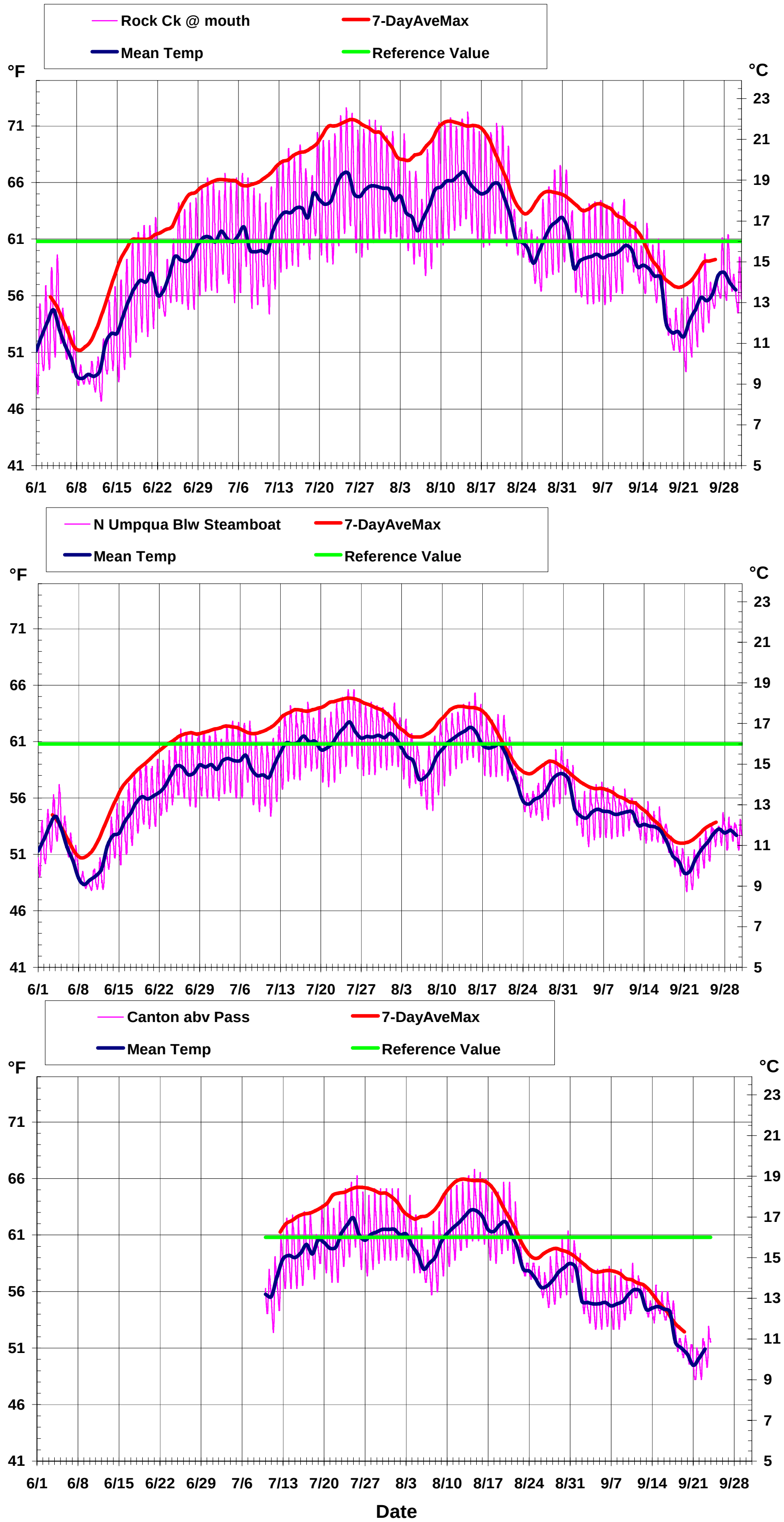


Figure 3-4: Daily fluctuation of stream temperature in 2004 for the average and 7DAM temperature compared to the ODEQ standard of 60.8°F.

Influences on stream temperature

The ultimate source of stream heat is the sun, either by direct solar radiation or by ambient air and ground temperature around the stream, which are also a result of solar energy.[59] This is reflected in Figure 3-4 by the similar pattern of stream temperatures portrayed across the 2004 summer for all three streams. Although the actual temperatures vary for each stream depending on individual stream characteristics, the pattern is similar. This similarity also corresponds with ambient air temperatures.

Groundwater has the least exposure to solar energy, and therefore is at the coolest temperature (usually around 52°F in the Umpqua Basin). Since groundwater accounts for the larger proportion of a stream's flow at the headwaters, stream temperature is generally coolest at the headwaters. When groundwater enters a stream and becomes surface water, it is exposed to solar energy and will become warmer until it reaches equilibrium with ambient temperatures and direct solar radiation levels. As solar energy inputs change, such as at night, so do the ambient and stream temperatures.

Stream temperatures usually follow a warming trend as the distance from the headwaters (and the corresponding stream size) increases. Those streams nearest the headwaters are usually coolest due to higher proportions of groundwater relative to surface water and less solar exposure. Most streams in the Umpqua Basin follow a similar pattern to that represented by the line for the Main Umpqua in Figure 3-5.[60] The line represents the coldest temperatures relative to distance from headwater sources for streams throughout most of the Umpqua Basin in the year 2000. The temperatures reflected along this line are the lowest temperatures expected for a stream at a given distance from its headwater source. As distance from the ridge above the headwaters increases, stream temperatures increase at a fairly constant rate. Stream temperatures for the Rock Creek Region and the two North Umpqua River sites with data for the year 2000 are shown in Figure 3-5 relative to this trend.

The Rock Creek Region data from the year 2000 show a similar warming trend in channels further from the headwaters. The amount of data available for the Region is insufficient to produce a statistically valid trend line as shown for the Main Umpqua. However, based on available stream temperatures for the year 2000, it appears that the trend for the Rock Creek Region is probably similar to slightly cooler than that of the Main Umpqua. This would indicate that the temperature standard of 60.8°F would be exceeded on most streams in the Region between four and six miles from the headwater ridge (see Figure 3-5). The two North Umpqua River sites that are within the Rock Creek Region are far to the cold side of the trend line. Although they are only two data points, they seem to reinforce the core cold water designation given to the North Umpqua River sub-basin below Soda Springs dam.

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[59] Friction adds a very small amount of heat to streams. Geothermal heat is a minor factor in the Umpqua Basin.

[60] The warming trend line in Figure 3-5 reflects the minimum expected temperature values at a given distance from the source ridge. It reflects the stream temperature trend of the colder values across a range of distances from the headwater ridge. These values indicate the cooler temperatures possible for that area.

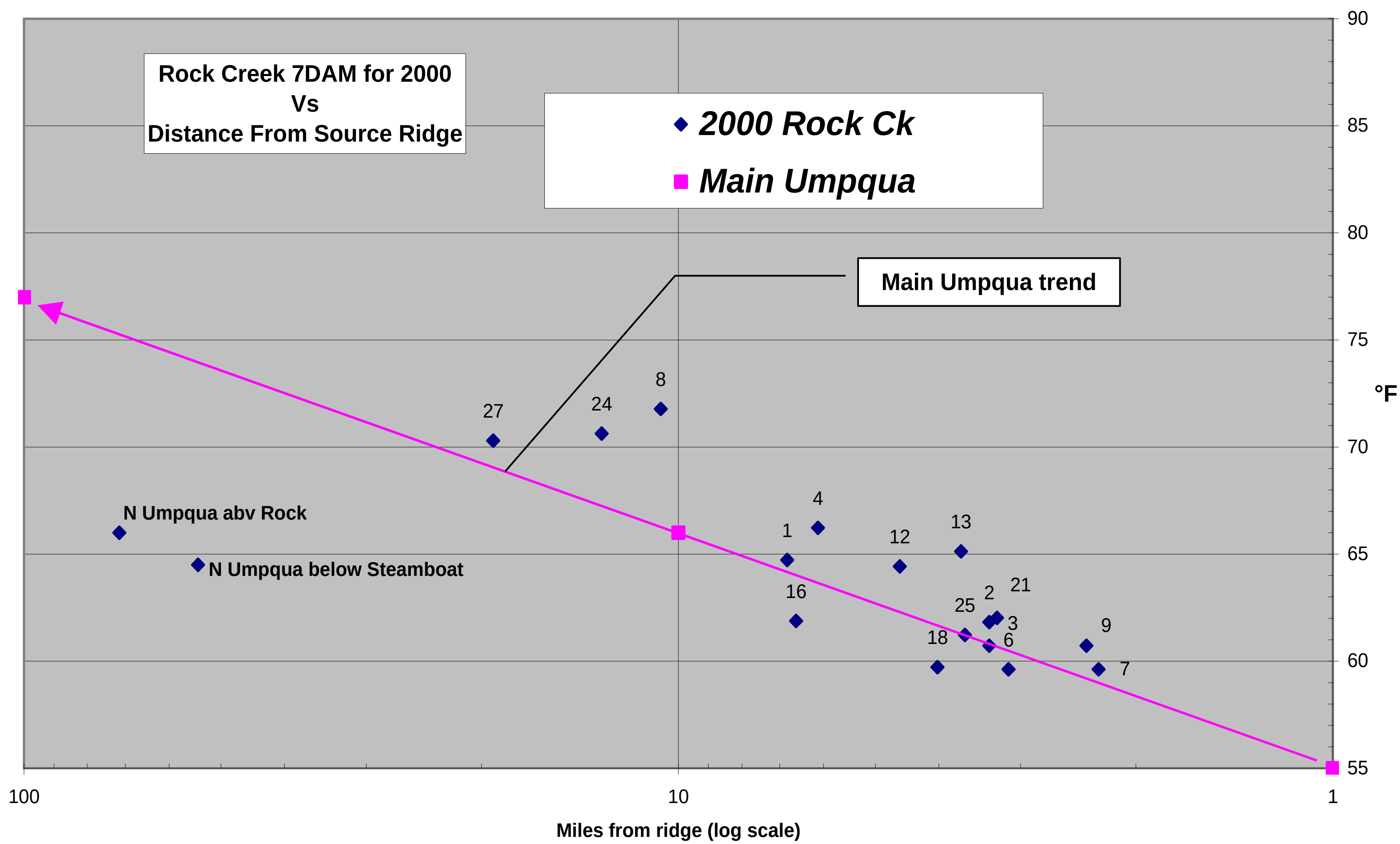

Figure 3-5: 7DAM temperatures in 2000 for the Rock Creek Region and the minimum expected temperatures relative to distance from headwater ridge throughout the Main Umpqua (trend line).

Larger streams are generally further from headwater sources than smaller streams, and reach warmer temperatures at greater distances. However, as shown above, fish can still use these streams if suitable cold water refuge is available. Although it may not be possible to reduce stream bulk temperatures in these larger streams to meet standards, fish in these channels may congregate in cool spots to survive. These may be created by deep shaded pools where water movement is slow allowing time for it to cool down in the shade. There is evidence that fish prefer the shaded areas in larger streams on hot days. This may be due to reduced predation or possible sensitivity to light or both (Smith, 2003). They may also be dependent on groundwater inflow areas where they can wait out the hottest parts of the day in summer.

If solar energy were the only influence on stream warming, it would be expected that stream temperature would increase at a smooth and steady rate until the stream was in equilibrium with solar energy inputs. However, stream temperature at a given location is influenced by two factors: the temperature of the upstream flow and local conditions that include solar inputs. As upstream flow reaches a given stream location, factors such as stream morphology, groundwater inflow, and riparian buffer conditions can affect the local stream temperature.

Localized groundwater influx and tributary flow can reduce stream temperatures. When groundwater enters a stream, it mixes with the warmer upstream surface flow until temperature equilibrium is reached. As the proportion of groundwater increases, so will the cooling effect. Groundwater has the greatest influence on small and medium-sized streams. This is partially because groundwater constitutes a greater proportion of small streams’ flow. As a result, cooler flow from small tributaries entering larger streams can, like groundwater influx, reduce stream temperature at that location.

In addition, highly incised channels often drain local groundwater supply faster and reduce the amount available during the summer periods. Non-incised streams will have a better groundwater supply that will help keep temperatures lower in the summer (Smith, 2003). The lower reaches and mouths of small and medium-sized tributaries, and reaches within warm streams that have high groundwater influx and shade, may provide important shelter for fish during the summer months.

If we compare year 2000 7DAM stream temperatures in the Rock Creek Region to the trend for the Umpqua Basin (Figure 3-5) we can see which streams may be the warmest relative to their size and distance from headwaters. These are streams that may lack riparian cover and pool structure. They may also have less groundwater flow. In the smaller channels, the water heats up more quickly with exposure to solar radiation. The temperatures of these same smaller channels can also be more readily influenced by increasing riparian cover or changing the stream morphology. Even shading portions of these streams can create an oasis effect by reducing evaporation and thus maintaining more water during hot periods (Smith, 2003).

In the North Umpqua River, measurements are below that expected for the Umpqua Basin as a whole, indicating the importance of maintaining this region as core cold water habitat. However, the smaller tributaries to the North Umpqua include two of the warmest relative temperatures measured in the Region: Susan Creek and Honey Creek (sites 12 and 13).

In the Canton Creek Watershed, Middle Canton (site 8) had the warmest relative temperature (about 6°F above the predicted trend) and is located far up into the watershed. The warmer tributaries include Pass Creek (sites 2 and 4), and Scaredman Creek (site 9).

In Rock Creek, the main channel temperature increases 8.7 °F from Rock Creek above Northeast Fork Rock (site 16) to Miller Creek (site 24). Although it was not measured in the year 2000, Harrington Creek (site 23), based on historical temperatures, is a very warm channel contributing to the increased temperature of Rock Creek. Woodstock Creek (site 21) is quite warm and also enters Rock Creek above Miller Creek. Although Rock Creek remains warm even at the mouth, its relative temperature trend has moved closer to that for the entire basin. It appears the middle section of Rock Creek is warmest relative to its distance from the headwater ridge than either the upper reaches of Rock Creek or lowest section near the mouth.

In addition to these sites, year 2000 temperature data presented in the US Forest Service's *Middle North Umpqua Watershed Analysis*, showed temperatures on five smaller tributaries to the North Umpqua River with 7DAM temperatures below the older standard of 64°F. These five sites ranged in temperature from 61.8°F to 63.6°F, all slightly above the current standard. Another site measured on the North Umpqua above Wright Creek was higher with a 7DAM temperature of 65.3°F. Detailed site locations were not available to measure distance from the headwater ridge, and thus these data were not included in Figure 3-5. See Appendix 4 for site locations and temperature data collected.

Conclusions and management implications

Temperatures on small streams can be strongly influenced by local conditions. Local stream temperature management restoration projects may be very effective in improving stream temperature conditions in many small streams in the Umpqua Basin (Smith, 2002). Most of the riparian areas previously harvested in the Rock Creek Region have been replanted; however time is required to establish optimum shade on many of the streams. Large wood structures placed in smaller channels or on the edges of larger channels can help create local cool spots that also provide shade cover and cool pools. These structures can also be used to reduce downcutting in higher velocity streams reducing the rate of groundwater drainage and maintaining groundwater flow during the hotter summer season.

Few of the stream temperatures measured in the Rock Creek Region meet the current ODEQ temperature standard of 60.8°F. The Rock Creek Region stream temperature trends are consistent with those throughout most of the Umpqua Basin, which show that as a stream's distance from its headwater source increases, so does the stream bulk temperature. Those streams that are considered both temperature impaired by ODEQ and that show high stream temperatures relative to their distance from headwater sources include the following:

- Canton Creek
  Although year 2000 data at the mouth of Canton Creek were not available for comparison to basin trends, temperatures higher up in Canton Creek are some of the warmest of any measured relative to temperatures in the Region.
- Honey Creek
  Honey Creek exceeded both the lower limit temperature expected from the basin trend line and the ODEQ standard by approximately 4°F.
- Rock Creek from the mouth to Northeast Fork Rock Creek.
  The warmest portion of Rock Creek was measured at the site above Miller Creek exceeding ODEQ by nearly 10°F and the lower limit basin trend temperature by almost 4°F.
- Susan Creek
  Susan Creek exceeded the lower limit basin trend temperature by over 2°F and the ODEQ standard by nearly 4°F.

Harrington Creek is also listed as temperature limited. Although year 2000 data were not available to compare Harrington Creek to basin-wide trends, historical measurements taken from 1997 to 1999 indicate very warm temperatures. A massive debris flow that occurred for over three miles of Harrington Creek following the 1996 storms may have contributed to higher temperatures. Much of the streambed and surrounding riparian vegetation on the hillslope was scoured away and deposited along the lower reaches where the topography flattens out near the confluence with Rock Creek. Large wood structure, coarse sediment, and gravel were pushed out of the upper reaches, creating a simplified channel structure that may be more exposed to solar radiation.

Treatments that restore riparian function along Harrington Creek, as well as Rock, Canton, Pass, and Miller creeks may reduce the rate of stream warming during high summer temperature periods. In addition, riparian protection of intact areas along East Fork Rock Creek, Rock Creek, and Canton Creek is important so as to not allow further warming (see Section 3.2.1).[61]

3.3.3. Surface water pH

The hydrogen ion concentration of a liquid, which determines acidity or alkalinity, is expressed using pH. A logarithmic scale, ranging from one to fourteen, measures pH. On this scale, a pH of seven is neutral, more than seven is alkaline, and less than seven is acidic.

The beneficial uses affected by high or low pH levels are fish and aquatic life, and water contact recreation. When pH levels exceed the stream's normal range, water can dissolve the protective mucous layer on aquatic organisms such as fish, amphibians, and mollusks. Without a healthy protective layer, fish and other animals become more susceptible to

[61] Refer to Appendix 7 for a complete discussion of riparian restoration priorities on streams within the Rock Creek Region.

diseases. Also, pH affects nutrients, toxics, and metals within the stream. Changes in pH can alter the chemical form and affect availability of nutrients and toxic chemicals, which can harm resident aquatic life and be a human health risk. In mining areas, there is the potential for both low pH levels and the presence of heavy metals. This can be an issue because metal ions shift to more toxic forms in acidic water, a concern for both wildlife and humans.

Physical and biological factors cause surface and groundwater pH to normally be slightly alkaline or acidic. The chemical composition of rocks and rainfall will influence pH. Respiration and photosynthesis are normal metabolic processes of aquatic organisms that can affect pH. Carbon dioxide (CO_2) is produced during respiration and used for photosynthesis. The level of dissolved CO_2 in a stream raises and lowers pH. Normally, there is a balance between instream metabolic processes and a natural chemical buffering system that prevents streams from becoming too acidic or alkaline from changes in CO_2 levels. However, stream inputs that increase or decrease respiration and photosynthesis by aquatic organisms can indirectly shift pH by changing CO_2 levels. For example, nitrogen and phosphorus from organic matter such as feces and urine, or from inorganic chemicals such as fertilizers, encourage algae growth in the summer and can result in algae “blooms.” When a stream’s algae population grows, so does the degree to which CO_2 is produced and used. When CO_2 levels in water are high, carbonic acid is produced, resulting in pH levels that are harmful to aquatic life.

In an attempt to differentiate between the natural variability of surface water pH and the changes caused by other factors, ODEQ established a range of acceptable pH levels for river basins or for specific bodies of water. In the Umpqua Basin, the acceptable pH range is 6.5 to 8.5. When 10 percent or more of pH measurements from the same stream are outside of the 6.5 to 8.5 range, the stream is designated water quality limited.

Between January 1998, and March 2005, pH was sampled continuously at a USGS monitoring station located on the North Umpqua above the mouth of Rock Creek (station 14317450). The actual percentage of these samples that tested outside the parameter range is unknown, since only maximum and minimum values by day were available. The number of maximum and minimum values by day that tested out of the range was only 7.6 percent (197 days). The percentage of total samples that resulted out of this range would probably be less. Only two days in the winter of 1999 showed a minimum value below 6.5, while 195 days during the summers of 2002 through 2004 resulted in values higher than 8.5. There were also six additional samples taken between July, 1998 and September, 1999 on Shoup Creek in the Rock Creek Watershed and on Canton Creek. All of these samples were within the desired range. Table 3-13 shows the sampling locations, the number of samples taken (or days sampled) at each site, and the number and percent of samples or days exceeding water quality standards.

Location within the Rock Creek Region	# of days or samples	# outside pH standards	%
North Umpqua above Rock Creek (14317450)	2,603 days	197	7.6 %
Shoup Creek at river mile 3.12 (13213)	1 sample	0	0 %
Canton Creek at river mile 15.66 (13244)	5 samples	0	0 %

Table 3-13: Rock Creek Region pH sampling locations and results.

Although there is limited data available in both the Rock Creek and Canton Creek watersheds, no streams within the Rock Creek Region are water quality listed for pH. However, Steamboat Creek located just east of Canton Creek (Canton Creek is a tributary to Steamboat Creek) is listed for pH, and the North Umpqua River is listed during the summer at mile 77 to 78 (approximately 22 miles upstream of the Rock Creek Region). Two additional samples taken in August, 1999 on the North Umpqua River above the mouth of Little River (approximately 6.5 miles below the Rock Creek Region) resulted in pHs of 8.8 and 9.0, indicating that the river tends to have fairly high pH.

A study done on the North Umpqua River sub-basin in 1992 through 1995 by the US Geological Survey (USGS) in cooperation with Douglas County (Anderson, *et al*., 1998), measured several water quality parameters including pH on the North Umpqua River within the Rock Creek Region. None of the sites on the main North Umpqua exceeded the standard of 8.5 during the study; however the site located just above Rock Creek recorded pH of 8.5 in 1993 and 1994, and 8.3 in 1995. Historical records show a pH as high as 8.8 measured on the main river near Wright Creek.

The study showed that the North Umpqua River is moderately to poorly buffered, and that pH is apparently very sensitive to small changes in the concentration of inorganic carbon. The study also showed that algal concentrations in the North Umpqua River appear to be somewhat higher than in the other major streams in the Western Cascades. This can cause higher rates of photosynthesis in the daylight (USDI Bureau of Land Management, 1995b). The process of photosynthesis consumes H+ ions during the daylight hours elevating pH, while at night pH decreases when photosynthesis slows down. On shaded stream reaches or on cloudy days, algae photosynthesize less and pH levels are lower. In rivers not influenced by pollution, photosynthesis by aquatic organisms takes up dissolved CO_2 during daylight and releases CO_2 through respiration at night. Daily fluctuations of pH may occur, with maximum pH values reaching as high as 9.0 (Hem, 1985).

3.3.4. Dissolved oxygen

In the Umpqua Basin, cold-water aquatic organisms are adapted to waters with high amounts of dissolved oxygen. Salmonid eggs and smolts are especially sensitive to dissolved oxygen levels. If levels drop too low for even a short period of time, eggs, smolts, and other aquatic organisms will die. Therefore, the beneficial use most affected by dissolved oxygen is fish and aquatic life.

The amount of oxygen that is dissolved in water will vary depending upon temperature, barometric pressure, flow, and time of day. Cold water holds more oxygen than warm water. As barometric pressure increases, so does the amount of oxygen that can dissolve in water. Flowing water has more dissolved oxygen than still water. Aquatic organisms produce oxygen through photosynthesis and use oxygen during respiration. As a result, dissolved oxygen levels tend to be highest in the afternoon when algal photosynthesis is at a peak, and lowest before dawn after organisms have used oxygen for respiration.

Since oxygen content varies depending on many factors, ODEQ has many dissolved oxygen criteria. ODEQ's standards specify different oxygen content during different stages of salmonid life cycles and for gravel beds. Standards change based on differences in elevation and stream temperature. During months when salmon are spawning, ODEQ uses a seven day mean minimum of 11.0 mg/L as the dissolved oxygen standard for the North Umpqua River within the Rock Creek Region. However if the inter-gravel dissolved oxygen levels are at least 8.0 mg/L during the spawning period, than the dissolved oxygen level in the water may be as low as 9.0 mg/L and meet the ODEQ standards. For the rest of the year, the standard is a thirty day mean minimum of 8.0 mg/L.

The US Geological Survey has been collecting continuous monitoring data for dissolved oxygen on the North Umpqua Station located above the mouth of Rock Creek (USGS station number 14317450) since February 1998. In addition, grab data were also collected at the Shoup Creek (13213) and Canton Creek (13244) sites. Table 3-14 shows the sampling locations and results from the three sites.

Location within the Rock Creek Region	**Number of samples**	**Number outside initial DO standards**	**Percent out of initial standard**	**Number outside revised* DO standards**	**Percent out of revised* standard**
North Umpqua River near Idlyld Park	2,247	639	28.4	173	7.7
Shoup Creek at Rm 3.12	1	0	0	--	--
Canton Creek at Rm 15.66	3	0	0	--	--

*Refers to the lowering of the dissolved oxygen standard from 11.0 to 9.0 mg/L during spawning due to inter-gravel dissolved oxygen levels that meet a minimum of 8.0 mg/L.

Table 3-14: Dissolved oxygen sampling locations and results for the Rock Creek Region.

Over 28 percent of the samples taken at the North Umpqua station did not meet the initial standard. Most of these were below the minimum standard of 11.0 mg/L during the spawning period. No inter-gravel dissolved oxygen data were available to determine if the standard could be lowered from 11.0 to 9.0 mg/L (where only 7.7 percent of the days did not meet this standard). To determine whether this section of the river does not meet the ODEQ standards, a determination of saturation would have to be done. If the reach meets 95 percent saturation, then it would be within acceptable dissolved oxygen levels. To measure saturation, temperature, altitude and pressure at the time the sample was taken would be necessary. These parameters were not available; therefore there is no determination that this reach did not meet ODEQ standards for dissolved oxygen. No streams are 303(d) listed for dissolved oxygen in the Rock Creek Region.

Nearly all of the dissolved oxygen samples taken during the study done by the USGS on algal conditions in the North Umpqua River sub-basin met the ODEQ standards in 1995. Three sites located outside of the Rock Creek Region had dissolved oxygen levels below the required 95 percent saturation level at the time (Anderson *et al.*, 1998).[62] In this report, they conclude that "dissolved oxygen concentrations in most of the North Umpqua River system appear to be controlled primarily by physical factors such as water temperature and reaeration, rather than biological metabolism." Although algae concentrations appear high in the North Umpqua, the elevated dissolved oxygen levels did not correspond to periods when photosynthesis would be highest (daytime), but instead seemed to correlate with water temperatures. Dissolved oxygen levels were highest in the morning when water temperatures were coolest, and minimum dissolved oxygen levels were lowest in the afternoon when water temperatures were highest.

This was especially true within the Rock Creek Region. Tributaries to the North Umpqua River including Wright and Susan creeks within the Rock Creek Region had minimum and commonly maximum dissolved oxygen levels above 9.0 mg/L during this study (ODEQ standard at this time of year is greater than 8.0 mg/L). These tributaries were commonly near saturation at all times although somewhat lower than the North Umpqua River due to their higher temperatures.

Although no dissolved oxygen data were available on the main Rock Creek, Stillwater Sciences in 2000 conducted sampling of oxygen flow in gravel beds (permeability) to determine if oxygen was limiting redds during spawning. They sampled widely throughout the Rock Creek drainage and found that oxygen flow was not limited in gravels measured that were most likely to house redds (Pedersen, 2005).

3.3.5. Nutrients

The beneficial uses affected by nutrients are aesthetic quality or "uses identified under related parameters" (Oregon Department of Environmental Quality, 2003c). This means that a stream may be considered water quality limited for nutrients if nutrient levels adversely affect related parameters, such as dissolved oxygen, that negatively impact one or more beneficial uses, such as fish and aquatic life.

Possible nutrient sources include feces and urine from domestic and wild animals, wastewater treatment plant effluent, failing septic system waste, and fertilizers. As stated in Section 3.3.3, high nutrient levels during the summer encourage the growth of algae and aquatic plants. Excessive algal and vegetative growth can result in little or no

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[62] Sites that did not meet the minimum DO concentration of 95 percent saturation were located at Steamboat Creek above Big Bend Creek, Lake Creek at the mouth, and on the North Umpqua River above Copeland Creek.

dissolved oxygen, and interfere with water contact recreation, such as swimming. Also, certain algae types produce by-products that are toxic to humans, wildlife, and livestock, as occurred in Diamond Lake in the summer of 2002.[63]

Currently, there are no Umpqua Basin-based ODEQ values for acceptable stream nutrient levels and no streams that are 303(d) listed for nutrients in the Rock Creek Region. Therefore, this assessment used the OWEB recommended standards for evaluating nutrient levels in the watershed. OWEB recommends using 0.05 mg/L for total phosphorus, and 0.3 mg/L for total nitrate (including nitrites and nitrates).

Table 3-15 shows the samples taken within the Rock Creek Region for total nitrate and total phosphorus. There are no samples that exceed the recommended levels. Samples taken on the North Umpqua River for the USGS algal study in 1993-95 indicate very low nitrogen levels in the river. In 1995, nitrogen was not detectable in samples taken. Although algae levels in the river are high, nitrogen was found to be limiting certain types of algal growth. Samples of the different species of algae present showed that nitrogen-fixing species made up a large proportion, probably a result of low nitrogen levels in the river. Since nitrogen was virtually undetectable in the North Umpqua River where algae are abundant, one theory is that all available nitrogen is being taken up by the algae. This may be significant in determining the effects of any added nitrogen to the system. Since the North Umpqua River is high in algae growth, additional nitrogen added to the system may further promote algae growth (Anderson *et al.*, 1998).

Location	**Year**	**Total nitrate**	**Total phosphorus**
Canton Creek at mouth*	1995	<0.005	0.003
Canton Creek at river mile 15.66	1998	<0.020	<0.010
Canton Creek at river mile 15.66	1999	0.024	0.010
Canton Creek at river mile 15.66	1999	0.025	0.010
N. Umpqua below Steamboat Creek*	1995	<0.005	0.029
N Umpqua below Wright Creek*	1995	<0.005	0.032
N Umpqua below Wright Creek*	1995	<0.005	<0.001
Susan Creek*	1995	0.039	0.023
Rock Creek near mouth*	1995	<0.005	0.039
Rock Creek near mouth*	1995	<0.005	<0.001
Shoup Creek at river mile 3.12	1998	<0.020	<0.010
N Umpqua above Rock Creek*	1995	<0.005	0.032
N Umpqua above Rock Creek*	1995	<0.005	0.001

* Minimum recording levels were 0.005 mg/L for total nitrate and 0.001 mg/L for total phosphorus.

Table 3-15: Total nitrate and total phosphorus sampling locations and results within the Rock Creek Region.

Phosphorus levels were also within recommended limits. Additional total phosphorus samples taken in the bed sediment by the USGS in 1993-95 showed relatively high

[63] Diamond Lake is within the Umpqua National Forest in the extreme eastern portion of the Umpqua Basin.

concentrations compared to values in other databases of trace element concentrations in streambed sediments and in soils. This finding is consistent with reports that the volcanic soils of the Western Cascades are rich in phosphorus.

3.3.6. Bacteria

Bacteria are present in all surface water. In general, resident bacteria are not harmful to the overall aquatic environment or to most human uses. However, ingestion of fecal bacteria such as *Escherichia coli* (*E. coli*) can cause serious illness or death in humans. The presence of fecal bacteria indicates a potential vector for other human diseases, such as cholera and giardiasis ("beaver fever"). Water contact recreation is the beneficial use most affected by bacteria. Private and public drinking water supplies are not affected because water filtration systems are able to remove harmful microorganisms.

There are many possible sources of *E. coli* and other fecal bacteria in water. Common sources include failing septic systems and aquatic warm-blooded animals, such as waterfowl and beaver. Upland areas with concentrated fecal waste, such as stockyards and kennels, are also bacteria sources; during rain events, high levels of bacteria may be washed down into streams.

There is no available *E. coli* data for the North Umpqua. Due to the low population of the area, and lack of agricultural activity, contamination from septic systems, stockyards or other concentrated sources is not likely. The few residences in the area are concentrated near the lower portions of Rock Creek, along the North Umpqua River near Honey Creek, and in the Honey Creek and Susan Creek sub-watersheds. These areas would be candidates for testing in the future to ensure low *E. coli* concentrations.

3.3.7. Sedimentation and turbidity

Sediment is any organic or inorganic material that enters the stream and settles to the bottom. When considering water quality, this assessment is specifically referring to very fine particles of organic or inorganic material that have the potential of forming streambed "sludge." The beneficial use affected by sedimentation is fish and aquatic life. Salmonids need gravel beds for spawning. Eggs are laid in a gravel-covered nest called a "redd." Water is able to circulate through the gravel, bringing oxygen to the eggs. The sludge layer resulting from stream sedimentation does not allow water circulation through the redd and will suffocate salmonid eggs. Although there are many aquatic organisms that require gravel beds, others, such as the larvae of the Pacific lamprey, thrive in sludgy streams.

There are three primary mechanisms of sediment delivery to the aquatic ecosystem: Mass wasting, generally referred to as landslides, includes debris flows, debris slides, rock slides, slumps, and earthflows; fluvial erosion occurs from streambank failures and channel incision caused by moving water; and finally surface erosion which is caused by water sheeting across the surface and rain splash, more common in areas with little to no vegetation. All three of these mechanisms contribute to the overall sediment load of streams.

Turbidity is closely related to sediment because it is a measurement of water clarity. In many cases, high turbidity indicates a large amount of suspended sediment in a stream. Small particles such as silt and clay will stay suspended in solution for the longest amount of time. Therefore, areas with soils comprised of silt and clay tend to be more turbid than streams in areas with coarser soil types. Also, turbidity levels can rise during a storm event. The greater energy of rapidly moving water causes more streambank erosion and channel incision, and increased surface flow moves more sediment into stream channels during these high intensity storms. These increases in erosion during storms cause turbidity levels to rise.

The beneficial use affected by turbidity is fish and aquatic life, public and private domestic water supply, and aesthetic quality. As turbidity increases, it becomes more difficult for sight-feeding aquatic organisms to see, impacting their ability to search for food. High levels of suspended sediment can clog water filters and the respiratory structures in fish and other aquatic life. Suspended sediment is a carrier of other pollutants, such as bacteria and toxins, which is a concern for water quality in general. Finally, clear water is simply more pleasant than cloudy water for outdoor recreation and enjoyment.

Sediment is considered to be water quality limiting if beneficial uses are impaired. ODEQ determines impairment by monitoring changes in aquatic communities (especially macroinvertebrates, such as insects), changes in fish populations, or by using information from non-ODEQ documents that use standardized protocols for evaluating aquatic habitat and fish population data. Currently, ODEQ monitors streams for total suspended solids, which indicates sedimentation. At the writing of this assessment, neither ODEQ nor OWEB has established criteria for these data.

Canton Creek (0 to 10 miles) was 303(d) listed for sediment as of the most recent 2002 final 303(d) list (see Table 3-11). However, Canton Creek has since been delisted for sediment.[64] According to ODEQ, the supporting data for this listing were obtained from the Canton R. Watershed Analysis, 5/95, which stated "Coastal Coho and Searun Cutthroat have been petitioned under the ESA (Endangered Species Act); habitat conditions are in poor condition, [with] large amounts of fine sediment in portions of the lower river."[65]

The initial listing was based on a qualitative assessment rather than quantitative data. The US Forest Service conducted macroinvertebrate sampling in 1999 and submitted their findings to ODEQ with a request for Canton Creek to be removed from the 303(d) list. The Forest Service used a scoring process to rate the macroinvertebrate collections relative to a reference site. The result showed Canton Creek as slightly impaired but well within the standards set by ODEQ. This information led to the delisting of this segment of Canton Creek for sediment.

[64] Personal communication with Paul Heberling, ODEQ, March 21, 2006.
[65] The reference for the listing is included with the ODEQ 303(d) list available at http://www.deq.state.or.us.

Turbidity is measured by passing a light beam through a water sample. As suspended sediment increases, less light penetrates the water. Turbidity is recorded in NTUs (nephelometric turbidity units); higher NTU values reflect greater turbidity. According to ODEQ, turbidity is water quality limiting when NTU levels have increased by more than 10 percent due to an on-going operation or activity, such as dam releases or irrigation. To date, there are no streams in the Rock Creek Region that are 303(d) listed for turbidity.

OWEB recommends using 50 NTUs as the turbidity evaluation criteria for watershed assessments. At this level, turbidity interferes with sight-feeding aquatic organisms and provides an indication of the biological effect of suspended sediment. Twenty-one out of 1,919 turbidity samples (1.1 percent) from the North Umpqua above Rock Creek station exceeded 50 NTUs.[66] Another 5 samples taken on Shoup Creek and Canton Creek were all below this recommended level.[67]

Turbidity changes relative to flow with higher flows increasing turbidity levels due to increased erosion of the stream. Turbidity levels may be high if measured immediately following a storm event that caused peak flows. As stream flow decreases to average or lower flows, turbidity levels may also decrease as erosion of the streambank and channel subside. Therefore when evaluating changes in turbidity over time on a stream, it is valuable to measure turbidity levels relative to stream flow levels. This measure is referred to as the turbidity ratio (measured in NTU/cfs). Although there is no standard for a turbidity ratio, monitoring relative turbidity ratios over time on a given stream can help evaluate the effects on turbidity of different activities.

Long-term turbidity monitoring of Canton Creek done by the US Forest Service shows that high turbidity relative to stream flow in the 1970s has decreased. Figure 3-6 shows US Forest Service monitoring of Canton Creek relative to flow levels from 1972 to 2003. Turbidity in Canton Creek was at its peak in 1972 and has been relatively low since, with several smaller spikes in 1991, 1992 and 2001.

Figure 3-7 shows the turbidity ratio in the North Umpqua above Rock Creek. Measurements were taken in the winter and summer for each year from 1993 through 2003 (with missing data in 1998 and summer 1999). Relative turbidity peaked in 1994 and has been generally lower in 2000, 2002, and 2003. As in Canton Creek, there was a small spike in turbidity relative to flow in 2001. Although actual turbidity is probably higher during peak storm flows in the winter, the turbidity level relative to stream flow calculated for the entire winter season was consistently lower than in summer in all years except 2003. Seasonal differences appear greatest in 1993 through 1995. This may indicate that suspended sediment resulting from storm events quickly settles out or is flushed downstream. Higher winter stream flows that are not considered peak events may not promote large increases in turbidity relative to their increased flows.

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[66] From the USGS monitoring station on the North Umpqua above Rock Creek.
[67] From ODEQ's LASAR database (Oregon Department of Environmental Quality, 2005).

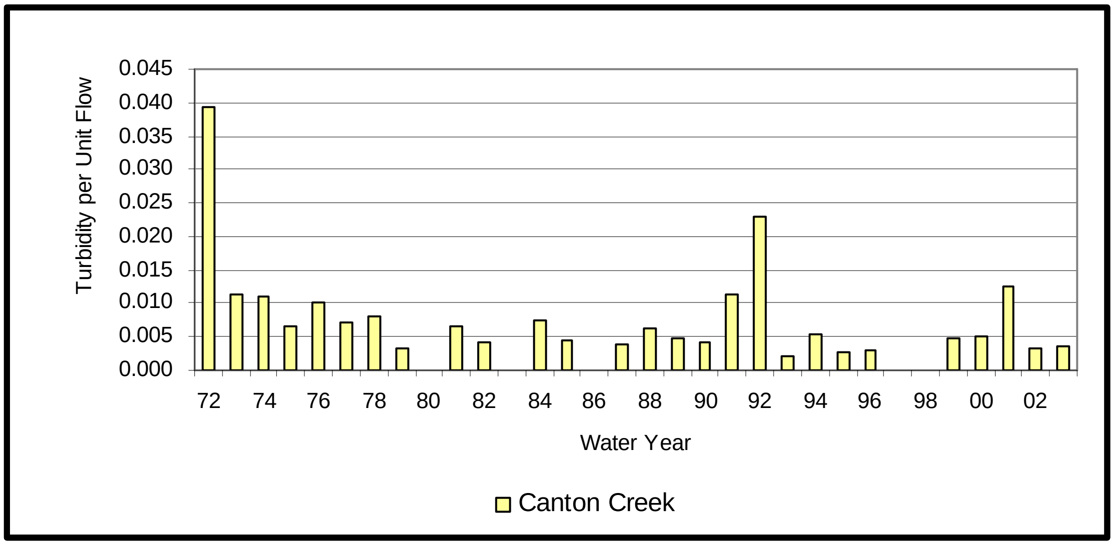

Figure 3-6: Turbidity relative to stream flow in Canton Creek.[68]

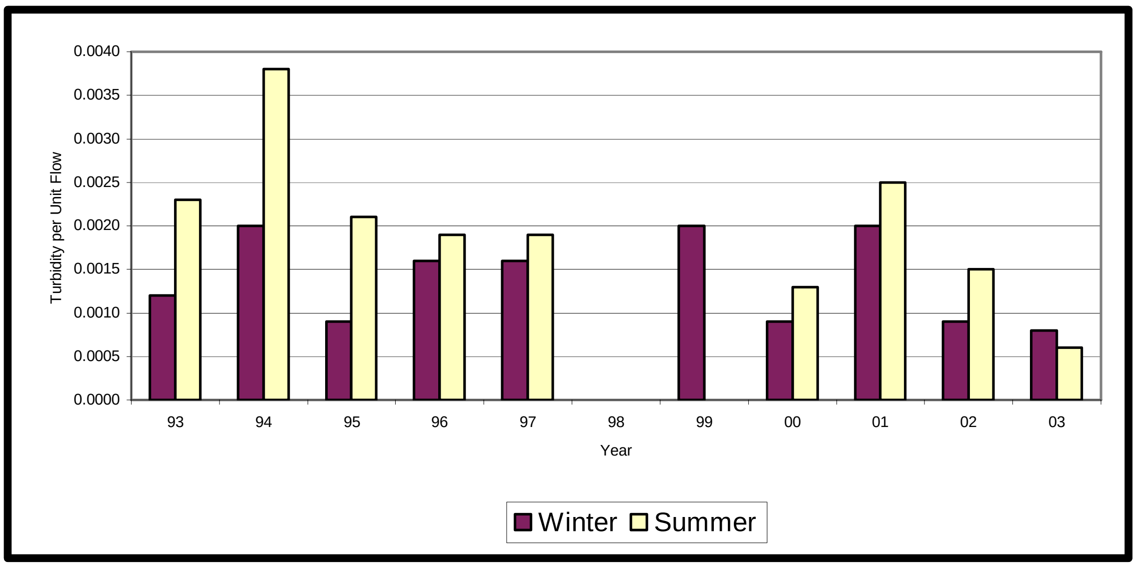

Figure 3-7: Turbidity in the summer and winter relative to stream flow in the North Umpqua River above Rock Creek. [69]

Sediment delivery processes

Disturbance from wildfire, wind storms, rain-on-snow events, and strong seismic jolts are considered the primary natural causes of erosion processes that drive sediment fluctuations in the Western Cascade range (Swanston, 1991). Erosion and fluctuations in sediment loads appear to have a wide range of natural variability over time frames of tens to hundreds of years (US Forest Service, 2001).

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[68] Data from the US Forest Service, Umpqua National Forest.
[69] Data from the US Forest Service, Umpqua National Forest.

Erosion is a natural process that produces sediment in streams. Streams vary in their sediment load depending on characteristics such as topography, flow patterns, soil type and geology, and surrounding vegetation. Aquatic plant and animal species adapted to a stream's environment are conditioned to the typical sediment quantity and fluctuation within that system. Sediment can become a problem in watersheds when erosion is accelerated by human activities. An increased amount of erosion producing levels of sediment that fish are not adapted to can be harmful to their populations by decreasing dissolved oxygen levels, decreasing sunlight penetration leading to degraded plant growth, and filling in spawning gravels. Certain human manipulations of the landscape are common causes of increased erosion. These include the construction of roads and their subsequent modification of fluvial (stream) processes, the removal of vegetation such as timber harvesting, crop and range agriculture, and residential development. Many of these human modifications occur in the Rock Creek Region. With good management, the impact of these practices can be minimized. This section identifies several factors that are important to sediment delivery processes.[70]

Stillwater Sciences (2000) identified four sources of sediment changes for the overall sediment load of the lower reach of the North Umpqua River sub-basin; mass wasting from landslides, from soil creep, streambank erosion, and surface erosion. They estimated that over four times more sediment was produced from landslides under current conditions compared to reference conditions pre 1946. No changes in soil creep were detected, and both streambank and surface erosion changes are unknown. Although changes in sediment inputs from soil creep and surface erosion are not known, they estimate the input from landslides was probably over two to twelve times greater than from soil creep or surface erosion during reference conditions. Rapid shallow landslides probably accounted for 67 percent of the overall sediment load within the sub-basin in the reference condition and 93 percent in the current condition.[71] Under current and reference conditions, the primary sediment delivery process is most likely from shallow rapid landslides.

According to the North Umpqua Cooperative Watershed Analysis (Stillwater, 2000), sediment in the North Umpqua River above Steamboat has been drastically reduced (15 to 70 percent) from historical levels by the Soda Springs dam upriver. They also determined that the further down river from the dam, the more the sediment level has increased back toward reference conditions. This was attributed to increased land disturbance from roads and harvest and increased landslides in the Western Cascade Terrain in this area.

There are a number of characteristics of the landscape, both natural and human induced that can trigger landslides and contribute to significant increases of sediment from

[70] Kristin Anderson and John Runyon of BioSystems, Inc., contributed to this section.
[71] The estimated increase in sediment produced from landslides may be high due to the lack of quality photography taken in 1946 compared to subsequent years. According to the USFS *Middle North Umpqua Watershed Analysis*, 1946 photography was found to have poor scale and resolution for detecting smaller landslides, potentially biasing the total sediment produced by primarily mapping large scale landslides.

historical levels. There are also many contributing factors that have probably increased fluvial and surface erosion, adding still more increases to the overall sediment amount.

The Roseburg BLM conducted a landslide inventory of the Old Fairview sixth-field sub-watershed (also known as the Susan Facial), which occupies the western half of the Middle North Umpqua Watershed.[72] The landslide inventory picked up only landslides that moved rapidly to produce a visible scar on aerial photos. Deep-seated slow moving earth flows and slumps are not detectable from the aerial photos. Many of these slump/earthflows are complexes generally greater than 20 acres in size. Late seral forest related landslides and small landslides are also difficult to find with aerial photo interpretation. For these reasons, the inventory is limited and under-represents small landslides as well as those in forests greater than 20 years of age.

However, the inventory gives a good depiction of rapid-moving landslides that occurred in the area and what may have triggered them. Understanding what may be high potential landslide areas is important in future management decision making. Results from this inventory will be used in the discussion that follows. For a detailed breakdown and analysis of the landslides mapped in Old Fairview, refer to the Roseburg BLM 2001 *Middle North Umpqua Watershed Analysis*.

This assessment reviews four potential sources of stream sedimentation and turbidity in the watershed: slope and landslide potential, roads and culverts, timber harvest, and burns. Although these are reviewed separately, they are interrelated. For example, potential erosion from roads or burns may be higher for those occurring on steep slopes.

Slope and landslide potential[73]

Although erosion processes today are considerably slower than at the time of geologic development, the Western Cascades Terrain is still considered a fairly young and active region. Wide-spread slope failures that occurred over time created a stair-step, slump/bench topography across much of this terrain (Section 1.2.4). Steep slopes provide greater energy to runoff and therefore have more power to deliver sediment to streams. Slope is an important consideration in sediment delivery, both in long-term erosion processes and in catastrophic events. Table 3-16 shows the distribution in slopes in each watershed and Map 3-15 shows the steepness of the Rock Creek Region.

Gentle to moderate slopes (0 to 65 percent slope) comprise 81 percent of the Rock Creek Region as well as each watershed. Because topographic maps tend to under-represent steeper slopes, these moderate slopes may be closer to around 75 percent of the Region. All three watersheds have approximately nine percent in the steepest slope categories (>75 percent slope) but the distributions vary.

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[72] This inventory was done for the *Middle North Umpqua Watershed Analysis*, completed in 2001.
[73] Much of this discussion comes from the two Middle North Umpqua Watershed Analyses, completed in 2001 by the Roseburg BLM and the Umpqua National Forest, as well as Kristin Anderson and John Runyon of BioSystems, Inc.

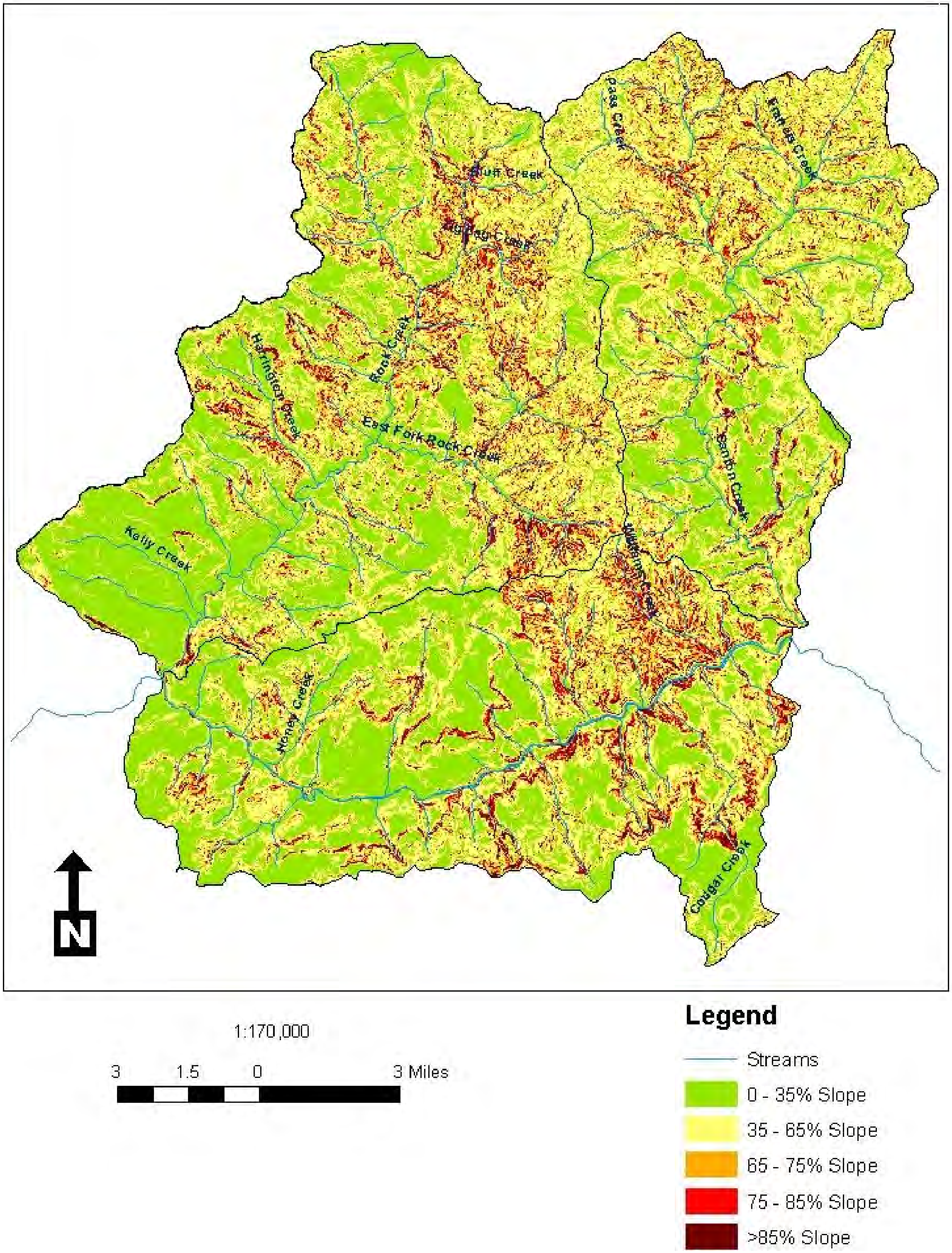
Percent slope	Rock Creek		Canton Creek		Middle N Umpqua	
	Acres	Percent of watershed	Acres	Percent of watershed	Acres	Percent of watershed
0 to 35	25,820	41	11,750	30	22,559	44
35 to 65	25,495	41	21,005	52	18,721	37
65 to 75	5,556	9	4,147	10	4,427	9
75 to 85	3,190	5	2,135	5	2,748	5
>85	2,593	4	1,509	4	2,431	5
Total	62,655	100	40,546	100	50,885	100

Table 3-16: Acres by slope distribution for each watershed within the Rock Creek Region.

Steep slopes can be seen scattered across the Canton Creek Watershed with some concentrated areas up Pass Creek and Hipower Creek. The Rock Creek and Middle North Umpqua watersheds each have very distinct areas of extreme slopes while much of the rest is gently sloping ground (0-35 percent). In Rock Creek the steepest areas are concentrated up North East Fork Rock Creek, Zig Zag Creek, Surprise Creek and near the headwaters of East Fork Rock Creek. In the Middle North Umpqua Watershed, the concentrations occur mostly in the Fairview Creek and Williams Creek drainages (
Map 3-15).

In the Rock Creek and Middle North Umpqua watersheds the most concentrated steep ground occurs on basaltic lava flows or igneous rock that formed near the surface (Map 1-4).[74] These areas are more likely to have cliffs and less incised mountain terrain. In general this rock is less erosive and more tightly held to the slope; however with such steep slopes, unstable areas are a concern. Steep ground also occurs on other parent materials throughout the Rock Creek Region. Steep slopes on tuffaceous or other sedimentary rock may be more prone to landslides than those on the basalt and igneous rock.

[74] Intrusive igneous rock forms beneath the surface. Intrusive igneous rock that forms beneath but near the surface is referred to as hypabyssal igneous rock.

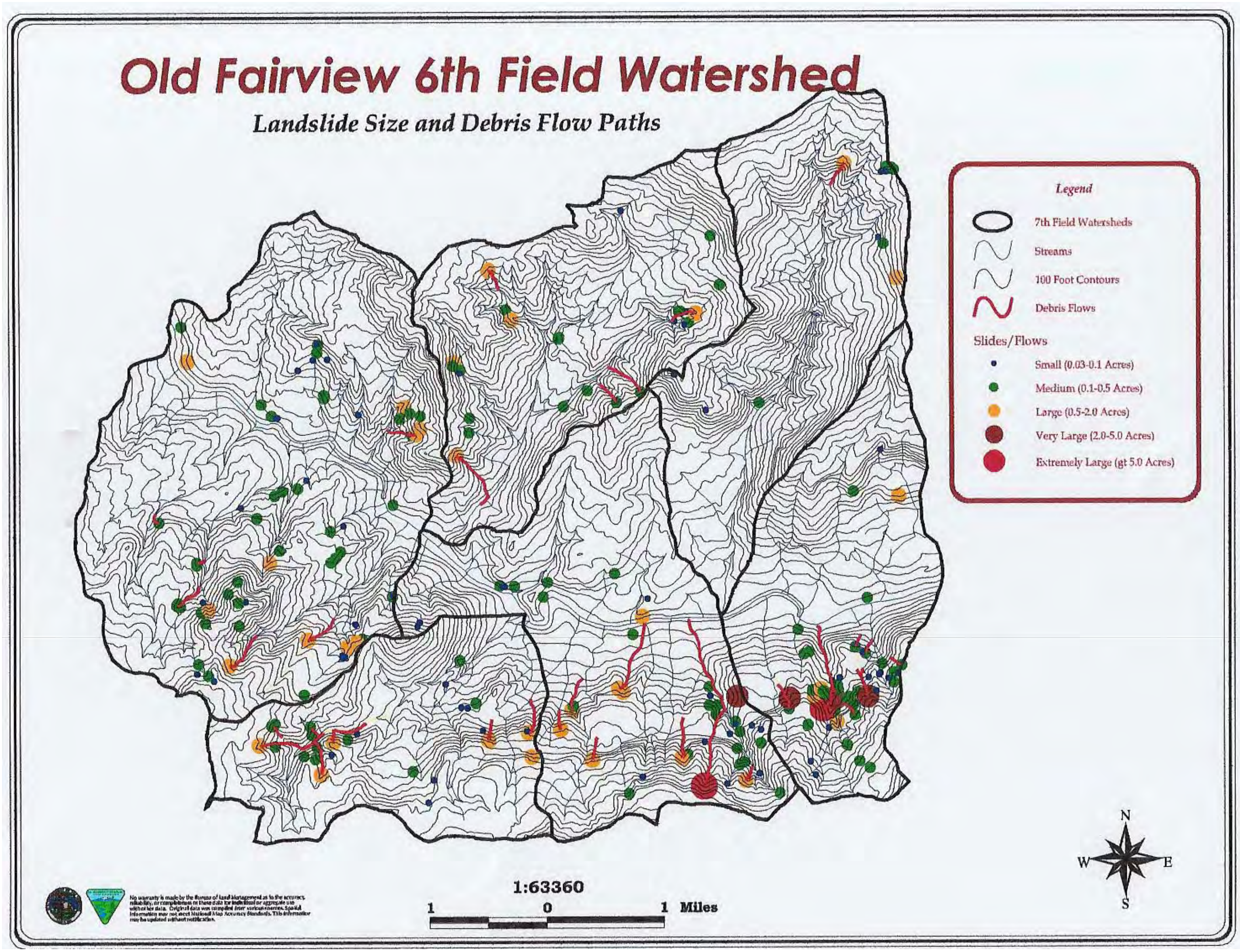


Map 3-15: Slope distribution within the Rock Creek Region.

Map 3-16 shows the distribution and size of the landslides and associated debris flows that occurred between the late 1950s and 1999 according to the BLM study in the Old Fairview sub-watershed. Heavy concentrations of the bigger landslides and debris flows occurred in the southeast portion of Old Fairview, south of the North Umpqua River. This area contained 58 percent of the total landslide area on 18 percent of the ground in the sub-watershed. It also contained 100 percent of the landslides that were greater than two acres. The largest event was a ten-acre debris flow of 1.4 miles to the North Umpqua River. This flow, on an unnamed creek, was probably triggered by the December 1964 rain-on-snow flood event. The larger debris flows greatly altered channels, streambanks and riparian zones.

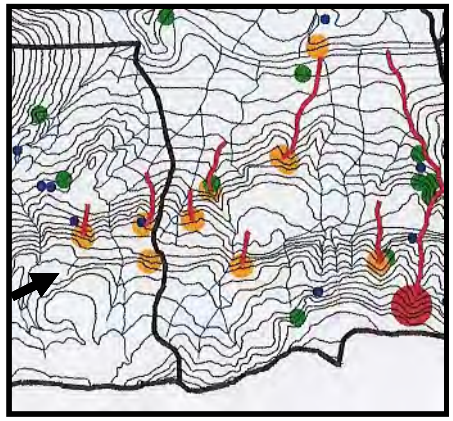
This inventory not only gives specific landslide and debris flow information that occurred within the area, but also shows topographic attributes where landslides and debris flows may be more prone to occur.

The Western Cascades Terrain is characterized by a stair-step topographical pattern caused by old slumps and earthflows that left steep pitches above flatter areas of deposited material. This region is still considered active and slumping. There is high subsurface flow and drainage beneath these earthflows where streams are trying to reestablish channels. Soils are shallow with localized rock outcroppings on the steeper portion, and the gently sloping benches have deeper soils. Water tends to accumulate on these flatter slopes and is then concentrated when it begins to move down slope as it passes over the slope break to the steeper section. These steep slopes can be highly prone to failure with the disturbance caused by fire, harvest, and road construction, during exceptional precipitation years or during significant rain-on-snow events (USDI Bureau of Land Management, 2001 and Cressy, 2005).



Map 3-16: Landslide size and debris flow paths mapped in the Old Fairview sub-watershed.

Map 3-17 is a close-up section of the lower center of Map 3-16. The red lines indicate the debris flow path that was initiated from the landslide (dot). Nearly all of the landslides and debris flows mapped here started at the top of a steep slope just below a slope break from a flat or gentle slope (see arrow for example). These are areas of weakness that were susceptible to failure.



Map 3-17: Landslide and debris flow initiation areas

This analysis of the Old Fairview sub-watershed resulted in the identification of several important terrain features contributing to landslides:

> At least 90 percent [of the mapped landslides] had their initiation points on steep slopes greater than 60 percent slope. About 60 percent of the landslides initiated on moisture converging slopes (headwalls, swales, stream channels, concave slopes and hollows). Planar and convex positions accounted for about 40 percent of the total. About 58 percent of all the landslides did not reach a stream, about 30 percent reached 1st and/or 2nd order streams, about 8 percent reached 3rd and 4th order streams, and about 4 percent reached the North Umpqua. Included in the four percent of landslides reaching the North Umpqua were the two extremely large debris flows/dam break floods in the SE part of Old Fairview.

The Oregon Department of Forestry (ODF) uses a number of criteria to identify areas vulnerable to landslides capable of causing damage to water quality and fish habitat. These areas are referred to as "high risk sites" and have the following landform characteristics:

1. Actively moving landslides;
2. Any slope steeper than 80 percent;
3. Concave slopes steeper than 70 percent;
4. Slope breaks where the lower slope exceeds 70 percent;
5. Inner gorges with slopes steeper than 60 percent; and
6. Other sites determined to be of marginal stability by ODF personnel.

ODF found in a study done in 1999 that digital elevation models used to estimate slope in GIS tend to underestimate steep slopes and overestimate moderate to gentle slopes due to the lack of on-the-ground detail they are able to portray (Robison *et al.*, 1999). For this reason, the slopes shown in
Map 3-15 and Table 3-16 have been broken out at five percent less than those listed in the ODF high risk site criteria above. Using
Map 3-15 we can see the areas with slopes greater than 75 percent which can be correlated to number two above, and slopes greater than 65 percent correlate to number three and so on. Criteria number four above correlates to the topographic stair-step pattern discussed above. Approximately 18 to 19 percent of each watershed has slopes

greater than 65 percent. Taking a closer look at these steep slopes to isolate those that occur at the slope break described above or those that occur on concave shaped slopes can further define these high risk potential areas.

There is also correlation between the amount of precipitation and landslide activity. The BLM landslide analysis in Old Fairview found that above-normal precipitation and high intensity storms from 1995 to 2000 caused a substantial increase in landslide activity over the early 1990s which experienced more drought conditions. In the southwest corner of the Old Fairview sub-watershed a concentration of eight debris flows located in the headwaters of Bob Creek originated in the late 1990s (after the large storms that occurred in 1996). The largest has a run-out distance of 3,100 feet. Three of the eight debris flows in this area were thought to be triggered by roads, and five were thought to be related to harvest areas. In addition, Harrington Creek in the Rock Creek Watershed experienced the largest debris flow in the entire Rock Creek Region (approximately three miles long) sometime following the storms of 1996. This debris flow also started immediately below a road.

Roads and culverts

Roads can contribute sediment to streams through surface erosion, channeling runoff and ground water to streams and thus increasing peak flows, or by increasing slope instability that may lead to more landslides. High sediment inputs often occur from surface erosion in the years immediately following road construction, but diminish rapidly over time. Sediment can increase again during periods of high traffic especially in the wetter months. Road-related sediment production by landsliding often exceeds chronic sediment production from road surfaces, but typically occurs only in response to extreme storms (Wemple, *et al*., 2001). Subsequent scour by debris flows and torrents, rather than the initial landslide volume, represent most of the landslide related sediment that is carried into and through stream channels (Robison *et al*., 1999).

Sediment delivery from dirt and gravel roads is a leading cause of increased sediment in stream systems. Road sediment production and delivery involves many factors and processes such as road surface type, ditch infeed lengths, proximity to nearest stream channel, condition of road, and level and type of use the road system receives. Since complete road data for the watersheds are not available, specific values for sediment delivery from the road system are not included in this assessment. Rather, this assessment looks at the current state of road types, proximity of roads to streams, hill-slope where roads are located, and culverts.[75]

Roads can be divided into two types: surfaced and unsurfaced. Surfaced roads are ones that have been paved or rocked. Unsurfaced roads are native surface (usually dirt) roads. Unsurfaced roads are much more likely to erode and fail than surfaced roads. There are 1,080 miles of roads in the Rock Creek Region. Table 3-17 lists the miles of road in each watershed by surface category (or “closed”), and the total road density. Both Canton Creek and Rock Creek watersheds have well over 80 percent of the roads surfaced. Canton Creek has more unsurfaced roads (13.2 percent) than Rock Creek (8.3 percent).

[75] Tim Grubert and John Runyon of BioSystems, Inc., contributed to this paragraph.

The Middle North Umpqua has far fewer road miles with a much greater percent surfaced (96.2 percent). Road density is highest in Rock Creek and lowest in the Middle North Umpqua.

Surface type	Rock Creek		Canton Creek		Middle North Umpqua	
	Miles	% of watershed	Miles	% of watershed	Miles	% of watershed
Paved	29.9	5.9	25.7	9.4	16.7	5.5
Major gravel	197.1	39.1	104.2	38.0	130.5	43.2
Minor gravel	219.2	43.5	102.8	37.5	143.1	47.4
Total surfaced	**446.2**	**88.6**	**232.7**	**84.8**	**290.3**	**96.2**
Major native	40.9	8.1	34.7	12.6	4.5	1.5
Minor native	1.2	0.2	1.4	0.5	5.0	1.6
Total unsurfaced	**42.1**	**8.3**	**36.1**	**13.2**	**9.5**	**3.1**
Closed	15.4	3.1	5.6	2.0	2.0	0.7
Total all roads	**503.7**	**100.0**	**274.4**	**100.0**	**301.8**	**100.0**
Road density mi/mi2	**5.1**		**4.3**		**3.8**	

Table 3-17: Miles and percent of roads by surface type, and road density in each watershed.

The closer a road is to a stream, the greater the likelihood that road-related runoff contributes to sedimentation. In the Rock Creek Region, there are about 324 miles (30 percent) of roads within 200 feet of streams. Of these, 290.5 miles (89.7 percent) are surfaced roads, 26.5 miles (8.2 percent) are unsurfaced roads, and 7.2 miles (2.2 percent) are closed. Table 3-18 shows the comparison by watershed.

Roads on steep slopes have a greater potential for erosion and/or failure than roads on level ground. ODF found that "damaging landslides are unlikely for roads constructed on slopes of less than 50 percent sideslope if these roads have frequent and properly sized drainage structures and also use minimum and balanced excavation practices [in construction] (Robison, *et al*., 1999)."

There are approximately 109.6 miles of roads (10.1 percent of 1,079.9 total miles) located on a 50 percent or greater slope and within 200 feet of a stream (see Map 3-18 and Table 3-18). Of these roads on steep slopes, 94.1 miles (85.9 percent) are surfaced, 13.7 miles (12.5 percent) are unsurfaced, and 1.8 miles (1.6 percent) are closed. Map 3-18 shows that many of these road segments are located in the east half of the Rock Creek and the west half of the Canton Creek watersheds. The Middle North Umpqua Watershed has fewer roads located in its steeper sections. An analysis of road conditions near streams is necessary to determine how much stream sedimentation is attributable to road conditions.

Surface type	Rock Creek		Canton Creek		Middle N Umpqua	
	Miles within 200 ft	**200 ft and >=50% slope**	**Miles within 200 ft**	**200 ft and >=50% slope**	**Miles within 200 ft**	**200 ft and >=50% slope**
Surfaced	136.2	45.0	83.4	33.3	70.8	15.8
Unsurfaced	13.1	7.5	12.0	5.7	1.4	0.5
Closed	4.6	0.9	2.5	0.9	0.1	0
Total	153.9	53.4	97.9	39.9	72.4	16.3

Table 3-18: Miles of road within 200 feet of a stream and on 50 percent or greater slopes in each watershed.

Road construction practices have been closely associated with road failure in many studies. Older roads constructed on steep ground required significant excavation, further steepening the slope. Excavated material was often used as fill to make the outside edge of the roadway. The resulting cut-and-fill slopes are always steeper than the original slope, resulting in a higher risk for slope failure (Mills, 1997).

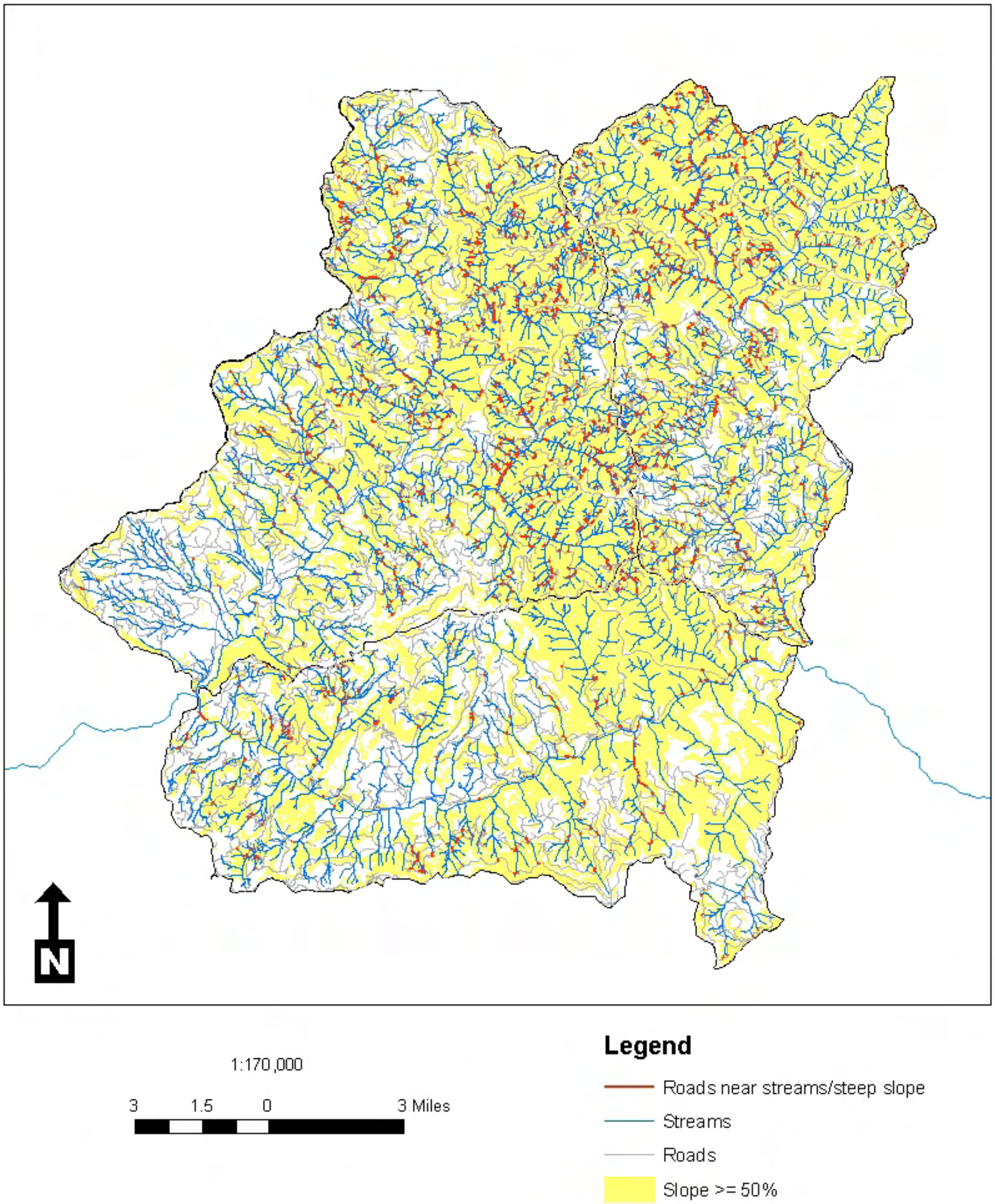
Landslides that result on the cutslope portion of the road are mostly deposited on the road. Some further erosion of the road surface can carry this sediment into streams. However, landslides that occur on the fillslopes are more likely to become debris flows, increasing in size and then entering stream channels. Current road construction techniques have greatly reduced the frequency of road-related landslides by minimizing and/or eliminating sidecast along roadways and endhauling material rather than using fillslopes to construct roads (Mills, 1997). The greatest potential hazards are most likely on older midslope roads constructed prior to 1983 when these standards were put in place.

Like roads, culverts can contribute to stream sedimentation when they are failing. Culverts often fail when the pipe is too narrow to accommodate high stream flows, or when the pipe is placed too high or too low in relation to the stream surface. In each case high flows can overwhelm the culvert's drainage capacity, and water floods around and over the culvert, eroding the culvert fill, road, and streambank. At this time, it is unknown how many crossings are culverts nor how many culverts are failing.

Peak flows during high storm events also create additional sediment by eroding streambanks and scouring streambeds. Roads not only can add sediment by erosion during these events but they may contribute to higher peak flows; thereby increasing the erosion potential in the stream channels (see Section 3.4.3).

A complete road maintenance inventory is not available to determine roads that could benefit from additional cross drains and surface improvement. However, ODF recommends old roads (built prior to 1983) on slopes steeper than 70 percent should receive priority for upgrading, especially when opening up old roads on these slopes.

This maintenance includes both improving surface water drainage and removing unstable fillslopes.



Map 3-18: Roads within 200 feet of streams and on 50 percent or greater slopes.

Timber harvest

Removal of trees from a hillslope can have both hydrological and mechanical effects that impact slope stability. These effects include decreased water interception and evapotranspiration, decreased soil infiltration, change in water routing, change in snow melt patterns, decreased root reinforcement, and decreased buttressing or arching at the base of slopes (Robison *et al*., 1999). In addition, a higher risk of surface erosion can occur on steeper slopes where vegetation has been cleared and the ground compacted by skid trails.

In 1996, the ODF conducted a study of landslides relative to large storm events. They found that following these events, harvest that occurred on steep slopes inherently prone to landslides, may cause an increase in the frequency of landslides than would otherwise have occurred (Robison *et al*., 1999).[76] Following large storms in 1996, the ODF evaluated a range of forest stands in areas that met their criteria for being at high risk for landslides. They found that recently harvested areas (less than nine years old) resulted in the highest frequency of landslides relative to older forested areas on these high risk sites. This emphasized the importance of quickly reforesting the sites after harvest. However, this potential increase in landslide frequency after harvest appeared short-lived. The ODF also found that stands that were between 10 and 100 years in age had a lower frequency of landslides compared to those over 100 years old. They measured the depth of the landslides and found no correlation to root strength; leading them to speculate that the increased frequency in very recently harvested areas is more likely due to other changes in hydrologic or geomorphic factors that result from vegetation removal, rather than loss of root strength.

The known harvest in the Rock Creek Region was at its peak from 1960 through the 1970s (Section 2.7.2). In 1964, a rain-on-snow event resulted in rapid saturation of the soils that probably triggered numerous landslides and surface erosion during that period. However, sediment produced from surface erosion or landslides caused by timber harvest have not been quantified for the assessment area.

Although data are not available for the entire Rock Creek Region, the BLM analysis in Old Fairview found that harvest-related landslides were highest prior to 1965. This was a period with high levels of timber harvest and new road construction. In addition, 34 percent of all of the landslides mapped for the entire period occurred in 1965, presumably due to the 1964 rain-on-snow flood event that triggered areas to slide that were at risk due to management and terrain features. Figure 3-8 shows the acres of landslides per year due to harvest (over two acres per year) exceeded that due to roads prior to 1965; however road-related landslides exceeded harvest-related in all of the years that followed. Both harvest- and road-related landslides exceeded forest related (non-management-related) landslides throughout; however mapping landslides in forested areas is much more difficult and probably did not account for all of the slides in these areas.

The Roseburg BLM *Middle North Umpqua Watershed Analysis* stated that recent streambank and channel erosion has been much less than in the 1950s through 1970s. This was attributed to better management practices and also to stream channel width and depth adjustments caused by road and harvest related disturbances having run their course to a new equilibrium. In addition, the analysis showed that as of 2001 harvest-

[76] Refer to the Slope and Landslide section for a list of ODF's high landslide risk criteria..

related surface erosion was not a large factor in stream sedimentation in the Old Fairview sub-watershed.

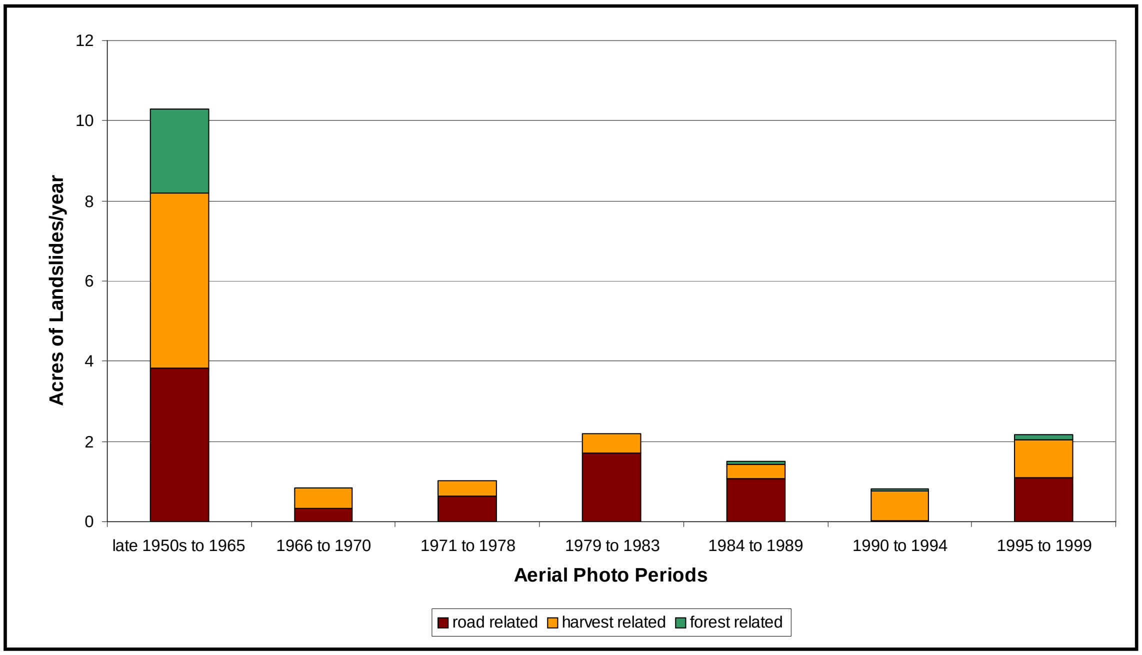


Figure 3-8: Chronology of landslide acres per year related to management in the Old Fairview sub-watershed.[77]

Burns

Burned areas erode more easily than unburned areas because of the lack of vegetative cover and abundance of fine material, such as ash. Although fire history has varied in these watersheds (Section 2.7.1), wildfires in the last ten years have amounted to only 6.2 acres burned in all three watersheds according to the Douglas Forest Protective Association. Fire suppression has been aggressive, and no large scale fires have occurred since 1991. During this ten-year period, there were 19 recorded starts in the Rock Creek Watershed, ten in the Canton Creek Watershed, and only five in the Middle North Umpqua Watershed. Several large-scale fires located near and along the North Umpqua River did however occur on Forest Service land in 2002 (Apple, Limpy, and Calf II fires). Although these fires occurred outside of the Rock Creek Region boundary, they may have affected sediment levels in the North Umpqua River within the Rock Creek Region. According to the *Wildfire Effects Evaluation Project* produced in 2003 by the Umpqua National Forest, portions of the Apple Fire within the Panther Creek sub-watershed that were already considered prone to rain-on-snow events experienced burning that opened up the canopy significantly. Some of this area is located directly above the North Umpqua River and could produce increased erosion into the river during peak storm events. Actual sediment delivered to the streams in these areas has not been measured and is difficult to quantify.

[77] From the Roseburg BLM *Middle North Umpqua Watershed Analysis*, 2001.

3.3.8. Toxics

Toxics are a concern for fish and aquatic life and for drinking water. A variety of substances can be toxic, including metals, organic chemicals, and inorganic chemicals. Toxics, according to ODEQ, are not defined by substance type, but rather by their effects on humans, fish, wildlife, and the environment:

> Toxic substances shall not be introduced above natural background levels in the waters of the state in amounts, concentrations, or combinations [that] 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, [or are detrimental to] aquatic life, wildlife, or other designated beneficial uses.[78]

The dominant industrial use in the region is forestry. The most likely inputs would result from petroleum spills related to logging on private or federal land. Both the US Forest Service and Bureau of Land Management follow stringent spill reporting procedures and have contingencies for cleanup. They contract each year with a hazardous waste cleanup company to be “available” if a spill occurs (Jones, 2005). Non-industrial landowners could contribute household hazardous waste most likely near the mouth of Rock Creek and in Honey Creek where most of this ownership occurs.

In 1993 through 1995, the USGS sampled filtered water from the North Umpqua River above Rock Creek and below Wright Creek at low flows for trace elements (Anderson *et al.*, 1998). Arsenic, barium, manganese, and aluminum were consistently detected in these samples although near minimum reporting levels. Trace elements detected at high flow included copper and nickel in addition to barium, manganese and aluminum. Arsenic was found only at low flows. Arsenic is the most significant of the trace elements detected as it is a human carcinogen, and the river is used for drinking water.

Arsenic

Samples taken for the USGS algal study of the North Umpqua in 1993 to 1995 showed arsenic levels of 1 μg/L during low flows. The study determined that this level of arsenic could pose a health hazard to people who depend on the North Umpqua for drinking water and the risk is accentuated when fish are also consumed from these waters. The study determined that the calculated cancer risk based on Environmental Protection Agency’s Risk Specific Dose Health Advisory for people whose drinking water source is the North Umpqua River and who regularly eat fish from the river is between 1:5,000 and 1:20,000. Similar concentrations are not necessarily expected downstream or in treated water. OWEB lists 190 μg/L as the chronic toxicity level and 360 μg/L as the acute toxicity level of arsenic to fish. This means that adverse affects to fish are expected when they are continuously exposed to arsenic levels of at least 190 μg/L for 4 days or 360 μg/L for one hour.

[78] From ODEQ’s *Oregon’s Approved 1998 303(d) Decision Matrix* (1998), (p. 22).

The North Umpqua River from Rock Creek to Steamboat Creek is 303(d) listed for arsenic. The listing for arsenic occurred in 2002, and the impairment is year round. The current ODEQ standard for arsenic is 0.0022 μg/L for "water and fish ingestion."[79] The listing is based on further sampling done by the USGS where three of four samples were greater than 0.0022 μg/L.

Arsenic is the 20th most abundant element on the earth, and arsenic compounds occur in many rocks, finding their way into soils and water.[80] The source in the North Umpqua River is unknown; however arsenic is commonly found in geologic sources within volcanic regions such as the North Umpqua River sub-basin. In the USGS study in 1993, arsenic was also found in bed sediment samples at elevated concentrations (Anderson, et al., 1998). It has also been found in relatively high concentrations in ground water in adjacent forested watersheds in the Willamette Valley near Eugene (Hinkle, 1997). This supports the theory that arsenic in the North Umpqua River is probably derived from geologic sources in the volcanic rocks of the Cascade Range.

3.3.9. Water quality key findings and action recommendations

Although there are a number of factors that influence water quality in the Rock Creek Region, the most limiting is temperature. High temperatures cause physical stress in salmonids. Stressed fish are more susceptible to predation, disease, and competition by warmer temperature tolerant species. The majority of streams measured in the Region do not meet the latest ODEQ 7DAM standard of 60.8°F. In addition, there are stream temperature trends within the Umpqua Basin that relate stream temperature to the distance from the headwater source. Streams that exceed both the temperature trend within the basin and the ODEQ standard are most likely to have the most significant problem areas related to temperature.

Arsenic levels in the North Umpqua River are the second most significant key finding related to water quality. Arsenic levels exceed the standard for "water and fish ingestion." Since the North Umpqua River is a domestic water source and food source for some people and arsenic is a human carcinogen, this is an important toxic.

Temperature key findings

- Streams that failed to meet water quality standards and basin trend expectations included the main channels of Canton and Rock creeks, and smaller tributaries Honey and Susan creeks. Harrington Creek also measured some of the warmest temperatures although data were not available to relate it to basin trends.
- Results show that 7DAM temperatures in the Rock Creek Region were frequently above 60.8°F. All three main channels (Rock and Canton creeks, and the North Umpqua River) had 7DAM temperatures exceeding 60.8°F every day throughout the majority of the 2003 summer. Consistently high stream temperatures could limit salmonid rearing in these reaches.

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[79] ODEQ Water Quality Criteria Summary (Table 20).

[80] Queensland Government, Queensland Health , Document 2676 "*Environmental Health Guidance Note – Arsenic*", located at *www.health.qld.gov.au*, accessed on 7/11/2005.

- Most monitoring sites located in the tributaries had 7DAM temperatures above 60.8°F for the majority of the seasons monitored between 1992 and 2004. The consistently warmest recorded areas were middle Canton Creek and Rock Creek above East Fork Rock Creek. The coolest tributaries with 7DAM temperatures that were generally better than the standard for the majority of the years monitored were Mellow Moon Creek, Trapper Creek, Scaredman Creek, and Kelly Creek.
- Those tributaries that just exceeded the criteria but are close to meeting the standard all summer are Pass Creek above East Pass Creek, Rock Creek above Northeast Fork Rock Creek, Woodstock Creek, and Miller Creek.
- Warmer sites often lack shade. Increasing and maintaining shade on small and medium-sized streams will reduce stream warming rates and improve habitat for salmonids.
- Slowing water movement through areas with good shade cover reduces the time that water spends in direct solar contact. This can reduce stream warming and provide cooler water refuge areas for fish.
- Groundwater and tributary flows can contribute to stream cooling. Gravel-dominated tributaries may permit cooler subsurface flows when surface flows are low. Bedrock substrate heats up more quickly than other areas when exposed to direct solar radiation.
- Reducing downcutting on tributaries can help reduce the rapid loss of groundwater early in the summer season and help maintain a more constant groundwater inflow throughout the warm season.
- Fish may find shelter from high summer temperatures in the lower reaches and mouths of small and medium-sized tributaries and in reaches within warm streams that have proportionately high groundwater influx and shade. Concentrating efforts to keep these important tributary connections cool can provide and maintain important resting areas during peak summer temperatures.

Surface water pH, Dissolved oxygen, Nutrients, Bacteria, and Toxics key findings

- Arsenic levels fail to meet water quality standards for "water and fish ingestion" in the North Umpqua River, which even in small amounts can be significant due to arsenic's human carcinogenic attributes. Although the source is unknown, data suggest it may be due to the local volcanic geology of the region.
- Temperature and the levels of pH, nutrients, and dissolved oxygen are interrelated. Within the Rock Creek Region, it appears that the North Umpqua River's pH levels are within the ODEQ's acceptable range. Above and below the Region, pH levels violate ODEQ standards. The USGS study found the river to have fairly high pH levels, and many measurements taken have been close to the maximum ODEQ standard even within the Region.
- Continued monitoring of pH on the North Umpqua River is recommended. Data on tributary streams for pH were not available. Steamboat Creek (to which Canton Creek is a tributary) is listed for pH, and additional monitoring of Canton Creek and Rock Creek is recommended to determine possible pH concerns.
- Many of the dissolved oxygen levels taken on the North Umpqua River failed to meet the numeric limits; however to determine whether this segment of the river is not

meeting the ODEQ standards, percent saturation would have to be determined at the time of the sample. Continued monitoring of dissolved oxygen including percent saturation is recommended on the North Umpqua River.

- No dissolved oxygen measurements were taken on Rock or Canton creeks. However, based on intergravel measurements throughout the Rock Creek Watershed, oxygen flow through gravel where salmonid redds are expected does not appear limited.
- Nutrient levels do not appear to limit water quality in the Rock Creek Region. However, nitrogen levels appear low in the North Umpqua River which may be increasing the proportion of algae growing in the North Umpqua River to be higher in nitrogen-fixing species. Small increases in nitrogen into the North Umpqua River may dramatically increase other species of algae growth in a river that is already high in algae.
- Bacteria do not appear to limit water quality in the Rock Creek Region; although bacteria measurements were not available. It is unlikely with the low population and minimal agricultural and industrial development within the Region that bacteria are limiting these streams.

Sedimentation and turbidity key findings

- Turbidity data indicate that levels measured in the Rock Creek Region should not affect sight-feeding fish like salmonids. Turbidity measures related to flow seem to show a decrease in turbidity since the 1970s with a few years of elevated levels.
- Canton Creek is listed as sediment impaired. This listing appears based on qualitative rather than quantitative information. The US Forest Service has gathered macroinvertebrate data on Canton Creek and has requested it be delisted based on this information.
- Sediment levels in the North Umpqua River above the Region have been drastically reduced from historical levels due to affects of the Soda Springs dam. The further down river from the dam, the more the sediment levels are increasing back toward historical conditions due to increased erosion from management activities and the erosive Western Cascade Terrain (Stillwater Sciences, 1998).
- Although there are numerous sources of sediment, rapid shallow landslides that initiate dam breaks and debris flows contribute the predominant portion of sediment to streams.
- Steep slopes can be seen scattered across the Canton Creek Watershed with some concentrated areas up Pass Creek and Hipower Creek. In Rock Creek the steepest areas are concentrated up North East Fork Rock Creek, Zig Zag Creek, Surprise Creek and near the headwaters of East Fork Rock Creek. In the Middle North Umpqua the concentrations occur mostly in the Fairview Creek and Williams Creek drainages.
- Several of the following features, especially when found in combination, can make areas more susceptible to landslides: concave and/or steep slopes; especially those located just below a flatter area, along with poorly managed, erosion-inducing human modifications such as roads and timber harvesting.
- Mid-slope roads on steep ground constructed prior to 1983 may be more vulnerable to slope failure due to road construction practices that included sidecast and fillslopes.

- Areas with tuffaceous geology are more likely to slide than basaltic or igneous rock that is more tightly held to the slope.
- Runoff from impervious surfaces, including roads, parking areas, roofs, and areas burned very hot, can increase peak flows and sediment loads to streams.

Water quality action recommendations

- Identify stream reaches that may serve as "oases" for fish during the warm summer months, such as at the mouth of small or medium-sized tributaries. Protect or enhance these streams' riparian buffers and, when appropriate, improve instream conditions by placing logs and boulders within the active stream channel to create pools and collect gravel.
- In very warm streams, increase shade by encouraging wide riparian buffers and managing for full canopies.
- Encourage landowners to protect intact riparian areas along tributary channels that are cooler than the main channel and work with adjacent landowners to develop more contiguous riparian cover along the tributaries.
- Identify tributaries with bedrock substrate to focus riparian management and develop more gravel with instream wood placement to encourage cooler temperatures where appropriate.
- Cooperate with ODEQ as necessary to document and reduce contamination by arsenic.
- Where data show that stream sediment levels exceed established water quality standards, identify sediment sources such as failing culverts or roads, landslide debris, or excessive streambank erosion. Take action to remedy the problem or seek assistance through organizations such as the UBWC, the Douglas Soil and Water Conservation District, and the Natural Resources Conservation Service.
- In areas with high landslide and debris flow hazards, encourage landowners to identify the specific soil types, slopes and topographic features that make their properties more susceptible to landslides, and include this information in their land management plans.
- Encourage land managers to complete road maintenance inventories to identify problem areas that are likely producing more runoff and sediment.
- Prioritize evaluation of older roads constructed prior to 1983 that are either in close proximity to streams or on steep midslope positions to target for maintenance that may include the following:
  - Remove or stabilize fillslope and sidecast material.
  - Increase cross drain culverts and/or other drainage methods (i.e. waterbars, dips) to divert runoff away from streams and disperse water and sediment on stable vegetated hillslopes.
  - Add surface rock or pavement to unsurfaced roads
  - Fix existing drainage structure problems.
- Encourage land managers to identify sediment producing roads that may be closed or decommissioned where problem roads can be rerouted or are not important to future management of the area.
- Encourage continued management of fuel loads to reduce the risk of high intensity catastrophic fire.

- Encourage landowner practices that will maintain the Rock Creek Region's low nutrient and bacteria levels:
  - Repair failing septic tanks and drain fields.
  - Use wastewater treatment plant effluent for irrigation.
  - Reduce chemical nutrient sources.
- Continue monitoring the Rock Creek Region for all water quality conditions. Expand monitoring efforts to include small tributaries.

3.4. Water quantity

3.4.1. Water availability[81]

Data from the Oregon Water Resources Department (OWRD) have been used to determine water availability in the Rock Creek Region. Availability is based on streamflow, consumptive use, and instream water rights. The amount of water available for issuance of new water rights is determined by subtracting consumptive use and the instream water rights from streamflow.

In most of the Umpqua Basin, including the Rock Creek Region, there is no water available for new water rights from "natural" streamflow during the summer.[82] A recent exception to this was just negotiated as part of a settlement agreement between ODFW and Douglas County on the North Umpqua River from the mouth of Rock Creek to the mouth of the North Umpqua River. In the early 1990s, ODFW applied for large instream rights on the North Umpqua River using up all of the available water that was left. This made no water available to new rights from June to November. Douglas County protested due to the negative effect on future development. The settlement agreement allows for 7 cfs to be made available for domestic, irrigation, and new industrial/commercial use.

To analyze water availability, OWRD has divided the Umpqua Basin into water availability units, or WABs. The Rock Creek Region consists of three WABs: Rock Creek (347), Canton Creek (293), and the North Umpqua River (71173). Both the Rock Creek and Canton Creek WABs correlate to watershed boundaries, while the North Umpqua River WAB (71173) extends below the Middle North Umpqua Watershed boundary along the North Umpqua River to just above Little River at Glide. Figure 3-9 shows surface water availability for each WAB.

The solid yellow area in Figure 3-9 is the 50 percent exceedence of streamflow in cubic feet per second (cfs); streamflow exceeds this level 50 percent of the time. For discussion purposes, this will be referred to as the average streamflow. The dark blue line represents the cfs for instream water rights, and the red line and corresponding

[81] David Williams, the Oregon Water Resources Department Watermaster for the Umpqua Basin, contributed the background text for Section 3.4.1. Water availability data are from OWRD's Water Availability Report System database (*www.wrd.state.or.us*).
[82] In some circumstances, domestic water rights can be obtained if there is no other source of water on a property. Contact the Water Resources Department for more information.

numbers are the estimated consumptive use.[83] The light blue line represents the expected streamflow, which is calculated by subtracting consumptive use from the average streamflow. Expected streamflow is close to average streamflow all year because consumptive use in the Region is so low. In Rock Creek and Canton Creek, instream water rights exceed average streamflow in October, and also in August for Canton Creek. In the North Umpqua River WAB, instream water rights are higher than average streamflow in August, September, and December.

Oregon law provides a mechanism for temporarily changing the type and place of use for a certificated water right by leasing the right to an instream use. Leased water remains in-channel and benefits streamflows and aquatic species. The water right holder does not have to pay pumping costs, and, while leased, the instream use counts as use under the right for purposes of precluding forfeiture.

[83] Consumptive uses are water rights that are "used" or removed from the stream. Instream water rights are non-consumptive rights.

Rock Creek WAB 347

Canton Creek WAB 293

North Umpqua River above Little River WAB 71173

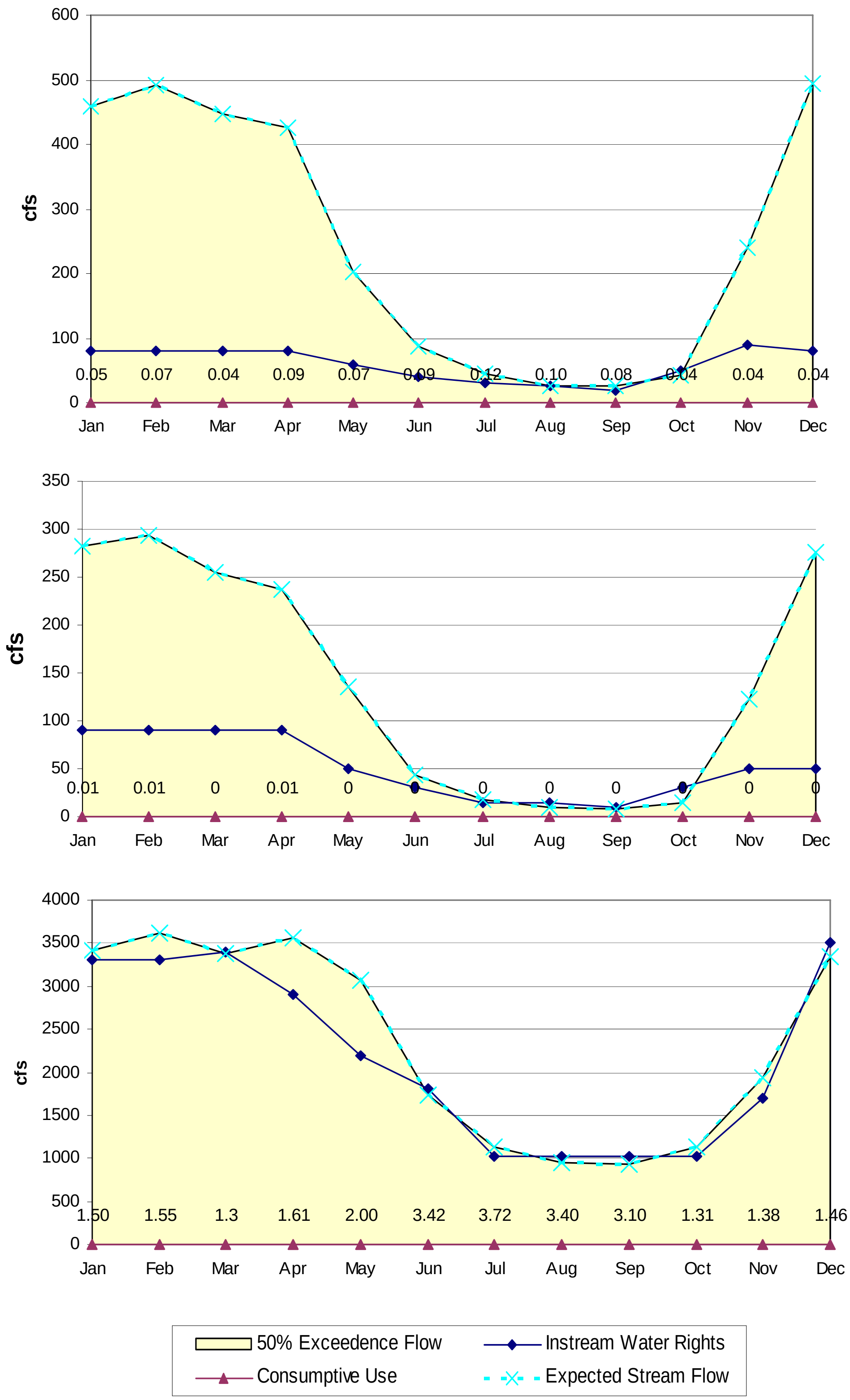

Figure 3-9: Water availability in all three WABs within the Rock Creek Region.

3.4.2. Water rights by use

Table 3-19 shows consumptive use by category for the Rock Creek Watershed, Canton Creek Watershed and the entire North Umpqua River WAB 71173.[84] Water rights listed include those on the main channel and all tributaries within the Rock and Canton watersheds. Water rights listed for the North Umpqua River include the entire WAB with all tributaries excluding Rock and Canton creeks. Appendix 5 lists the possible uses included in each category. Table 3-19 shows uncanceled water rights that do not indicate actual water consumption.[85]

	Rock Creek and tributaries (347)		**Canton Creek and tributaries (293)**		**North Umpqua and tributaries[86] (71173)**	
Use	**Cubic feet/sec**	**% Total**	**Cubic feet/sec**	**% Total**	**Cubic feet/sec**	**% Total**
Domestic	0.15	0.2%	0.00	-	1.8	0.1%
Irrigation	0.51	0.8%	0.00	-	5.1	0.2%
Commercial	0.00	-	0.00	-	2.3	0.1%
Recreation	<0.01	0.0%	0.00	-	<0.1	<0.1%
Power	0.00	-	0.00	-	0.3	<0.1%
Fish	23.01	35.8%	0.00	-	32.0	1.3%
Livestock	0.00	-	0.00	-	<0.1	<0.1%
Municipal	0.00	-	0.00	-	2.0	0.1%
Instream	40.00	62.1%	30.00	93.4%	2,475	98.0%
Forest Mgmt	0.69	1.1%	0.17	0.5%	0.0	-
Storage	0.00	-	1.97	6.1%	0.0	-
Total	**64.36**	**100%**	**32.14**	**100%**	**2,518.77**	**100%**

Table 3-19: Water rights by use for each WAB within the Rock Creek Region.

“Instream” is the largest use of water in all three watersheds. The only other uses in Canton Creek are “Storage” with 6.1 percent and a minor amount for “Forest Management”. “Fish” is the second largest water use for Rock Creek and the North Umpqua River. “Fish” use of water is for the Rock Creek Hatchery that draws water from Rock Creek in the winter and from the North Umpqua River in the summer. Although this is a consumptive use due to the water diversion to the hatchery, the water is also fed back into the stream to be used again. “Irrigation” is the next largest use in the North Umpqua River. “Municipal,” “Commercial,” and “Domestic” represent less than one percent of the use in the North Umpqua River. There is also some small use for “Power” in the North Umpqua River and “Domestic,” “Irrigation,” and “Forest Management” in Rock Creek.

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[84] Water rights data are available from OWRD’s Water Rights Information System database available at *www.wrd.state.or.us*.

[85] Uncanceled water rights include: 1) valid rights, which are ones that have not been intentionally canceled, and the beneficial use of the water has been continued without a lapse of five or more consecutive years in the past 15 years; and 2) rights that are subject to cancellation because of non-use. For more information about water rights, contact the Oregon Water Resources Department.

[86] Tributaries exclude Rock Creek and Canton Creek.

The low volume of consumptive water rights in the Rock Creek Region has little effect on these stream systems. The low number of residents living within the Region, and the dominance of forestry land use require little to no water from the streams. However, instream water rights play a significant role and reserve the entire remaining available water in the stream during the summer months. In fact in several months, the water supply does not meet the instream need during average flow.

3.4.3. Streamflow and flood potential

Four stream gauges operated by the US Geological Survey and the OWRD have collected data within the Rock Creek Region. The gauge on Rock Creek near the mouth (14317600) has been active from 1957 through 1973 and again from 1981 to the present. The gauge at Canton Creek near the mouth (14317530) has been active since 1981. There are two sites on the North Umpqua River. One located above Rock Creek (14317500) was active from 1925 to 1956, and the other below Steamboat Creek (14316800) started collecting in 1981 and is still active. All four gauges collected average monthly streamflow, annual average streamflow, and peak flow data.

Monthly flow

Figure 3-10 charts the monthly historical average flow for Rock Creek (for two distinct time periods), Canton Creek, and the North Umpqua River at both the Rock Creek and Steamboat Creek locations. As would be expected from climate information in Section 1.2.6, all four gauge locations have the greatest average flow during the winter months (December through February) and lowest during the summer (July through October). Rock Creek's streamflow was higher in the past (1957 to 1973) than the more recent records indicate, and generally flows more water than Canton Creek overall. The North Umpqua River had higher flows at the Steamboat Creek site in more recent years than the earlier (1925 to 1944) years above Rock Creek. However, at both sites the river's flow has dropped below 1000 cfs during the summer months. In August, average monthly streamflow for Canton Creek is 14 cfs and 29 cfs for Rock Creek.

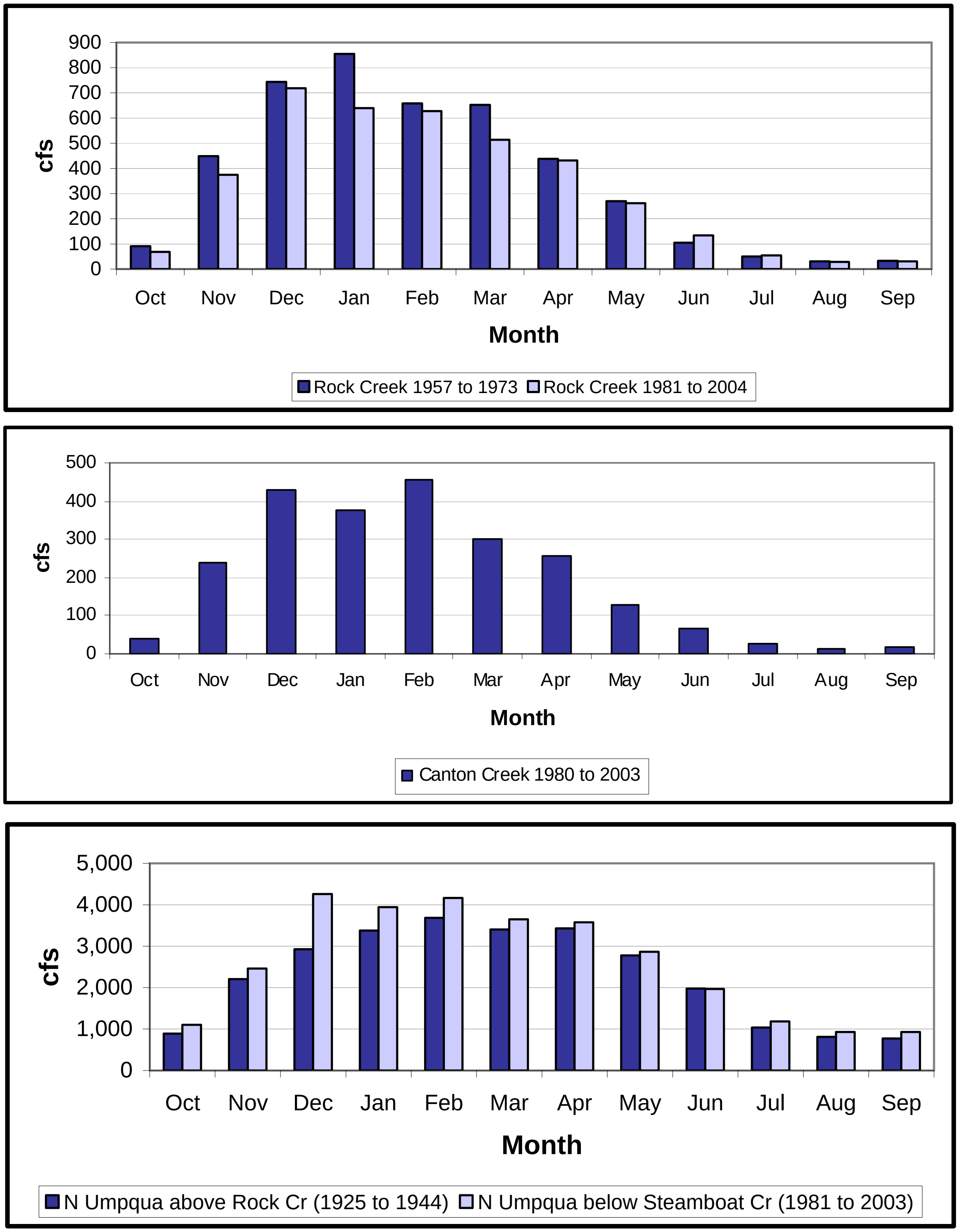

Figure 3-10: Average monthly streamflow for all four gauging stations within the Rock Creek Region.

Annual average streamflow and peak flow

Figure 3-11 and Figure 3-12 show peak flow and annual average streamflow data for Rock Creek beginning in water year 1957 with a break between 1974 and 1980.[87] Annual average streamflow and peak flow levels vary from year to year. Although in general, peak flow trends follow overall annual average streamflow trends, there are exceptions; 1997 had the second highest annual average streamflow recorded to date for the mouth of Rock Creek (499 cfs), but the peak flow was only slightly above average.

There is a distinct difference in the variability of peak flows between the two time periods recorded for Rock Creek in Figure 3-11. The peak flow in 1965 was 22,800 cfs. This storm event created flow levels so far above any other event that the scale of the graph makes the recent peak flow data appear to have low variability. Seven of the peak flows recorded in Rock Creek between 1957 and 1973 are greater than the highest peak flow (7,220 cfs in 1986) recorded since 1981. This difference is not present in annual average streamflow where the second highest level recorded was in 1997 at 499 cfs (Figure 3-12).

Annual peak flows since 1987 in Canton Creek also have low variability (Figure 3-13). The highest peak flow in Canton Creek occurred in 1986 with 8,000 cfs, but the annual average flow was only slightly above average (Figure 3-14). Peak and average flows in 1982 and 1996 were some of the highest recorded. There are strong similarities in peak and average flows between Canton Creek and Rock Creek. Both experienced their highest peak flows in 1982 and 1986. Similarly, some of their highest annual average flows were in 1982 to 1984, and 1996. Rock Creek also had high peak and average annual flows in 1997, but Canton Creek had no data for 1997.

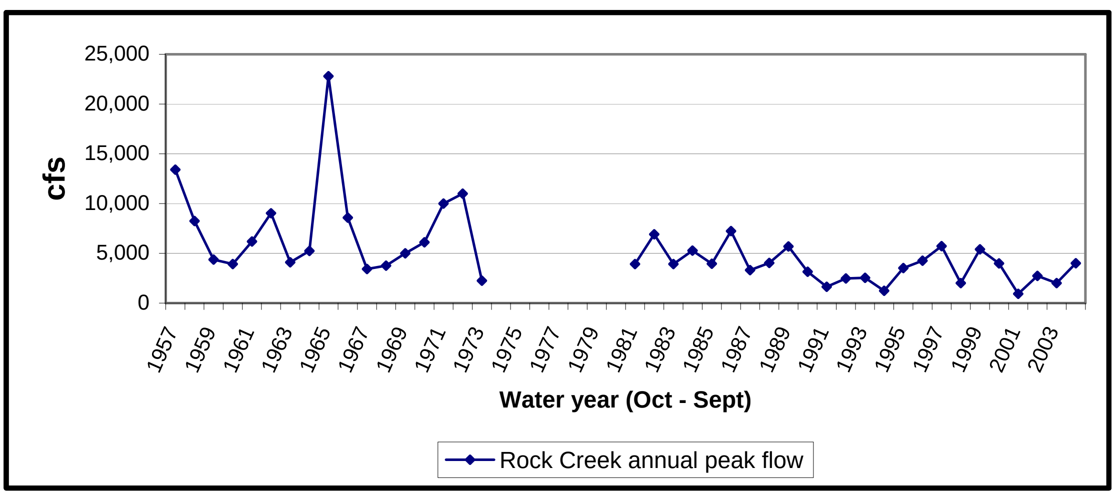

Figure 3-11: Annual peak flows near the mouth of Rock Creek for two different time periods (gauge 14317600).

[87] Data are shown by water year. Water years begin October 1 and end September 30. Therefore, a flood event in December, 2001 will be recorded in the 2002 water year.

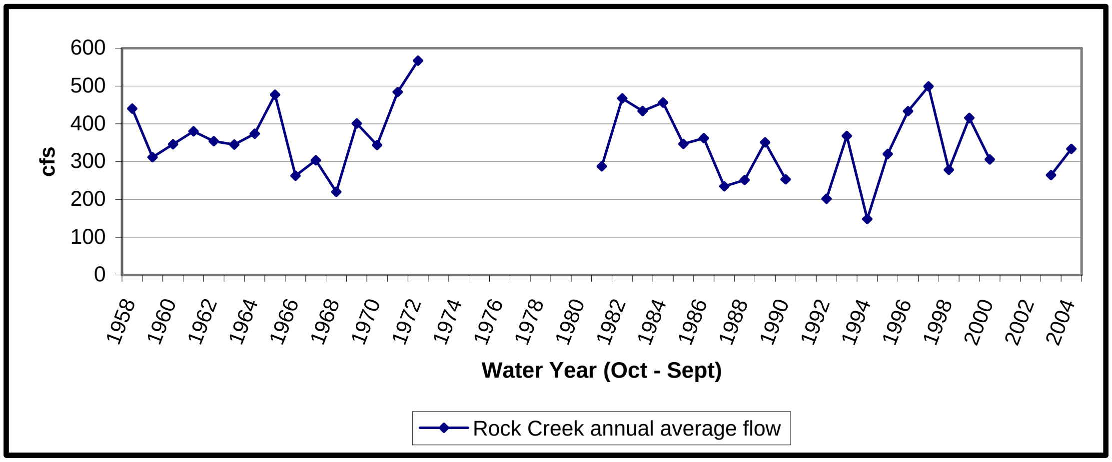

Figure 3-12: Annual average flows near the mouth of Rock Creek (gauge 14317600).

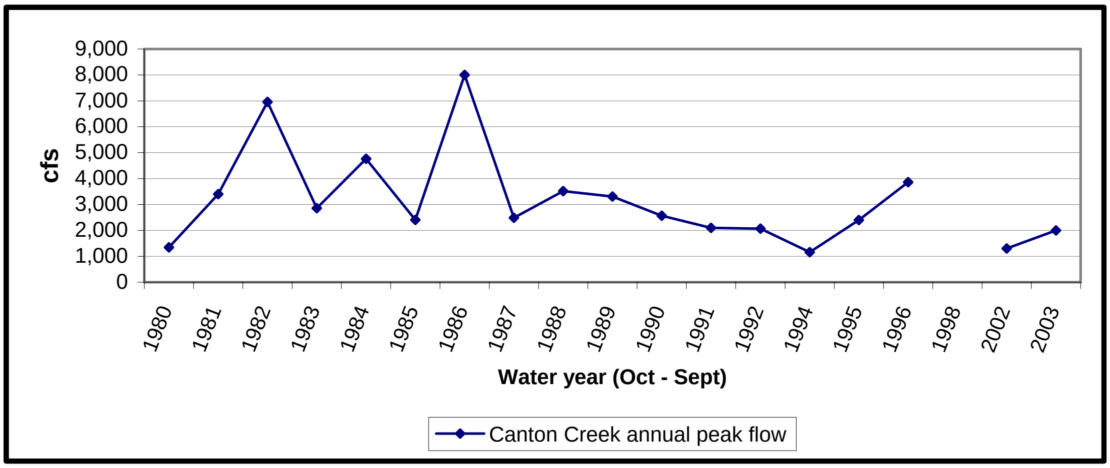

Figure 3-13: Annual peak flows near the mouth of Canton Creek (gauge 14317530).

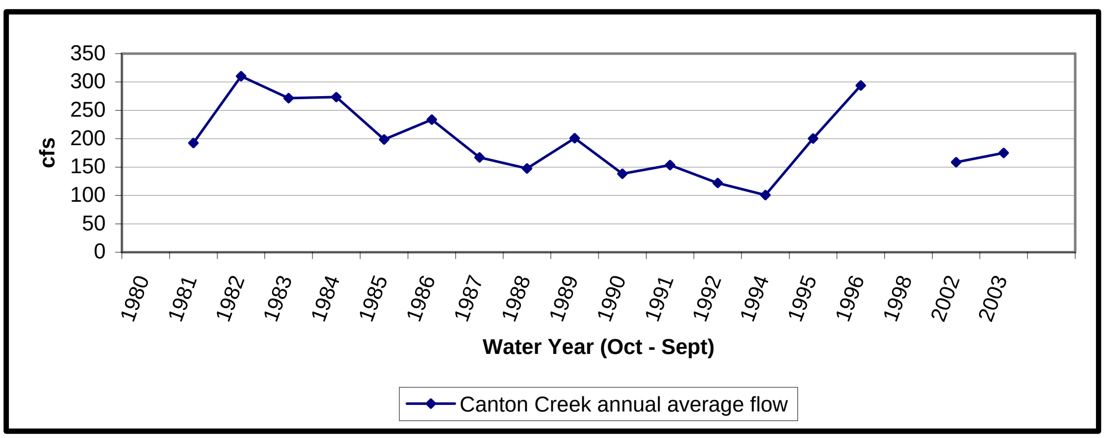

Figure 3-14: Annual average flows near the mouth of Canton Creek (gauge 14317530).

Figure 3-15 and Figure 3-16 show peak and average flow data for the North Umpqua River from two different sites. The site located above Rock Creek measured data from 1925 to 1945 with two additional collections of peak flow in 1955 and 1956. The second site is located just below Steamboat Creek and shows data from 1981 to 2003. High peak flows at the site below Steamboat Creek also occurred in 1982 (41,400 cfs) and 1986 (42,700 cfs). Peak flows above Rock Creek were greater in 1927 (53,000 cfs) and 1943 (52,100 cfs). This site is approximately 17 river miles below the Steamboat Creek site on the North Umpqua River and thus would probably accumulate more water for a given storm. Although average annual flows were also high in these same years, the highest recorded was in 1997 (4,137 cfs).

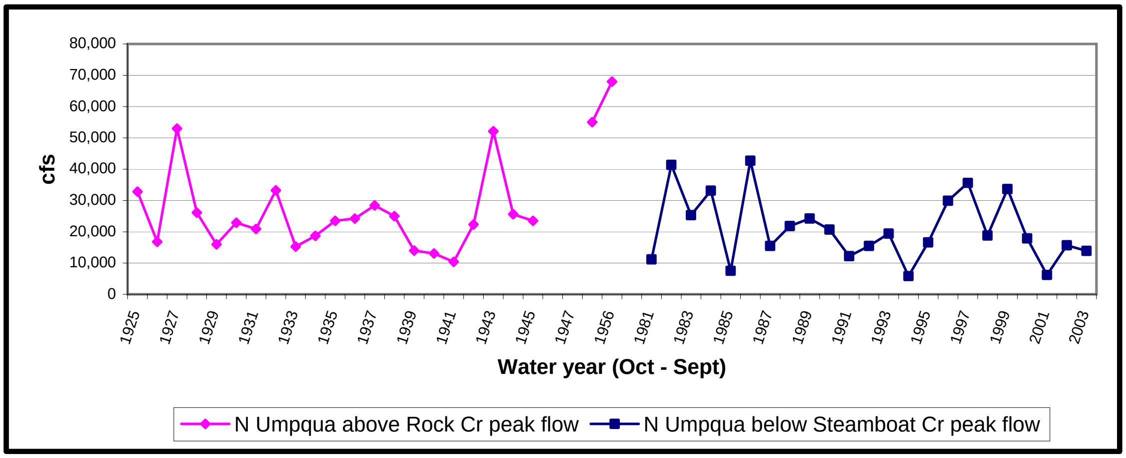

Figure 3-15: Annual peak flows for the North Umpqua River at two locations collected at two different times; above Rock Creek (gauge 14317500) and below Steamboat Creek (gauge 14316800).

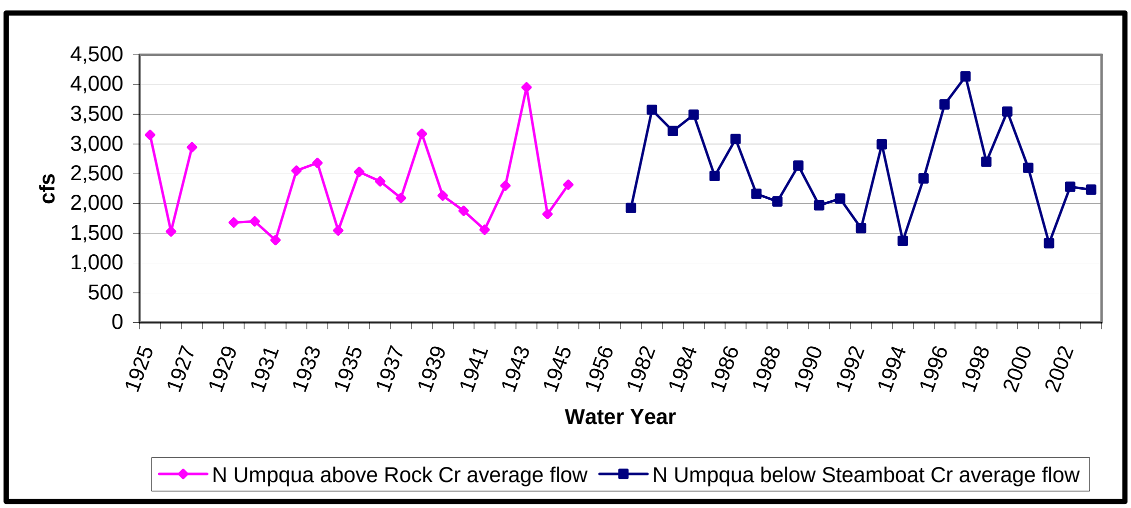

Figure 3-16: Annual average flows for the North Umpqua River at two locations above Rock Creek (gauge 14317500) and below Steamboat Creek (gauge 14316800).

Influences on flood potential

Rain-on-snow events

Approximately 74 percent of the Rock Creek Region is within the transient snow zone (TSZ) (see Section 1.2.3). In the TSZ, snow can accumulate in areas with open canopies such as meadows, burned areas, and timber harvest units. When warmer rain falls on the accumulated snow, the snow quickly melts and can result in high runoff levels and peak streamflows. Streams with headwaters in the TSZ zone, such as Northeast Fork Rock Creek and Grizzly Creek, are more susceptible to rain-on-snow events than lower elevation streams.

A large storm in 1964 brought high rainfall on deep accumulated snow. Although precipitation for the year was not exceptional (see Section 1.2.6), the warmer storm event caused rapid melting of snow. This created massive flooding in the Region and throughout many areas of the Umpqua Basin. In Rock Creek, the stream scoured out bedload and riparian areas, removing coarse wood and vegetation from the system dramatically altering many of the channels. According to one resident who lived near and regularly fished Rock Creek and Kelly Creek, the fish catch was dramatically reduced after that event. He no longer fished within the Rock Creek Watershed due to the loss of habitat and consequent loss of fish (see Section 5.1.2).

According to the OWRD flood analysis reports, the December, 1964, peak flow event of 22,800 cfs that occurred in Rock Creek was a 100-year flood event.[88] Since this event occurred in December, it is reflected for water year 1965 in Figure 3-11. The next highest peak flows are predicted ten year flood events. These are listed below:

- Canton Creek, 8,000 cfs in February, 1986 (water year 1986)
- Rock Creek, 13,400 cfs in December, 1956 (water year 1957)
- North Umpqua River, 68,000 cfs in December, 1955 (water year 1956)

Road density

Road density can also influence peak flows. Paved roads are impermeable to water, and rock or dirt roads are compacted, nearly impermeable surfaces that typically do not allow much water percolation. When it rains or snow accumulated on road surfaces melts, water that is not absorbed will flow off the road. Roads also block groundwater moving downslope causing it to accumulate in ditches and culverts placed along the road. Some of this runoff eventually finds its way into nearby streams. Road construction or reconstruction that provides frequent cross drain culverts or other drainage features (such as waterbars or dips) allows water to disperse into vegetated areas. This allows for more ground infiltration, rather than concentrated flow directly into adjacent streams that may increase peak flows. The relationship between roads, streams, and peak flows is dependent on many factors, and the influence of roads on streamflow and peak events is debatable.

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[88] A 100-year flood event means that on average, this level of flow has a one percent (1 in 100) chance of occurrence in a given year. Ten-year flood events have a ten percent chance of occurrence in a given year.

Table 3-20 shows the miles of road per square mile for surfaced and unsurfaced roads. Rock Creek has the highest road density with 5.1 road miles per square mile. The Middle North Umpqua has the lowest with 3.8 road miles per square mile.

	Road miles / square mile		
Road type	**Rock Creek**	**Canton Creek**	**Middle North Umpqua**
Paved	0.3	0.4	0.2
Gravel	4.3	3.3	3.4
Dirt	0.4	0.6	0.1
Closed	0.2	0.1	<0.1
Total*	5.1	4.3	3.8

* Totals do not necessarily equal the sum of densities due to rounding.

Table 3-20: Miles of road per square mile for surfaced, unsurfaced, and closed roads in the Rock Creek Region.

<u>The North Umpqua Hydroelectric Project</u>
There are eight dams on the North Umpqua River and two major tributaries that are part of the North Umpqua Hydroelectric Project. The dams were built between 1947 and 1956, and are above the Rock Creek Region. PacifiCorp was recently granted a renewal of their license to operate the facility with several new stipulations. Included in these was an increase in the minimum flows and decrease in the level of flow fluctuation.

During the summer months, all of the North Umpqua River's flow passes through PacifiCorp's Soda Springs Powerhouse. The Powerhouse is located below the Soda Springs Dam, which is about 60 miles east of Roseburg near Toketee in the Umpqua National Forest. The powerhouse stabilizes flows providing a minimum of 275 cfs through the bypass reach in the summer and winter. The resulting flows are estimated at 31 percent and 27 percent, respectively, of the average undiverted baseflows. This level of flow is expected to provide 94 to 99 percent of the maximum useable area for rearing juvenile steelhead, coho salmon, and chinook salmon; and 84 to 96 percent for spawning of these same species (US Dept. of Commer., 2002).

Hydroelectric projects often cause fluctuations in river flow resulting for purposes of generating electricity. Under the latest guidelines, PacifiCorp will not produce any flow fluctuations from the Soda Springs Powerhouse when the flow in the North Umpqua River is below 1,600 cfs. When flows are greater than 1,600 cfs, fluctuations in the North Umpqua River Wild and Scenic River reach will be limited to 0.1 ft/hr and 6.0 inches/day (US Dept. of Commer., 2002).

<u>Riparian function</u>
Riparian areas can reduce stream velocity during peak flow events by adding roughness to streambanks and to flow that exceeds the banks extending into floodplain riparian areas during floods. Vegetation and down wood in riparian areas can slow water movement and trap sediment during these events. Improving riparian function along

Harrington, Pass, and Miller creeks may help reduce the effects of peak flows to these channels (see Appendix 7).

3.4.4. Water quantity key findings and action recommendations

Water availability and Water rights by use key findings

- In all three Rock Creek Region WABs, instream water rights are close to or exceed average streamflow during one or more months of the year.
- During the summer, there is no "natural" streamflow available for new water rights.
- "Instream," a nonconsumptive use, is the largest water right within each of the WABs in the Region. "Fish" is the second largest water use for the Rock Creek and North Umpqua River WABs to supply water to the Rock Creek Fish Hatchery. Although a consumptive use, this water is channeled back into the streams for additional use.

Streamflow and flood potential key findings

- In August, average monthly streamflow is 14 cfs for Canton Creek and 29 cfs for Rock Creek. Within the Middle North Umpqua Watershed, the North Umpqua River's flow has dropped below 800 cfs during September and below 1,000 cfs for most of the summer months.
- No flooding trends were determined from the records to date.
- The degree to which road density and the TSZ influence flood potential in the Rock Creek Region is unknown at this time. However, the 1964 rain-on-snow event was exceptional and caused scouring of bedload and vegetation throughout the Region, most notably in the Rock Creek Watershed. The peak flow that resulted is considered a 100-year flood event.
- The North Umpqua Hydroelectric Project influences North Umpqua River flows, especially during the summer.

Water quantity action recommendations

- Reduce summer water consumption through instream water leasing and by improving irrigation efficiency.
- Educate landowners about proper irrigation methods and the benefits of improved irrigation efficiency.
- Continue monitoring peak flow trends in the watershed. Try to determine the role of vegetative cover, flooding, road density, and the TSZ on water volume.

3.5. Fish populations

3.5.1. Fish presence

Table 3-21 lists the native fish species in the Rock Creek Region that have viable, reproducing populations or annual runs. Anadromous species include winter and summer steelhead, coho salmon, spring chinook salmon, cutthroat trout and Pacific lamprey. The rest are resident species that include some resident steelhead (rainbow trout) and cutthroat trout. Brown trout (*Salmo trutta)* and brook trout (*Salvelinus fontinalis)* are non-native salmonids that have been observed in the North Umpqua River. These species emigrated from lakes where they were stocked for recreation and established stream-dwelling populations (US Forest Service, 2001). They have not been found in the Rock Creek or Canton Creek watersheds.

Common Name	***Scientific Name***
Steelhead (summer and winter)	*Oncorhynchus mykiss*
Coho salmon	*O. kisutch*
Chinook salmon (spring)	*O. tshawytscha*
Cutthroat trout	*O. clarkii clarkii*
Western brook lamprey	*Lampetra richardsoni.*
Pacific lamprey	*Lampetra tridentata*
Sculpin	*Cottus sp.*
Umpqua dace	*Rhinicthys evermanni*
Speckled dace	*Rhinicthys osculus*
Long-nose dace	*Rhinichthys cataractae*
Redside shiner	*Richardsonius balteatus*
Umpqua pikeminnow	*Ptychocheilus oregonensis*
Largescale sucker	*Catostomus macrocheilus*

Table 3-21: Fish with established populations or runs within the Rock Creek Region.

The Oregon Coast coho salmon was listed as a threatened species in 1998 under the Endangered Species Act of 1973. In 2001, a federal district court set aside the listing, finding that hatchery stocks determined to be a part of the Oregon coast coho population were improperly excluded from the listing. In response to this ruling and a listing petition, NOAA Fisheries Service initiated a new review of Oregon coast coho. In June, 2004, NOAA Fisheries Service put out a listing update for the entire West Coast that included a proposed "threatened" finding for the Oregon coast coho. In June, 2005, the agency extended the time by six months for the final listing determination on the Oregon coast coho. This was due to "substantial disagreement regarding the sufficiency or accuracy of available data." In January, 2006, NOAA Fisheries Service announced its final determination that the listing for the Oregon coast coho salmon is not warranted.

Currently, there are no other threatened or endangered aquatic species in the Rock Creek Region. In January, 2003, various groups petitioned to protect the Pacific lamprey and western brook lamprey, as well as two other lamprey species, under the Endangered Species Act. In December, 2004, the USFWS declined to list these species stating that "the petition does not contain sufficient information to warrant further review at this time."

3.5.2. Winchester Dam fish counts

Winchester Dam on the North Umpqua River is located approximately seven miles upstream from the confluence of the North Umpqua River and the South Umpqua River. Since 1946, the Oregon Department of Fish and Wildlife (ODFW) has recorded the number of cutthroat, coho, spring chinook, fall chinook, winter steelhead, and summer steelhead crossing through the dam's fish passage corridor. Since 1965, the ODFW has also kept records of three non-game fish species: Pacific lamprey, northern pikeminnow, and largescale sucker. Many of the anadromous fish passing through the dam will eventually spawn or reside in the lower North Umpqua River (below the Rock Creek Region), or further upstream than the Rock Creek Region. Therefore, Winchester Dam data cannot be used to estimate fish abundance within the Region. However, fish passage information can be used to approximate returns of hatchery and wild fish, and historical fish population fluctuations for the Region.

Hatchery and wild trends

The Rock Creek Hatchery is located along the lower portion of Rock Creek, approximately one quarter mile up from the North Umpqua River. The hatchery currently produces spring chinook, summer steelhead, and coho salmon smolts that are released into the North Umpqua River. Numerous studies have documented differences in survival and habitat use of hatchery fish compared to wild fish populations. In addition, some of these studies have shown adverse effects of hatchery fish on wild populations. However, the relationships are complex and difficult to determine as they vary greatly by different fish populations and different hatchery practices.

In 2000, Flagg *et al*. conducted a review and analysis of issues regarding the impacts of salmonid hatchery practices in the Pacific Northwest on the abundance and trends of wild salmonid populations. In their analysis, they reviewed current and historical studies on hatchery fish to summarize the differences between hatchery and wild populations, as well as the effects hatchery fish may have on wild populations. The discussion that follows is based on that study.

Biological comparison

A summary of the differences found between wild and hatchery reared salmonids in the 2000 study is listed in Table 3-22. Hatchery rearing generally increases egg-to-smolt survival. However, the survival after release of hatchery fish is often considerably lower than that of wild-reared fish. A primary cause of this poor survival after release is due to starvation. Hatchery fish tend to be less efficient food gatherers. They continue to feed at the water surface on mostly terrestrial and winged insects while wild fish consume a greater diversity of food. After extended periods in the estuary, hatchery fish begin to adapt to available high quality food sources.

Hatchery fish were found to prefer using habitat higher in the water column that typically requires more energy output than the lower areas occupied by wild stocks. However, when densities are high, and competition for habitat is high, hatchery fish are more aggressive and displace wild fish more readily. This often leads them to better feeding positions that require less energy output. This is not the case however, under low density situations where wild fish were found to respond aggressively.

Category	Wild	Hatchery
Survival		
egg-smolt survival	lower	higher
smolt-adult survival	higher	lower
Behavior*		
foraging ability	efficient	inefficient
aggression	lower	higher
social density	lower	higher
territorial fidelity	higher	lower
migratory behavior	disperse	congregate
habitat preference	bottom	surface
predator response	flee	approach
Morphology		
juvenile shape	more variable	less variable
nuptial coloration	brighter	duller
kype size	larger	smaller
Reproductive potential		
egg size	smaller	larger
egg number	lower	higher
breeding success	higher	lower

* Behavior deficits of hatchery fish tend to remediate over time as hatchery fish acclimate to the post-release environment.

Table 3-22: Relative differences between wild and hatchery reared salmonids from Flagg *et al.*, 2000.

Hatchery fish have been found more vulnerable to prey for several reasons; increased tendency to feed at the surface, increased risk-taking behavior, and lowered fright responses relative to wild populations. Many hatchery fish also develop with less camouflage when reared in monochrome cement surroundings.

Potential effects on wild populations

One potential impact of hatchery fish on wild fish includes causing genetic changes in wild stocks that influence the above mentioned biological differences. This is more likely with large numbers of hatchery fish produced relative to wild populations that exist in an area. Competition for habitat and food, predation of hatchery fish on wild fish, increased predator populations, and increased infectious disease problems are also potential concerns that may adversely impact wild salmonid populations. The review of this information in 2000 found increases in predator populations occurred in several studies as predators such as Northern pikeminnow learned that hatchery salmonids were easy prey. The predator diets largely changed to mostly hatchery fish.

Management practices associated with fish hatcheries such as the Rock Creek Hatchery have evolved with time in an attempt to minimize the adverse effects on wild salmonid populations. The Oregon Fish and Wildlife Commission recently adopted several policies to help guide the management of wild and hatchery fish in Oregon. These policies describe the brood collection, rearing, release, and health management strategies currently used at the Rock Creek Hatchery.

The Rock Creek Hatchery Operations Plan outlines several measures taken to reduce the effects of hatchery fish on wild populations:[89]

- Fish are reared to sufficient size that smoltification occurs within nearly the entire population.[90] Smolts released into the stream environment spend less time in the stream as they migrate downstream toward salt water. This reduces the time they may influence wild stocks.
- Fish are reared for several weeks in water where they will return for spawning. This causes strong homing to the hatchery; thus reducing the stray rate to into wild populations.
- Various release strategies are used to ensure that fish migrate from the hatchery with the least amount of interaction with native populations.
- Several broodstock selection and spawning criteria are used to maintain genetic resources of native fish populations within the hatchery raised fish. These criteria vary by species. For coho and spring chinook salmon, 30 percent of the adult fish collected to use for spawning are wild fish. (Up to 100 percent wild spring chinook have been used.) For summer steelhead, collection has been 100 percent wild fish collected since 1987. All fish are bred at a 1:1 male to female ratio.
- Numerous strategies are employed to restrict the introduction, amplification, or dissemination of disease agents in hatchery produced fish and in natural environments.

Hatcheries have continued to modify their management to minimize effects on wild populations. The total release of hatchery fish from the Rock Creek Hatchery has been substantially reduced in recent years to help protect wild fish stocks.

ODFW is analyzing the feasibility of installing a fish trapping and sorting facility at the Rock Creek Hatchery diversion dam to monitor adult fish escapement and reduce the potential for interbreeding and competition between hatchery and wild fish in the Rock Creek drainage.

Hatchery production compared to wild populations

Stocking of hatchery reared winter steelhead has occurred only a few times. In 1986, ODFW established a policy to manage for wild winter steelhead only in the North Umpqua River sub-basin. Both wild and hatchery adults have been recorded at Winchester Dam for spring chinook, coho, summer steelhead, and winter steelhead. Most of the winter steelhead hatchery fish recorded at the dam were actually summer steelhead crossing the dam during winter months (OR Dept. of Fish & Wildlife, 1986).

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[89] Refer to the Rock Creek Hatchery Operations Plan, 2004 for details of these strategies.
[90] Smoltification is the process that juvenile salmon undergo that causes a series of physiological and behavioral changes that prepare them to move from freshwater to saltwater. Upon completion of these changes, the fish are referred to as smolts.

Since hatchery coho were first recorded passing through Winchester Dam, the number of hatchery fish has exceeded wild fish in 22 of 31 years (71 percent). Since 1982, hatchery fish have, on average, constituted over 75 percent of the total coho run. There were three nonconsecutive years for which hatchery spring chinook exceeded wild fish: 1954, 1970, and 1972. In 1999 through 2004, hatchery fish averaged 67 percent of the spring chinook run. Summer steelhead had three periods with consecutive years when hatchery fish exceeded wild fish: 1967 to 1976, 1985 to 1990, and 1996 to 2003. Hatchery fish averaged 64 percent of the runs during these three periods. At no point have hatchery winter steelhead runs exceeded wild runs.

Figure 3-17 through Figure 3-20 show the Winchester dam fish counts of hatchery and wild fish for coho, spring chinook, and winter and summer steelhead over time. Figure 3-17 shows that wild coho numbers were at their lowest in the 1970s during which time hatchery coho were first counted at very low levels. The population trend for wild coho has been increasing since the late 1990s. Hatchery numbers of coho rapidly increased in the 1980s and reached there highest levels in 2001 with over 17,000 fish counted.

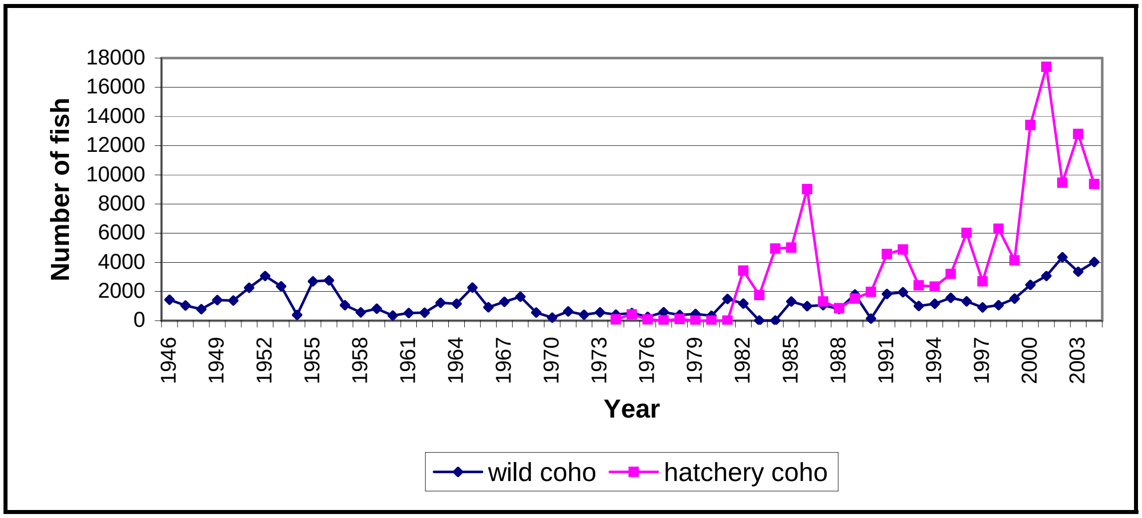

Figure 3-17: Coho fish counts of wild and hatchery fish at the Winchester Dam.

Hatchery spring chinook were first counted at the dam in 1952 (see Figure 3-18). In 1969, hatchery returns increased dramatically followed by fluctuations for many years until they peaked in 2002 with over 17,000 fish counted. Wild stocks appear somewhat less variable but had a similar trend since 1969.

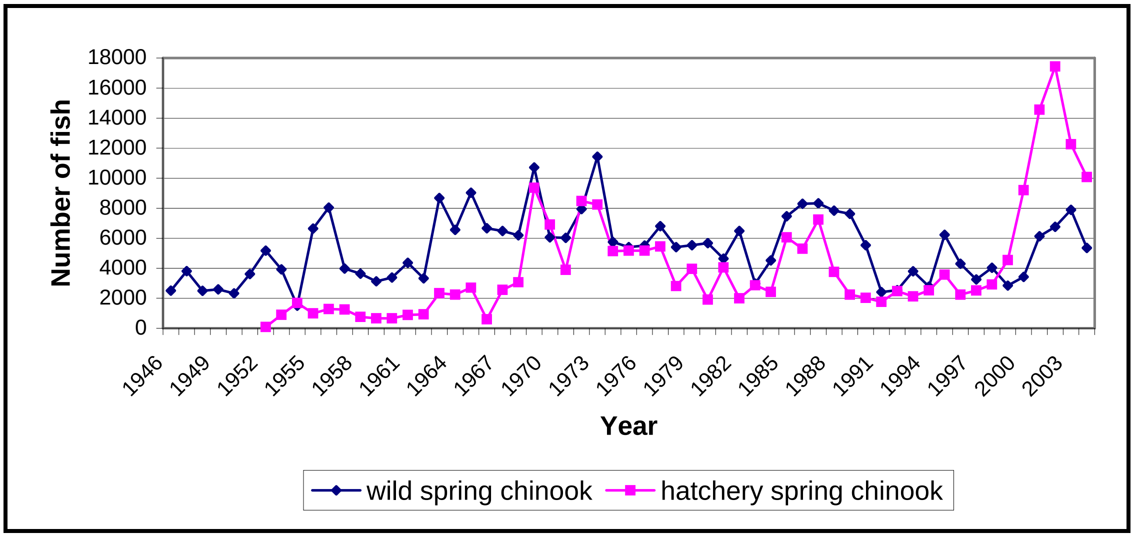

Figure 3-18: Spring chinook counts of wild and hatchery fish at the Winchester Dam.

Summer steelhead counts in Figure 3-19 show two periods where hatchery stock far exceeded wild stocks (between 1969 to 1973 and 1986 to 1990). The general trend for wild summer steelhead does not appear to be increasing or decreasing. The wild winter steelhead trend shown in Figure 3-20 appears stable, although the 1990s was a period of low returns. The earliest years of data collection from 1946 to 1957 showed the most annual variability. Numbers of hatchery winter steelhead are very low as the North Umpqua is managed for wild winter steelhead only and most of the hatchery fish are summer steelhead crossing the dam in the winter.

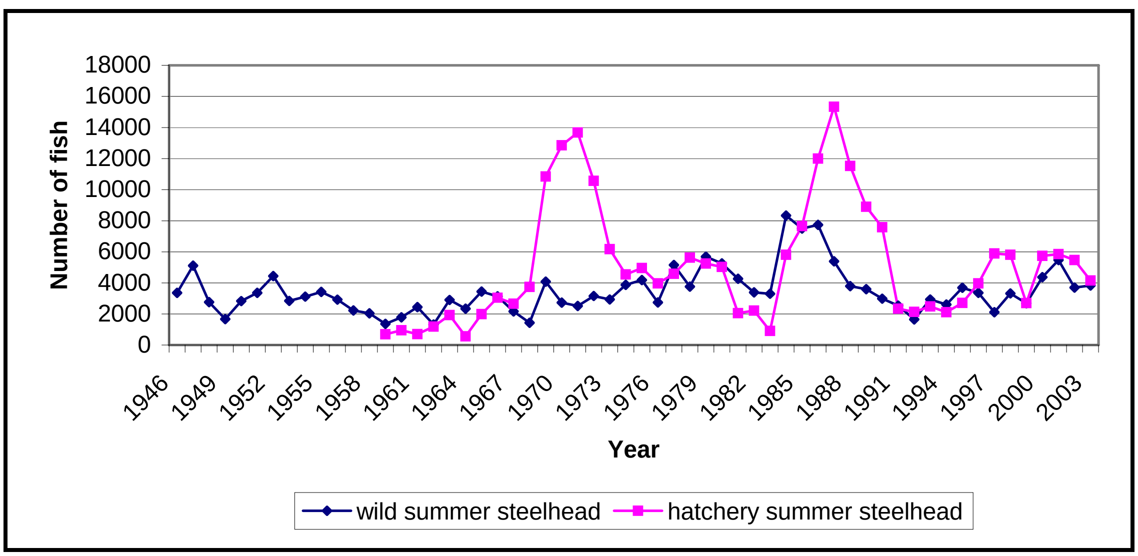

Figure 3-19: Summer steelhead counts of wild and hatchery fish at the Winchester Dam.

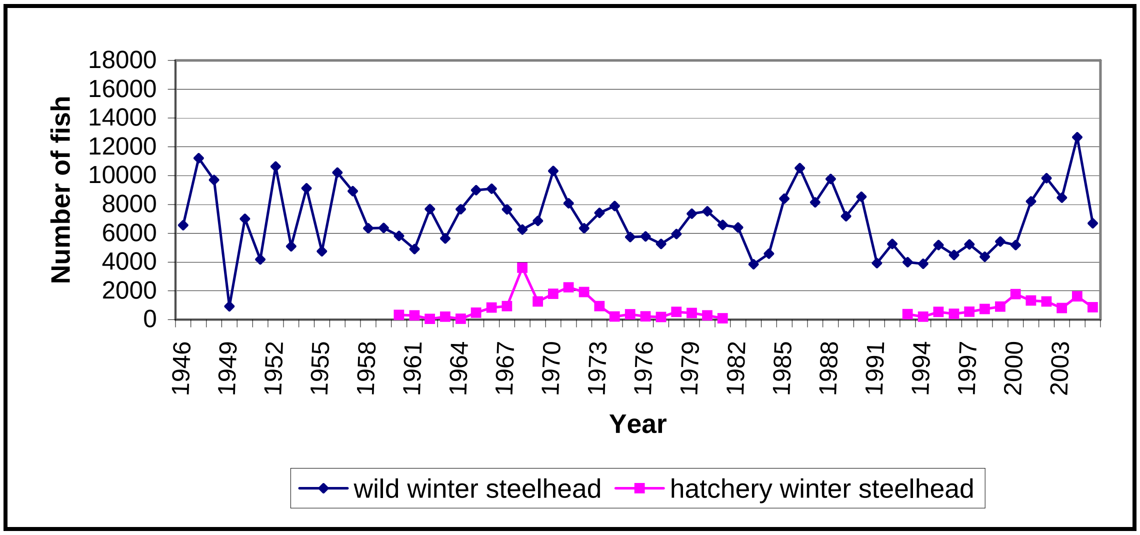

Figure 3-20: Winter steelhead counts of wild and hatchery fish at the Winchester Dam.

In June, 1994, Johnson, O.W. *et al*. published a report on "The Status Review for Oregon's Umpqua River Sea-Run Cutthroat Trout." The following discussion is based on that report. Hatchery cutthroat trout smolts were released in the North Umpqua River from 1961 to 1976 a few miles below the Winchester Dam.[91] The average annual release during this period was over 16,000 hatchery smolts, and nearly 20,000 fish were released in over half of those years (see Figure 3-21). The smolts were from Alsea River broodstock located on the north coast of Oregon; thus they were not from a local source. Although no stocking has occurred since 1976, adult cutthroat returns through 1979 at the dam could reflect hatchery fish.

The effect on native fish in the North Umpqua River is unknown. Figure 3-21 shows that adult cutthroat trout returns at the dam increased beginning in the first few years hatchery fish were released below the dam and dramatically increased as hatchery numbers increased. However, adult counts were declining steeply before hatchery planting was stopped in 1976. Although there is not quantitative data on straying rates during the years of hatchery releases near the dam, ODFW biologists believed that the straying rate was high, since many hatchery cutthroat trout (identified by fin clips) were found throughout the North and South Umpqua rivers and in tributaries of the mainstem river. This would indicate that hatchery stock with high stray rates released below the dam, probably increased numbers at the dam from fish straying upriver. In addition, the 1994 study by Johnson *et al*. found that the timing of migration upriver observed at the dam shifted to later dates during the hatchery release years. Later migration dates also coincided with hatchery fish migration times. These migration dates returned to earlier periods after hatchery fish were no longer stocked.

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[91] Hatchery cutthroat were also released in the Smith River (from 1975 to 1993) and Scholfield Creek (from 1982 to 1993) within the Umpqua Basin.

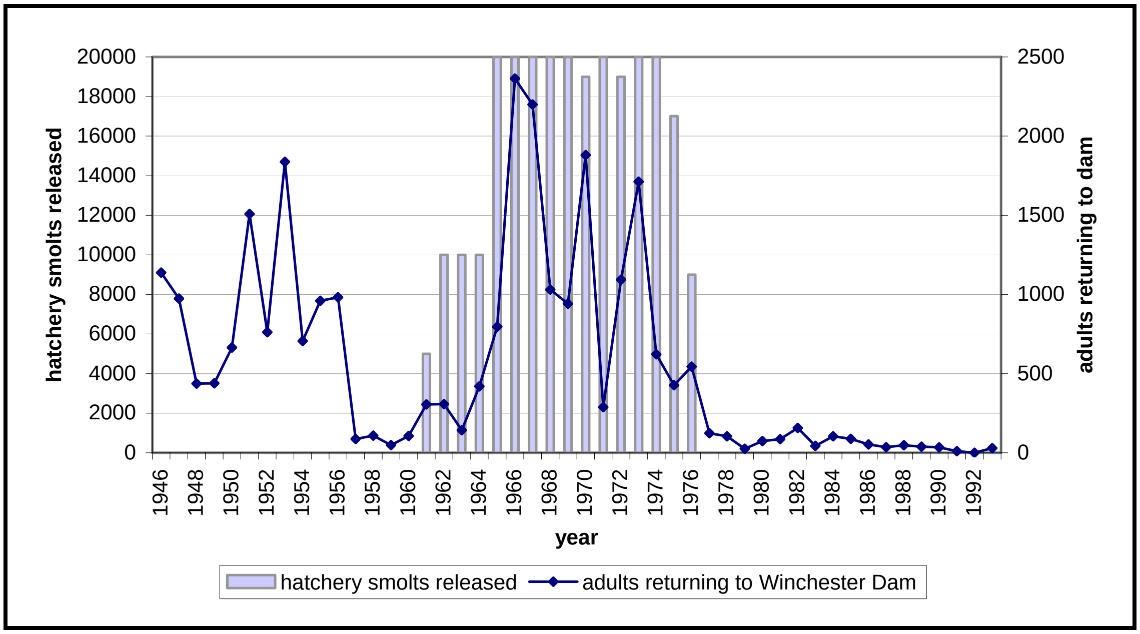


Figure 3-21: Adult cutthroat trout (wild and hatchery) returning to the Winchester Dam relative to hatchery cutthroat trout released below the dam.

Hatchery cutthroat were also released in the Smith River and Scholfield Creek located nearer the mouth of the Umpqua River. Data was not available on possible interactions of these hatchery fish competing with North Umpqua cutthroat for estuary habitat. However, based on studies in other estuaries in Oregon, the authors suggest that naturally spawned fish and Alsea River hatchery fish planted in to the Lower Umpqua River tributaries probably interacted extensively in the Umpqua River estuary.

Fish population fluctuation

Figure 3-22 shows the Winchester Dam count for all six salmonid species from 1946 through 2005.[92] The right axis provides the scale for fall chinook and cutthroat counts. Annual fluctuation is similar for all anadromous salmonids except coho. Data from species with similar trends support the theory that ocean conditions are a primary influence on annual anadromous fish runs. Coho follow similar trends until the 1970s. All other anadromous salmonid species show substantial increases in the early 1970s and smaller increases in the late 1970s. Alternatively, coho drop to very low levels in the early 1970s and remain at their lowest until the 1980s, when their numbers increase and again follow somewhat similar trends to other anadromous salmonids. This ten year period is characterized with high commercial and sport harvest, increased timber harvest and road building within the North Umpqua River sub-basin, and the beginning of a cycle of declining ocean productivity (US Forest Service, 2001). Beginning in 1981, coho levels have rebounded substantially.

[92] Data on winter steelhead and cutthroat trout were available through 2005. Coho and chinook data were through 2004 and summer steelhead data were through 2003.

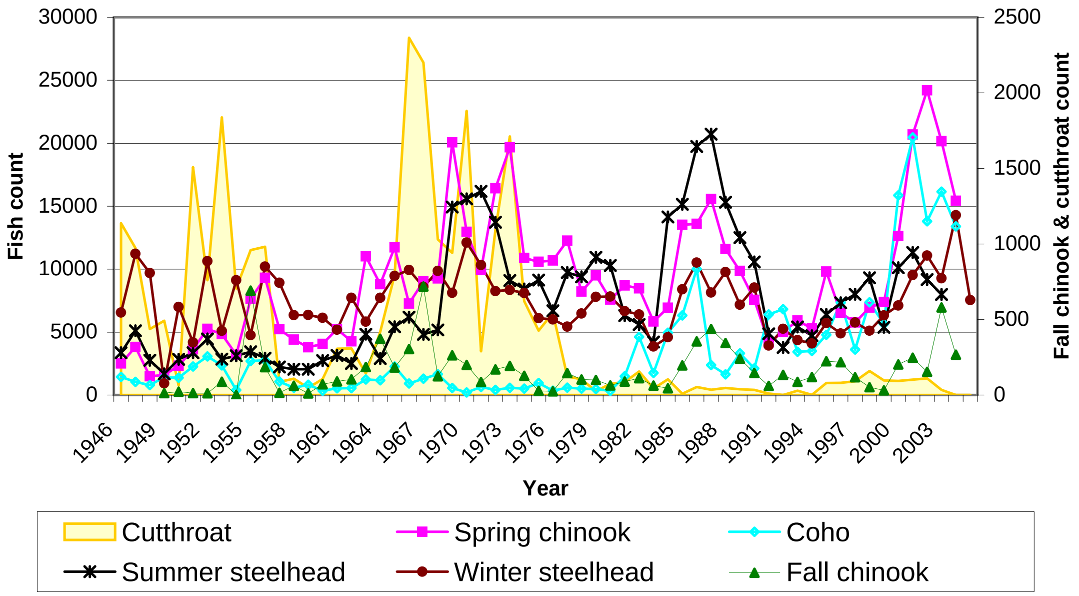


Figure 3-22: Winchester Dam fish passage trends for salmonids.

The cutthroat trout population trend is different from the other salmonids. Cutthroat can be anadromous, stream-specific residents, or migratory within a basin. Since resident, migratory, and anadromous cutthroat cannot be differentiated, Winchester Dam counts include all types. In addition, the fish counts for cutthroat trout represented in Figure 3-22 probably include native and hatchery fish. As mentioned previously, hatchery cutthroat trout were released in the North Umpqua River from 1961 to 1976 at high levels (they averaged over 16,000 fish annually). Differences between hatchery and wild fish recorded at the dam were not consistent to know what proportion of the count were wild fish or hatchery fish. It is assumed that the high levels of adults returning during this period and probably through 1979 are composed of mostly hatchery fish.

Some of the variability in cutthroat trout numbers was similar to other salmonids prior to 1961 when hatchery cutthroat trout were introduced. However, the decline of the population in the mid 1950s to the mid 1960s was much greater than for other salmonids, and the population has not recovered since the hatchery releases stopped in 1976. It is unknown why the population has not recovered. The fact that cutthroat trout can be anadromous, resident, or migrate within a river system makes the species complex, and the answers difficult to determine. The Johnson *et al*. study in 1994 discussed a number of possible influences on the declining population including:

- Stream temperatures have increased in much of the freshwater habitat. In some areas, temperatures are at the lethal limit for cutthroat in the summer.[93]

[93] Although increased stream temperatures may have played an important role in decreasing trout populations, Johnson *et al*., 1994 also found evidence that the Umpqua Basin cutthroat trout population seemed to have adaptations to higher stream temperatures than most other populations.

- Competition for habitat may be limiting their survival. Cutthroat trout are usually subordinate to other salmonids and they tend to make use of the least preferred habitat. However, adaptation to less desirable habitat can also increase their survival.
- Cutthroat trout spend less time in ocean environments with most of their time (if not all of their lives) in freshwater conditions. Thus, degradation of the freshwater environment may have a larger impact on cutthroat trout populations than on other salmonids.
- Hybridization with rainbow trout may be detrimental to both species survival. Although hybridization has not been proven in the North Umpqua River, it is not uncommon where both species overlap in habitat. Hybridization can produce fish less fit for survival in both species.
- Large amounts of non-local broodstock from the Alsea River Hatchery mixing with native populations for many years may have made fish less adapted to local conditions.

Figure 3-23 shows Winchester Dam counts for largescale sucker, northern pikeminnow, and Pacific lamprey. All three species show reduced counts since the 1970s. The anadromous Pacific lamprey shows the greatest decline. Prior to 1975, the average Pacific lamprey count was over 20,000 fish. From 1995 to 2004, the average count was 67 fish.

The decline of the Pacific lamprey since the 1970s has been attributed to predation by smallmouth bass and other warm water fish that have been introduced into the Umpqua Basin. Despite plummeting adult counts, ODFW reports that juvenile Pacific lamprey are found throughout the Umpqua Basin, including upstream of Winchester Dam. More research is needed to understand the Pacific lamprey's life cycle and population status.

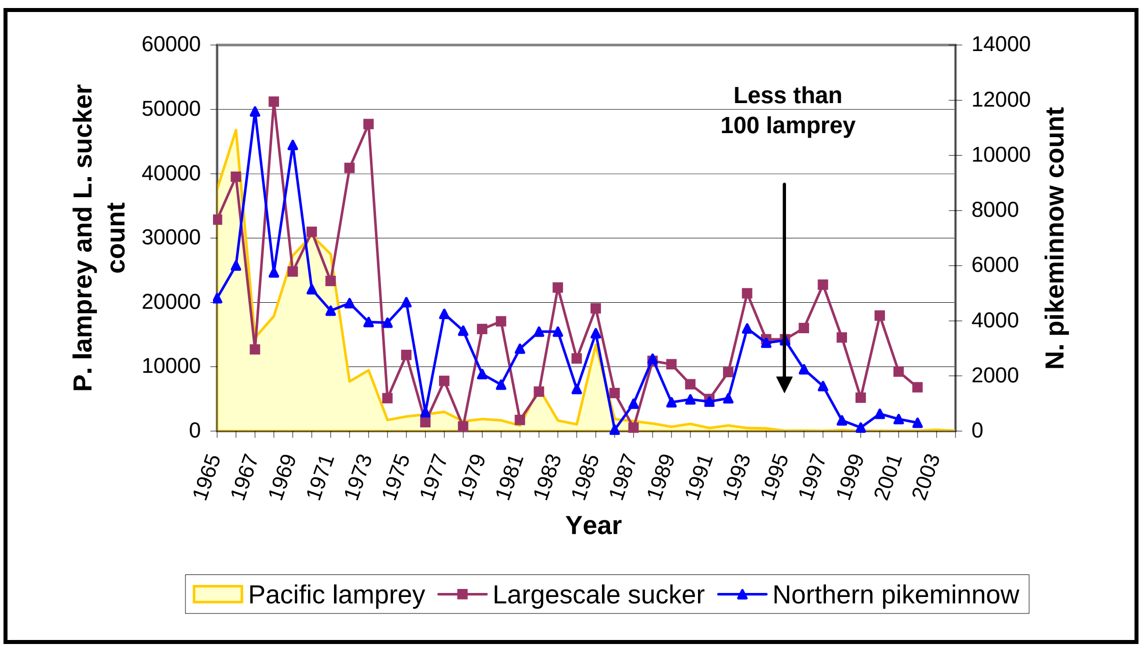


Figure 3-23: Winchester Dam counts for non-salmonid fish.

3.5.3. Fish distribution and abundance

Information on fish distribution and abundance within the Rock Creek Region is limited. Until recently, most surveys focused only on the presence or absence of salmonids in isolated sections of streams adjacent to proposed upland projects. There have been few surveys to determine coho salmon distribution within the North Umpqua River sub-basin. At the time of writing this assessment, the ODFW is in the early stages of coho surveying in the sub-basin. Some coho surveys have been done in the Rock and Middle North Umpqua watersheds. In addition, some smolt trap and snorkel count data have been collected in Rock and Canton creeks. Although non-salmonid fish species are important as well, there are insufficient accessible data on the location of these types of fish, and they could not be included in the assessment. More information about these species may be available in the future.

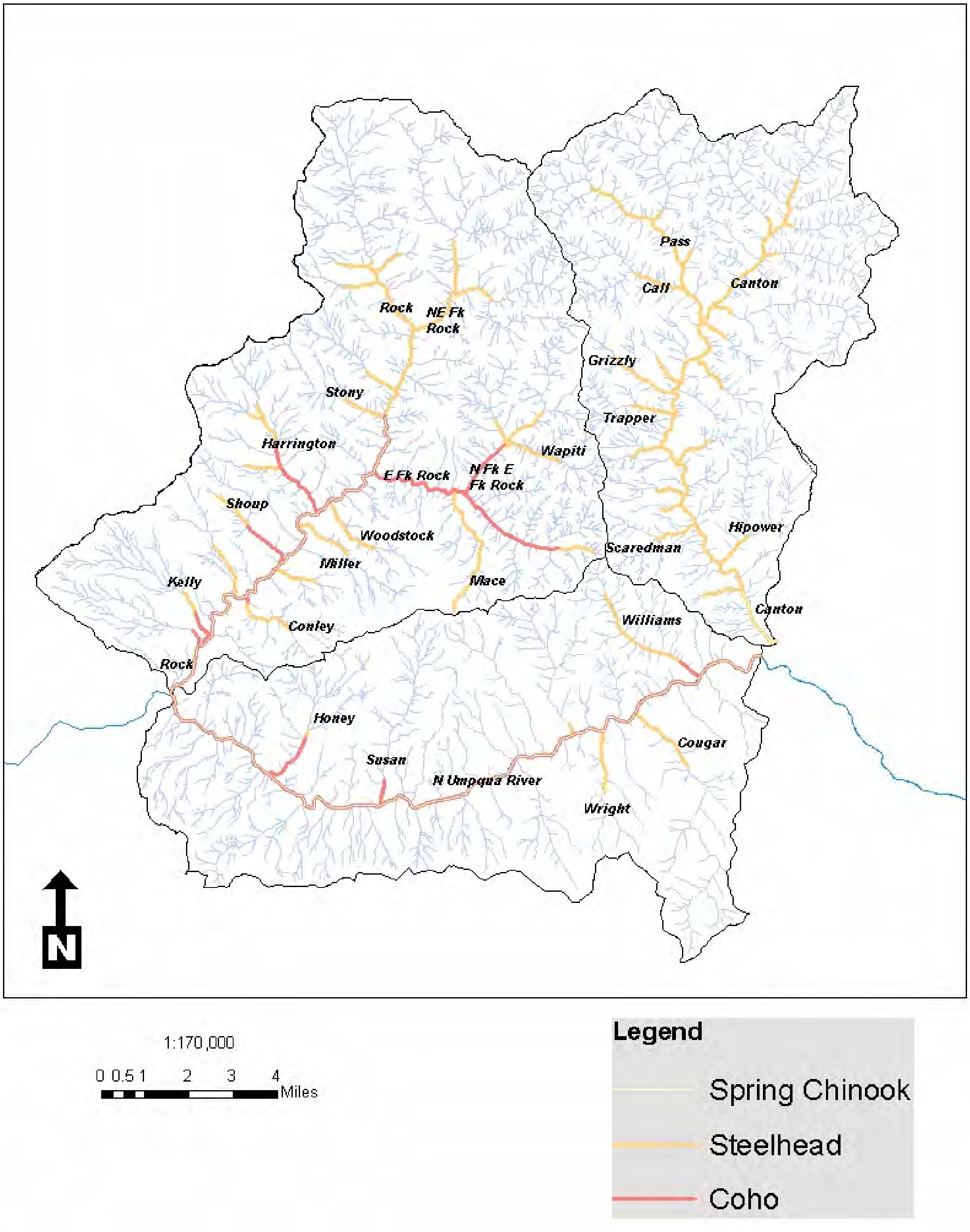
Anadromous salmonid distribution

The Oregon Department of Fish and Wildlife (ODFW) has developed anadromous salmonid distribution maps based on fish observations, assumed fish presence, and habitat conditions. Fish observations are the most accurate because ODFW personnel have seen live or dead fish in the stream. Assumed fish presence delineations are streams or reaches included in the distribution map because of their proximity to fish-bearing streams and adequate habitat. Also included on the map are streams that appear to have adequate habitat for a given salmonid, even if there have been no fish sightings and the stream is not near a fish-bearing stream. It is possible that some streams have been included in the distribution maps that do not have salmonid presence.

According to the ODFW, there are 141 stream miles within the Rock Creek Region used by anadromous salmonids. Map 3-19 shows the distribution of chinook, steelhead, and coho salmonid use within the watershed and Table 3-23 lists the miles of stream used by each salmonid species. Map 3-20 shows the potential range of cutthroat trout. The total stream miles with anadromous salmonids do not equal the sum of miles used by each species because many species overlap.

Species	**Rock Creek**	**Canton Creek**	**Middle North Umpqua**	**Total**
Spring chinook	10	2	69	81
Coho	21	0	36	57
Summer steelhead	52	34	41	127
Winter steelhead	57	36	48	141
Cutthroat trout	152	95	190	437
Total miles anadromous habitat	**57**	**36**	**48**	**141**

Table 3-23: Miles of stream supporting anadromous salmonids and resident cutthroat trout within the Rock Creek Region.



Map 3-19: Anadromous salmonid distribution within the Rock Creek Region.

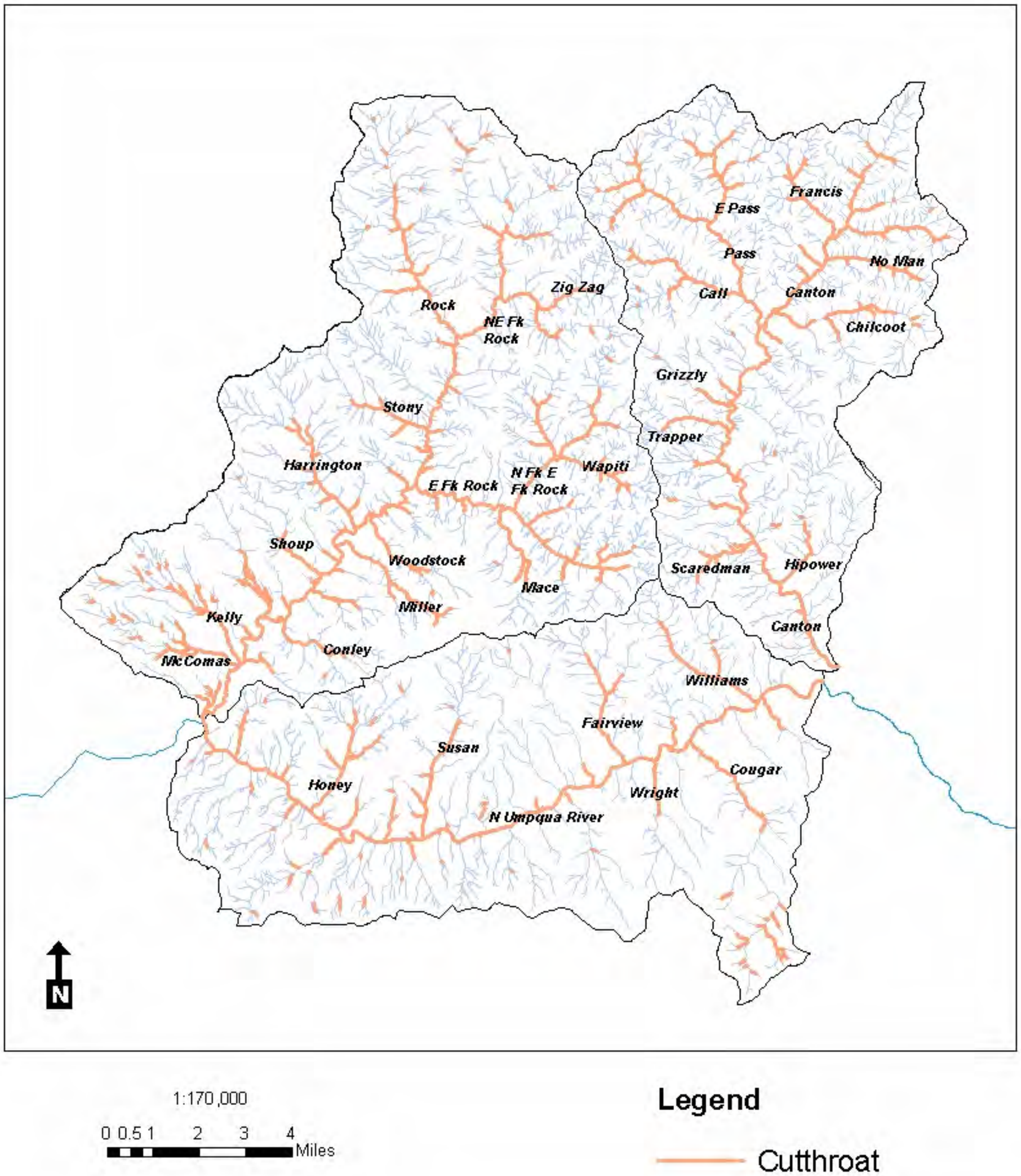
Fall chinook spawning occurs in the lower reaches of the North Umpqua River and few, if any make it into the Rock Creek Region. Spring chinook use the North Umpqua River throughout the Middle North Umpqua Watershed. Their habitat is also found in the first two miles of Canton Creek and in Rock Creek as far up as Stony Creek. Coho not only use the same habitat in the North Umpqua River and Rock Creek, but are also found in many of their tributaries. Coho have been observed in the lowest segments of Canton Creek but not in sufficient numbers to support a run. Winter and summer steelhead are the most abundant species in the Region, using many of the same stream reaches but at different times of the year. Winter steelhead tend to extend their use further up many of the smaller tributaries than summer steelhead. Their habitat is widespread throughout all three watersheds. There is no available mapped habitat for Pacific lamprey at this time.

Resident and anadromous cutthroat trout distribution

There are no comprehensive data about resident salmonid distribution in the Umpqua Basin. The only resident native salmonids in the Rock Creek Region are cutthroat trout and rainbow trout. Relatively small numbers of rainbow trout exist throughout the North Umpqua River. Cutthroat trout can be anadromous or resident fish. They use streams with sustained gradients of up to 15 percent, while other anadromous salmonids prefer streams up to four percent. However, steelhead are sometimes found in streams with gradients up to five or six percent. There is significant overlap of use between cutthroat trout and other anadromous species in the lower gradient sections. However, cutthroat trout are also present in numerous areas beyond the range of even winter steelhead.

Map 3-20 shows the distribution for cutthroat trout (both resident and anadromous) based on fish observations by ODFW personnel and potential habitat based on streams with less than 18 percent sustained gradient. In order to ensure cutthroat trout habitat is not overlooked, ODFW biologists recommend using a more conservative stream gradient of 18 percent (rather than 15 percent) to evaluate possible trout locations. Since cutthroat trout are both resident and anadromous, there are isolated pockets of habitat not connected to anadromous habitat.

Streams such as the upper reaches of Rock Creek, and upper tributaries of Canton Creek may provide suitable habitat for cutthroat trout, where winter steelhead use is absent. However, there are many factors other than stream gradient that determine fish habitat suitability.



Map 3-20: Potential cutthroat trout habitat in the Rock Creek Region.

Salmonid abundance

Fish abundance is difficult to assess within the Region particularly in the Middle North Umpqua Watershed. Information presented here focuses on smolt trap data from Rock Creek and Canton Creek, coho spawning surveys and seeding levels on several tributaries in the Middle North Umpqua and Rock Creek watersheds, and snorkel counts for steelhead and cutthroat in Canton Creek. Watershed-specific abundance data for non-salmonid fish could not be located.

Smolt traps

Smolts are juvenile salmonids that have undergone a physical transformation from regulating fresh water to regulating salt water.[94] This results in internal changes to the fish that can also be observed by external changes in appearance.[95] The Roseburg BLM operated smolt traps in Rock Creek and Canton Creek for coho salmon and steelhead from 1998 to 2000. The ODFW continued to monitor the Rock Creek trap during 2001.

Table 3-24 shows the total counts for each species and their estimated populations within the Rock Creek and Canton Creek watersheds. The estimated coho population for the four years of data collection was at its highest in Rock Creek in the year 2000. However, during the same year in Canton Creek, the sampled number was so small that population estimates are close to zero.[96] Canton Creek tends to be more of a step-pool structure with higher gradient and more cobble rather than gravel substrate. This habitat is more conducive to steelhead than coho, although coho have been present in the lowest reaches.

Steelhead population estimates for 1998 to 2000 follow a similar pattern in both watersheds with the highest levels occurring in 1998 and the lowest in 1999. Although the Rock Creek Watershed is over one and a half times the size of the Canton Creek Watershed, the steelhead production in Canton Creek appears far greater than in Rock Creek. In the three years of survey on both systems (1998 to 2000), nearly two times the smolts were trapped on Canton Creek and the estimated populations were over 16 and 19 percent higher in 1998 and 2000 respectively. The population rose 30 percent in 2001 in Rock Creek from the previous year. However no fish were sampled that year in Canton Creek. In 2001, there were also 14,323 spring chinook trapped in Rock Creek, and the population estimate was 42,843 fish. No other spring chinook data were collected in the smolt traps.

Watershed	**Year**	**Coho salmon**		**Steelhead**	
		Smolt count	**Estimated population**	**Smolt count**	**Estimated population**
Rock Creek	1998	997	4,174	4,146	27,623
	1999	463	1,814	2,069	22,179
	2000	760	6,779	5,844	25,841
	2001	1,813	6,362	6,792	36,820
Canton Creek	1998	169	1,307	9,593	32,886
	1999	52	0	3,967	18,915
	2000	21	0	10,349	30,129

Table 3-24: Smolt counts and population estimates for coho and steelhead in the Rock Creek and Canton Creek watersheds.

[94] Salmon "regulate" their salt intake through their kidneys and their gills. Excess water can be lost through the gills and excess salt can be lost through the kidneys.
[95] Smolts lose their parr marks and turn silver like adult salmon, and their scales become easy to slough off.
[96] Estimated populations are based on the recapture percentage of a number of marked and released fish from the original smolt trap capture. When the number of trapped fish is too low to begin with, recapture of any marked fish is not likely. Therefore the population is determined or assumed to be something close to zero.

The ODFW, Forest Service, and BLM operated downstream migrant traps on Canton Creek and East Fork Rock Creek during 1958 and on Pass Creek, Francis Creek, and Honey Creek in the late 1960s and 1970. The objectives were to obtain age-length data on cutthroat, determine migration timing of adult and juvenile cutthroat, collect stream temperature data, and determine species composition. Refer to Appendix 6 for complete data from these traps. Although the data are limited in that the traps were only operated for one to several years at each site, it does show species distribution and use during those periods.

Although the goals were focused on cutthroat trout, several other species caught in the traps were noted. There were large numbers of coho trapped in Honey Creek in the late 1960s, and a few even reached Pass Creek in 1970. A few lamprey made it into East Fork Rock Creek and Honey Creek, and substantial numbers of dace used Canton Creek, East Fork Rock Creek, and Honey Creek. A sculpin was caught in each of Pass Creek and Francis Creek. Cutthroat trout were present in large numbers in Francis Creek, Honey Creek, and Pass Creek in the late 1960s to 1970. Cutthroat trout numbers were low in East Fork Rock Creek and Canton Creek since the traps were operated from May or June to October when cutthroat migrants should have left the system already. Those caught were resident cutthroat only. Steelhead were present in all of the surveyed streams although only two were trapped in Francis Creek.

Coho spawning surveys

ODFW conducts coho spawning surveys throughout the Umpqua Basin. Volunteers and ODFW personnel survey pre-determined stream reaches and count the number of live and dead coho. The same person or team usually does surveys every 10 days for 2 or 3 months. In the Rock Creek Watershed, Miller Creek was surveyed over a 4 month period for 31 years (between 1946 and 1978). Figure 3-24 shows the coho survey results for Miller Creek. These surveys indicate that coho were consistently low in numbers from 1956 to 1963. These data correlate very well to a low period shown in the Winchester Dam fish counts from 1957 to 1964 (see Section 3.5.2). Coho partially rebounded after that in Miller Creek and to a lesser extent, in the North Umpqua River sub-basin. The decade-long decline evident in the 1970s at Winchester Dam was not evident in Miller Creek. However, data from 1975 and 1978 show two of Miller Creek's lowest years of collection. Since no other Rock Creek Watershed stream was surveyed during this period, there is no way to evaluate annual coho spawning fluctuation within the watershed. More data are needed to draw conclusions about coho abundance within the Rock Creek Region.

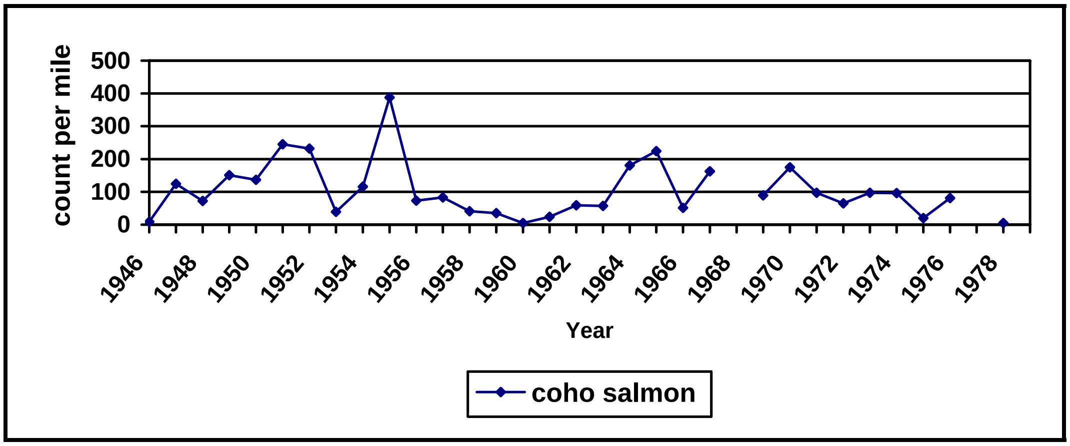


Figure 3-24: Miller Creek coho spawning surveys from 1946 to 1978 in the Rock Creek Watershed.

ODFW has conducted more recent coho spawning surveys in the Rock Creek and Middle North Umpqua watersheds in December, 2004 (see Table 3-25). These data have no reference for comparison of trends but provide documentation of current use and comparison between streams that may help prioritize restoration projects in the Region.

Watershed	Stream	Adults	Jacks	Redds
Rock Creek	East Fork Rock Creek	58	0	0
	Harrington Creek	8	0	2
	Rock Creek	4	0	0
	Total	**70**	**0**	**2**
Middle North Umpqua	Susan Creek	65	3	23
	Williams Creek	36	3	9
	Honey Creek	11	2	2
	Total	**112**	**8**	**34**

Table 3-25: Coho spawning peak count surveys from 2004 in the Rock Creek and Middle North Umpqua watersheds.

East Fork Rock Creek, Susan Creek, and Williams Creek supported the highest levels of coho. Although the fish count in East Fork Rock Creek was nearly as high as in Susan Creek, there were no visible redds during the survey, while Susan Creek had 23 redds observed. This may be an indication of lower numbers expected in 2005 within East Fork Rock Creek. Harrington Creek is the location of the largest debris flow that occurred in the Region following the 1996 heavy storms. Much of the creek and surrounding vegetation was scoured away during the three-mile-long disturbance. In spite of this, coho and redds are present in Harrington Creek. This may be a good candidate stream for habitat improvement to further increase coho use.

ODFW snorkeled Harrington and Mace creeks in the summer of 2005 to determine seeding levels of coho. A fully seeded stream should have a coho density of 1.0 fish per square meter. They evaluated 14 pools in Harrington Creek and found a coho density of

0.6 coho per square meter. In Mace Creek, ten pools were evaluated for a coho density of 0.3 coho per square meter. Both streams are currently underseeded.

Snorkel counts

ODFW has also conducted snorkel counts for summer steelhead and cutthroat trout since the early 1990s within Canton Creek.[97] Figure 3-25 shows the peak fish counts from these data. Summer steelhead counts were much more variable than cutthroat trout. The trend of numbers is similar from 1998 where both species are declining to their low point in 2000 when they subsequently begin to increase their numbers again, although cutthroat trout increases are much more moderate than steelhead.

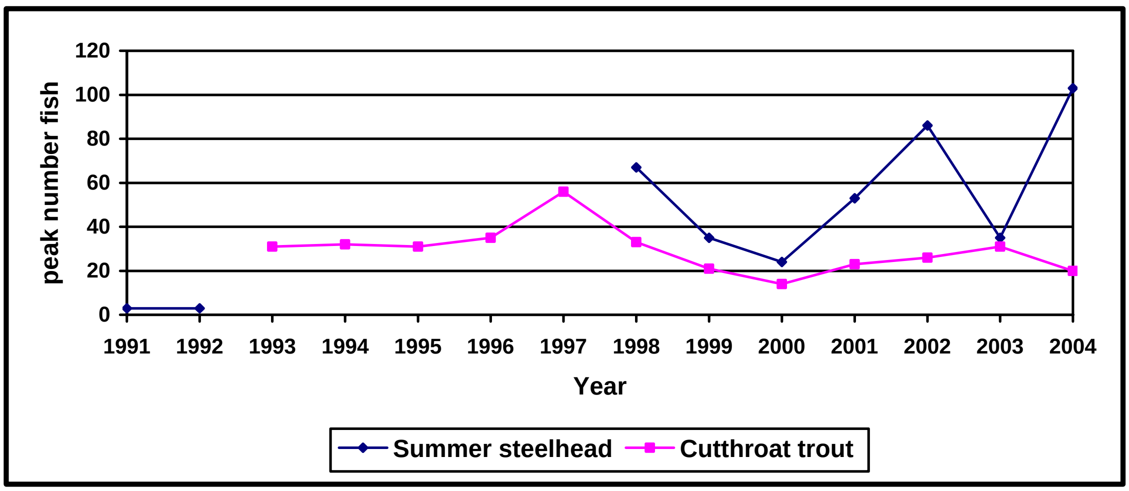


Figure 3-25: Peak numbers of fish from snorkel counts in Canton Creek.

Although the data here are limited, there are some similarities to the Winchester Dam trends. In 1991 and 1992, steelhead numbers were at their lowest in Canton Creek, which correlates to low numbers for the North Umpqua River sub-basin as well. Following these low years, the sub-basin numbers built back up to high levels in 1998 similar to Canton Creek. The pattern continued for both with a short decline and rise in numbers in the next few years. Cutthroat trout numbers in Canton Creek were fairly flat as they were for the entire North Umpqua River sub-basin. These similarities may imply that fluctuations in numbers are more attributed to ocean conditions rather than stream conditions; however, conclusions on population effects within the watershed are difficult because the data are limited in duration and fish populations are highly variable.

The ODFW conducted snorkel surveys for cutthroat trout on Rock Creek in 2000. Approximately 3.55 miles of stream were surveyed from Shoup Creek to North East Fork Rock Creek. Surveys were also done on two North Umpqua River tributaries outside of the Region (Cavitt Creek and Little River) and are included in Table 3-26 for comparison. The surveys in Rock Creek averaged 18 fish per mile with 1.2 fish observed per pool. Fish were observed in 46 percent of the pools surveyed. Rock Creek had a slightly lower average fish observed per mile than Cavitt Creek (20) and more than Little

[97] Data from 1993 through 1997 was not available for cutthroat trout.

River (13). However, the number of fish per pool was slightly higher than either Cavitt Creek or Little River that both averaged 1.1 fish per pool compared to 1.2 in Rock Creek. During this survey, observers also sighted 18 chinook and 19 steelhead using Rock Creek.

	Rock Creek	Cavitt Creek	Little River
Cutthroat observed	63	17	46
Pools surveyed	52	16	44
% of pools with fish	46 %	50 %	48 %
Fish per pool	1.2	1.1	1.1
Total distance (miles)	3.55	0.85	3.50
Fish per mile	18	20	13
Other species observed*	18 CH, 19 ST	1 CH, 1 ST	3 CH, 2 ST, 15 CO

* CH = chinook salmon, ST = steelhead salmon, CO = coho salmon

Table 3-26: Cutthroat trout snorkel surveys in year 2000. Cavitt Creek and Little River surveys included for comparison.

Table 3-27 shows data from snorkel counts that were also conducted in 2001 from the mouth of Rock Creek to the hatchery diversion dam. ODFW conducted these snorkel counts to determine how the fish ladder at the diversion dam was functioning. These data show heavy use of the lower stream segments of Rock Creek by spring chinook. Numbers of spring chinook were still high in August and steelhead numbers were the same, indicating the diversion dam is a partial barrier to fish at low flows in Rock Creek. Redesign of the ladder is underway and replacement is expected in the near future (see Section 3.1.2).

Date	Spring chinook	Summer steelhead
June 7, 2001	906	40
August 20, 2001	534	40

Table 3-27: ODFW snorkel fish count data in 2001 from the mouth of Rock Creek to the Rock Creek Hatchery diversion dam.

3.5.4. Salmonid population trends

According to Dave Harris of the Oregon Department of Fish and Wildlife, adult salmonid returns to the North Umpqua River system have increased from 1998 to 2002. This trend is due to greater numbers of wild and hatchery fish surviving to adulthood because of several years of low intensity winter storm events (i.e. no major floods or landslides) and ocean conditions that favor survival and growth. When both of these limiting factors are favorable over several years or fish generations, the result is an increase in adult run sizes. This trend is expected to continue until there is a change in ocean conditions or winter freshwater events.

Activities that improve freshwater conditions for salmonids will also help increase fish runs. These activities include removing barriers to fish passage, increasing instream flows, and improving critical habitat in streams and estuaries. It is also important to continue gathering data about salmonids and educating the public. The UBWC and Roseburg BLM hosted a fish summit working meeting in November, 2005 with the goal of prioritizing fish habitat restoration work within the Rock Creek Region. The meeting included fish biologists, hydrologists, and other resource specialists with specific knowledge of the streams in the Region from seven different agencies, companies, and non-profit groups. This initiated the process of finding those areas within the Region where restoration work can significantly enhance salmonid habitat. The results and details of that meeting are discussed in Appendix 7.

3.5.5. Fish populations key findings and action recommendations

Fish presence key findings

- The anadromous fish species in the Rock Creek Region are coho, winter steelhead, summer steelhead, spring chinook, sea-run cutthroat trout, and lamprey. Except for low numbers in the bottom reaches, coho and spring chinook are generally not found in Canton Creek. Although many Rock Creek Region medium and large tributaries are within the distribution of one or more salmonid species, salmonid ranges have not been verified for each tributary.
- Resident cutthroat and small numbers of rainbow trout are also present. Low numbers of non-natives including brown trout and brook trout may be present in the North Umpqua River and some smaller tributaries within the Middle North Umpqua Watershed. These species have emigrated from nearby stocked lakes and established stream populations.

Fish distribution and abundance and Salmonid population trends key findings

- Hatchery fish have a number of physical and behavioral differences to wild fish.
- Hatchery management has evolved over time in an attempt to minimize the effects of hatchery stock on native populations.
- In 1986, ODFW established a policy to manage for wild winter steelhead only in the North Umpqua River sub-basin.
- In most years, the number of hatchery coho exceeded wild coho in the North Umpqua River. Hatchery fish occasionally outnumber wild fish in the spring chinook and summer steelhead runs.
- The population trend for wild coho has been increasing since the late 1990s. Hatchery numbers of coho rapidly increased in the 1980s and reached there highest levels in 2001.
- Hatchery spring chinook increased dramatically in 1969 followed by fluctuations for many years until they peaked in 2002. Wild stocks appear somewhat less variable but had a similar trend since 1969.
- The general trend for wild summer steelhead does not appear to be increasing or decreasing. The wild winter steelhead trend also appears stable, although the 1990s was a period of low returns.
- ODFW is considering a fish trapping and sorting facility at the Rock Creek Hatchery diversion dam to monitor adult fish escapement and reduce the potential for

interbreeding and competition between hatchery and wild fish in the Rock Creek Watershed.

- Annual total fish count fluctuations (of hatchery and wild fish) are similar for all anadromous salmonids except coho and cutthroat trout. Data from these species with similar trends support the theory that ocean conditions are a primary influence on annual anadromous fish runs.
- Coho follow similar trends to other anadromous species until the 1970s, when coho numbers drop and remain at very low levels until the 1980s. Their numbers then increase and again follow somewhat similar trends to other anadromous salmonids. This ten year period is characterized with high commercial and sport harvest, increased timber harvest and road building within the North Umpqua River sub-basin, and the beginning of a cycle of declining ocean productivity (US Forest Service, 2001). Beginning in 1981, coho levels have rebounded substantially.
- Cutthroat trout population numbers include wild and hatchery fish. There are a number of possible influences on the decline in cutthroat trout population but definitive causes are not known.
- Largescale sucker, northern pikeminnow, and Pacific lamprey counts have declined since the 1970s. The Pacific lamprey's decline has been the most extreme. Little is known about this species' distribution and abundance within the Rock Creek Region.
- More quantitative data are needed to evaluate salmonid and non-salmonid abundance and distribution in the Region.
- Umpqua Basin-wide data indicate that salmonid returns have improved. Although ocean conditions are a strong determinant of salmonid run size, improving freshwater conditions will also increase salmonid fish populations.

Fish populations action recommendations

- Work with ODFW to obtain match-funding to help pay for the sorting station planned for the diversion dam above the Rock Creek Hatchery.
- Work with local specialists and landowners to verify the current and historical distribution of salmonids in tributaries.
- Support local salmonid (both wild and hatchery) and non-salmonid distribution and abundance research activities in the Region.
- Encourage landowner and resident participation in fish monitoring activities.
- Conduct landowner education programs about the potential problems associated with introducing non-native fish species into Umpqua Basin rivers and streams.
- Encourage landowner participation in activities that improve freshwater salmonid habitat conditions.

4. Current Trends and Potential Future Conditions

This chapter evaluates the current trends and the potential future conditions that could affect important stakeholder groups in the Region.

Key Questions

- What are the important issues currently facing the various stakeholder groups?
- How can these issues affect the future of each group?

4.1. Overview

There are many commonalities among the identified stakeholder groups. All landowners are concerned that increasing regulations will affect profits, and all have to invest more time and energy in the battle against noxious weeds. The non-industrial private landowners are concerned about the global market's effect on the sale of local commodities. These groups also struggle with issues surrounding property inheritance. Some groups are changing strategies in similar ways; community outreach is becoming increasingly important for both the Oregon Department of Environmental Quality (ODEQ) and industrial timber companies. Overall, the future of fish habitat and water quality conditions in the Umpqua Basin is bright. According to ODEQ, basin-wide conditions are improving and have the potential to get better.

4.2. Stakeholder perspectives[98]

4.2.1. The communities of Glide and Idleyld Park

Glide and Idleyld Park are small communities located just west of the Rock Creek Region along Highway 138, which follows the North Umpqua River. According to the 2000 census, Glide had a population of 1,690. Idleyld Park is part of a much greater census area. Therefore only unofficial estimates are currently available ranging from 785 to 887. Census data were unavailable prior to 2000, and therefore population growth in either community could not be determined. Population growth in Glide is probably comparable to the county as a whole. However, the availability of residential private property is limited near Idleyld Park and within the Rock Creek Region due to the large amount of public and industrial timber land ownership. This ownership pattern is probably limiting growth in these areas.

[98] It was not possible to develop a comprehensive viewpoint of the current trends and potential future conditions for the conservationist and environmentalist community in the Umpqua Basin. Therefore, this perspective is not included in section 4.2.

4.2.2. Family forestland owners[99]

The term “family forestland” is used to define forested properties owned by private individuals and/or families. Unlike the term “non-industrial private forestland,” the definition of “family forestlands” excludes non-family corporations, clubs, and other associations. Of the 154,215 acres in the watershed, about 3,084 acres (2 percent) are non-industrial private forestlands. Family forestlands most likely constitute a slightly smaller percent of these private non-industrial forests.

Family forestlands differ from private industrial forests. Industrial timber companies favor expansive stands of even-aged Douglas-fir. Family forestlands are more often located in lower elevations, and collectively provide a mixture of young and medium-aged conifers, hardwood stands, and non-forested areas such as rangeland. Family forestland owners are more likely to manage their property for both commercial and non-commercial interests such as merchantable timber, special forest products, biological diversity, and aesthetics.

Family forestland owners play a significant role in fish habitat and water quality restoration. Whereas most public and industrial timber forests are in the middle to upper elevations, family forestlands are concentrated in the lower elevations. In the Rock Creek Region, family forestlands are located primarily along the lower reaches of Rock Creek, near the North Umpqua River, and near Honey Creek and Susan Creek (see Map 1-10). Streams in these areas generally have low gradients and provide critical spawning habitat for salmonids. As such, issues affecting family forestland property management may impact fish habitat and water quality restoration efforts.

Family forestland owners

Who are Douglas County’s family forestland owners? In Oregon, most family forestland owners are older; nearly one in three are retired and another 25 percent will reach retirement age during this decade. Douglas County woodland owners seem to follow this general trend. Local observation suggests that many family forestland owners in Douglas County are either connected to the timber industry through their jobs or are recent arrivals to the area. The impression is that many of the latter group left higher-paying jobs in urban areas in favor of Douglas County’s rural lifestyle. In general, few family forestland owners are under the age of 35. It is believed that most young forestland owners inherit their properties or have unusually large incomes, since the cost of forestland and its maintenance is beyond the means of people just beginning their careers.

[99] The following information is largely from the UBWC’s South Umpqua River Watershed Assessment, 2003. Information for that assessment was based on an interview with Bill Arsenault, President of the Douglas Small Woodland Owners Association and member of the Family Forestlands Advisory Committee, and from “Sustaining Oregon’s Family Forestlands” (Committee for Family Forestlands, 2002). For more information about this document, contact Wally Rutledge, Secretary of the Committee for Family Forestlands; Forestry Assistance; Oregon Department of Forestry; 2600 State Street SE; Salem, OR 97310.

Factors influencing family forestlands

Changing markets

There are very few small private mills still operating in Douglas County, so timber from family forests is sold to industrial timber mills. Timber companies are driven by the global market, which influences product demand, competition, and production locations. As markets change, so do the size and species of logs that mills will purchase. Family forestland owners must continually reevaluate their timber management plans to meet the mills' requirements if they want to sell their timber. For example, mills are now favoring smaller diameter logs, and so family forestland owners have little financial incentive to grow large diameter trees.

Another aspect of globalization is a growing interest in certified wood products as derived from sustainably managed forests. Family forestland owners follow the Oregon Forest Practices Act. Many family forestland owners consider their management systems sustainable. The Committee for Family Forestlands is concerned that wood certification parameters do not take into account small forest circumstances and management techniques. They fear that wood certification could exclude family-forest-grown timber from the expanding certified wood products market. However, the long-term effect of wood certification is still unclear.

Ultimately the key to continued family forestland productivity is a healthy timber market. Although globalization and certification may change the way family forestland owners manage their timber, foreign log imports have kept local mills in operation, providing a place for family forestland owners to sell their timber. The long-term impact of globalization on forestland will depend on how it affects local markets.

Indirectly, changes in the livestock industry also influence family forestland owners. The livestock market is down, and many landowners are converting their ranchlands to forests. Douglas County supports these efforts through programs that offer landowners low-interest loans for afforestation projects.[100] Should the market for livestock remain low, more pastureland will probably be converted to timber.

Land management issues

Exotic weeds are a problem for family forestland owners. Species like Scotch broom, gorse, and blackberries can out-compete seedlings and must be controlled. Unlike grass and most native hardwoods, these exotic species require multiple herbicide applications before seedlings are free to grow, which raises the cost of site maintenance by about $200 per acre. The cost is not enough to "break the bank" but can narrow family forestland owners' profit margins. The cost of weed control may increase if these exotic species and others such as Portuguese broom become more established in the Umpqua Basin.

[100] "Afforestation" is planting trees in areas that have few or no trees. "Reforestation" is planting trees in areas that recently had trees, such as timber harvest sites or burned forests. Contact the Douglas County Extension Forester for more information on this program.

Regulations

Many family forestland owners fear that increasing regulations will diminish forest management profitability. For example, some Douglas County forestland owners are unable to profitably manage their properties due to riparian buffer protection laws. Although most family forestland owners support sound management practices, laws that take more land out of timber production would further reduce the landowners' profits. This would probably discourage continued family forestland management.

Succession/inheritance

Succession is a concern of many family forestland owners. It appears that most forestland owners would like to keep their property in the family; however, an Oregon-wide survey indicates that only 12 percent of private forestland owners have owned their properties since the 1970s. Part of this failure to retain family forestlands within the family unit may result from complex inheritance laws. Inheritors may find themselves overwhelmed by confusing laws and burdensome taxes and choose to sell the property. Statewide, over 20,000 acres of timberland leave family forestland ownership every year. Private industrial timber companies are the primary buyers. Although the land remains forested, private industrial timber companies use different management prescriptions than do most family forestland owners. Other family forestlands have been converted to urban and residential development to accommodate population growth.

4.2.3. Industrial timber companies[101]

Most industrial timberlands in the assessment area are located throughout the Rock Creek Watershed, the west half of the Middle North Umpqua Watershed, and the west side of the Canton Creek Watershed in areas that favor Douglas-fir. These areas are mostly located on the middle elevations within the Region with the exception of one company's holdings in the high elevation areas in the northwest of the Rock Creek Watershed. Higher gradient streams often located in these middle elevation areas provide important habitat for cutthroat trout. Riparian buffer zones in stream headwater areas may influence stream temperatures in lower gradient streams.

Industrial timber companies own 33 percent of the Rock Creek Region. These lands are intensively managed for timber production. For all holdings, timber companies develop general 10-year harvest and thinning schedules based on 45 to 60 year timber rotations, depending upon site indices.[102] The purpose of these tentative harvest plans is to look into the future to develop sustained-yield harvest schedules. These harvest and thinning plans are very general and are modified depending on market conditions, fires, regulatory changes, and other factors, but are always developed to maintain sustained timber yield within the parameters outlined by the Oregon Forest Practices Act.

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[101] The following information is primarily from an interview with Dick Beeby, Chief Forester for Roseburg Forest Products' Umpqua District, and Jake Gibbs, Forester for Lone Rock Timber and President of the Umpqua Chapter of the Society of American Foresters (at the time of the interview). The interview was conducted by Nancy Geyer, past UBWC Assessment Coordinator.

[102] Site index is a term used to describe a specific location's productivity for growing trees. Specifically, it relates a tree's height relative to its age, which indicates the potential productivity for that site.

Current land management trends

Land acquisition

Most industrial timber companies in the Umpqua Basin have an active land acquisition program. When assessing land for purchase, industrial timber companies consider site index along with the land's proximity to a manufacturing plant, accessibility, and other factors. The sale of large private forestlands is not predictable, and it would be difficult for timber companies to try to consolidate their holdings to a specific geographic area. However, most land holdings and acquisitions by timber companies tend to be where conditions favor Douglas-fir production. While purchasing and selling land is commonplace, land exchanges are rare.

Weeds

Noxious weeds are a concern for industrial timber managers. As with family forestlands, species such as Scotch broom, hawthorn, and gorse increase site maintenance costs. Weeds can block roads, which add additional costs to road maintenance. Some weeds are fire hazards; dense growth creates dangerous flash and ladder fuels capable of spreading fire quickly. To help combat noxious weeds, some industrial timber companies are working with research cooperatives to find ways of controlling these species.

Fire management

Fires are always a concern for industrial timber companies. The areas at greatest risk are recently harvested and thinned units, because of the flammable undecayed slash left behind. Timber companies believe that the fire risk is minimized once slash begins to decay. Although many timber companies still use prescribed burning as a site management technique, it is becoming less common due to regulations and the associated cost versus risk factors.

Road maintenance

Although a good road system is critical to forest management, poorly maintained roads can be a source of stream sediment, and undersized or damaged culverts can be fish passage barriers. Roads on industrial timberlands are inventoried and monitored routinely. Problems are prioritized and improvements scheduled either in conjunction with planned management activities or independently based on priority. Currently, most industrial timber companies repair roads so they do not negatively affect fish habitat and water quality, such as replacing failing culverts with ones that are fish-passage friendly. Road decommissioning is not common, but is occasionally done on old roads. When a road is decommissioned, it is first stabilized to prevent erosion problems, and then nature is allowed to take its course. Although these roads are not tilled or plowed to blend in with the surrounding landscape, over time vegetation is re-established. New roads are built utilizing the latest technology and science to meet forest management objectives while protecting streams and other resources.

Community outreach

The population of Douglas County is growing, and local observation suggests that many new residents are retirees or transfer incomes from urban areas. Many of these new residents moved to the area for its "livability" and are not familiar with the land management methods employed by industrial timber companies. As a result, establishing and maintaining neighbor relations is becoming increasingly important. Many timber companies will go door-to-door to discuss upcoming land management operations with neighboring owners and address any questions or concerns that the owners may have. These efforts will continue as the rural population within the Umpqua Basin grows.

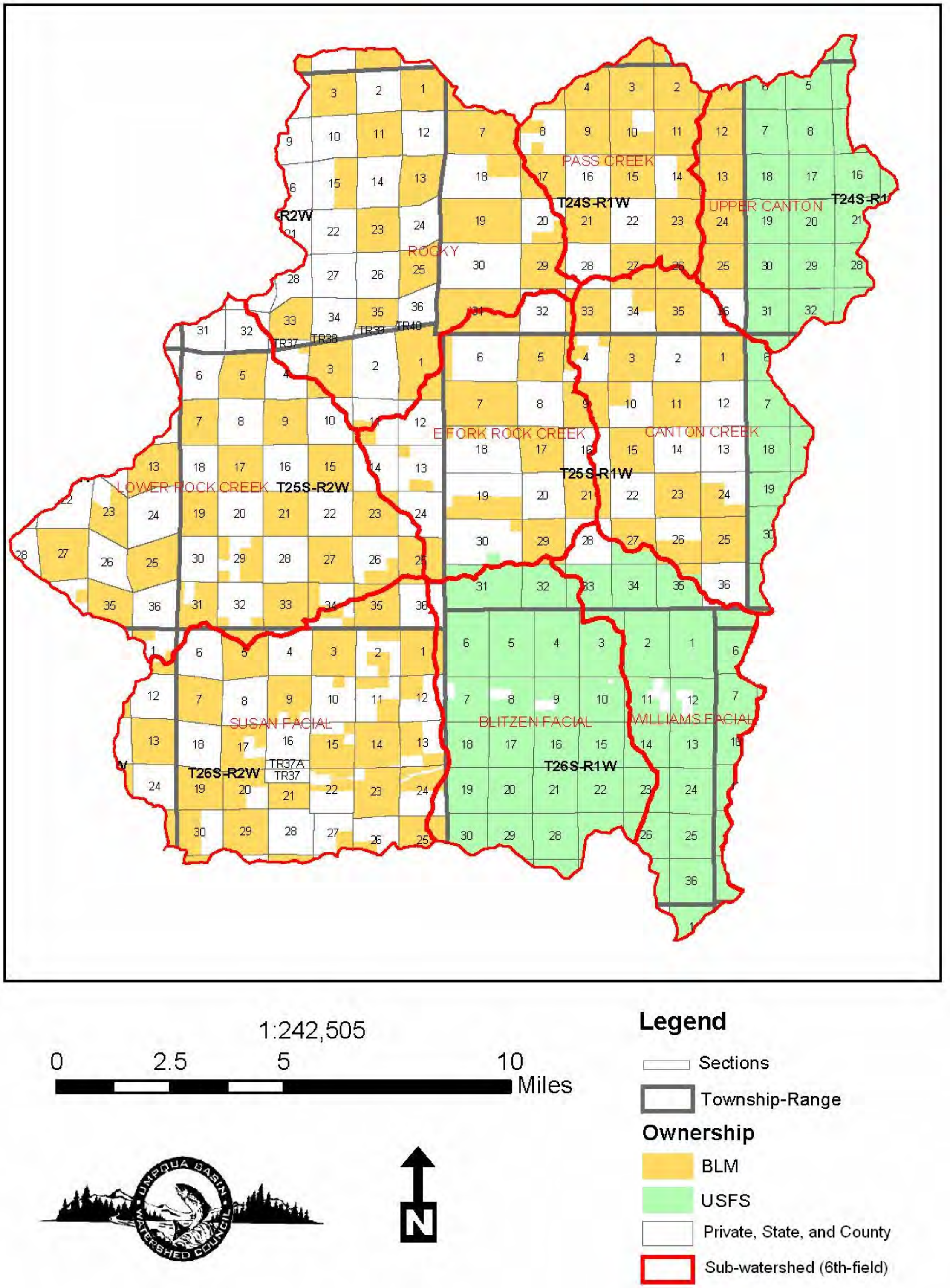
Regulations

Increased regulations will most likely have the greatest impact on the future of industrial timber companies. Like family forestland owners, most industrial timber companies believe in following sound forest management principles and consider their current management systems sustainable. There is concern that the efforts and litigation that changed forest management methods on public lands will now be focused on private lands. Should forestry become unprofitable due to stricter regulations, industrial timber companies would most likely move their business elsewhere and convert their forestlands to other uses.

4.2.4. The USDI Bureau of Land Management

The Roseburg District Office of the United States Department of the Interior Bureau of Land Management (BLM) administers 38 percent (approximately 58,600 acres) of the Rock Creek Region (see Map 4-1). The BLM and US Forest Service activities within the range of the Northern Spotted Owl follow the guidelines of the 1994 Northwest Forest Plan. In compliance with this policy, the Roseburg BLM's District Office developed a Record of Decision and Resource Management Plan in 1995.[103] The plan outlines the on-going resource management goals and objectives for lands administered by the BLM. All of the BLM's activities are guided by the resource management plan, and this assessment summarizes the main points of the document.

[103] For copies of this document, contact the Bureau of Land Management Roseburg District Office at 777 Northwest Garden Valley Road, Roseburg, Oregon 97470.



Map 4-1: **Federal lands and sub-watershed boundaries within the Rock Creek Region.**

General overview

The BLM Roseburg District Office's vision is that the "Bureau of Land Management will manage the natural resources under its jurisdiction in western Oregon to help enhance and maintain the ecological health of the environment and the social well-being of the human population." Ecosystem management is the strategy used by the Roseburg BLM to guide its vision:

> Ecosystem management involves the use of ecological, economic, social, and managerial principals to ensure the sustained condition of the whole. Ecosystem management emphasizes the complete ecosystem instead of individual components and looks at sustainable systems and products that people want and need. It seeks a balance between maintenance and restoration of natural systems and sustainable yield of resources.

The BLM manages all its land using two primary management concepts outlined in the Northwest Forest Plan. The first is "Ecological Principles for Management of Late Successional Forests." One goal for this management concept is "to maintain late-successional and old-growth species habitat and ecosystems on federal lands." The second goal is "to maintain biological diversity associated with native species and ecosystems in accordance with laws and regulations."

The second management concept is the "Aquatic Conservation Strategy." This strategy was developed "to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within them on public lands." A primary intent is to protect salmonid habitat on federal lands administered by the BLM and US Forest Service through activities such as watershed restoration and protecting riparian areas.

Land use allocations and resource programs

As part of its strategy, the BLM has four land use allocations that are managed according to specific objectives and management actions/directions that contribute to the two primary management concepts. The first land use allocation is Riparian Reserves. These areas are managed to provide habitat for various wildlife species. The second is Late-Successional Reserves (LSR). These are managed to protect and enhance conditions of late-successional and old-growth forest ecosystems that provide habitat for many species such as the northern spotted owl. Third, Matrix Areas have multiple objectives, which include providing a sustainable supply of timber and other forest commodities, connecting late successional reserves, and providing habitat for organisms associated with young, mature, and older forests. The last land use allocation is Adaptive Management Areas, where the agency develops and tests new management approaches to integrate ecological health with other social parameters, such as economic stability. In the Roseburg BLM District, the Adaptive Management Area is located in the Little River Watershed. The BLM also manages for 20 specific resource programs such as wilderness, timber resources, rural interface areas, and noxious weeds. As with the land use allocations, there are specific objectives and management actions/directions for each of the resource programs that are congruent with the Northwest Forest Plan management concepts. [104]

Current and future trends

A requirement of the Roseburg District BLM's Resource Management Plan is to publish a report on its annual activities. This document is called the Annual Program Summary and Monitoring Report.[105] It describes the BLM's accomplishments during the fiscal year, provides information about its budget, timber receipt collections, and payments to Douglas County.

Overall, the Roseburg BLM District is implementing the Northwest Forest Plan. The BLM met its goals for its land use allocations and for many of its resource programs, such as "water and soils" and "fish habitat." However, uncertainty surrounding the Survey and Manage standard, as well as on-going litigation, has affected the BLM's ability to implement some of its program elements.[106] For the seventh year in a row (fiscal years 1999 to 2005), the BLM's forest management and timber resource program fell short of achieving its goal of sustainably harvesting 45 million board feet (MMBF) of timber. Under the Resource Management Plan, more acres of BLM-administered forested lands are approaching late-successional stage than are being managed for timber.

Shortly after the completion of the Northwest Forest Plan, the American Forest Resource Council filed a lawsuit against the BLM and Forest Service. The major issues concerned the alleged inappropriate application of reserves and wildlife viability standards to Oregon and California Railroad lands (O&C lands).[107] In August, 2003, a settlement agreement was reached, including the following points:

- Within Northwest Forest Plan areas, the BLM and the US Forest Service will do their best to annually offer 805 million board feet (MMBF) of timber from matrix lands.

- The BLM and USFS will offer thinning sales in Northwest Forest Plan Late Successional Reserve lands totaling 300 MMBF annually (100 MMBF for the BLM and 200 MMBF for the USFS).

- By 2008, the BLM will revise its land use plans in western Oregon. During this process, the BLM will develop alternatives that address a variety of issues, including

[104] For specific information about land use allocations and management, see the BLM Roseburg District's Resource Management Plan.
[105] Copies of the Roseburg District BLM's Annual Program Summary and Monitoring Report for each fiscal year are available through the Roseburg District Office.
[106] The Northwest Forest Plan's Survey and Manage standard requires that all agencies conduct surveys prior to any activities on public lands to identify resident species of which little is known (such as mosses, mollusks, and fungi) and develop appropriate management strategies. Depending on the specific species requirements, surveys for a project can take two years or more to complete.
[107] The lawsuit claimed that the BLM was violating the O&C Lands Act because large blocks of O&C lands were designated as "reserves" and not subject to timber harvest. The O&C Lands Act of 1937 directed the Department of the Interior to manage these lands under the principles of "sustained yield" managing these lands for "permanent forest production."

at least one that will propose eliminating reserves on O&C lands, except where threatened or endangered species would be put at risk.

In September, 2005, the BLM began the revision process on all Resource Management Plans for BLM-managed lands in western Oregon. The BLM has collected comments from the public and is in the process of preparing a draft Resource Management Plan and environmental impact statement for the western Oregon BLM-managed lands. The draft will be available for public review in early 2007. BLM intends to complete the plan revision by spring of 2008. The new plan will then be the guide for all BLM-managed lands including those within the Rock Creek Region.

4.2.5. The Forest Service[108]

In the Rock Creek Region, all USDA Forest Service lands are part of the Umpqua National Forest. The Umpqua National Forest (UNF) administers approximately 26 percent of the Rock Creek Region land base (see Map 4-1). An overview of the UNF's management plans, and specific activities within the Rock Creek Region, are provided below.

Watershed restoration in the Umpqua National Forest

In August, 2000, the UNF developed its Watershed Restoration Business Plan (Umpqua National Forest, 2000). This plan establishes the UNF's goals and proposes a 10-year, $40 million budget for restoring the diversity of forest and stream habitats within six watersheds. Although none of these highest priority watersheds are within the Rock Creek Region, Steamboat Creek Watershed, of which Canton Creek Watershed is a tributary, was listed as the highest priority for restoration work. The purpose of the plan is to "[provide] a vision of what the Umpqua's landscape will look like and a description of what is needed to restore the Forest to that vision." Within the plan, the Umpqua Basin Vision is described as follows:

> The Umpqua Basin maintains a balance between human and ecological needs. Basin residents and visitors benefit from clean water, diverse native species, and pleasant outdoor experiences in the headwaters of the Umpqua. Commodity and non-commodity forest users are full partners in realizing their respective benefits from the watersheds. The residents of Douglas County, the Umpqua Basin Watershed Council, and the Umpqua National Forest restoration program provide the vision, leadership, and resources necessary to improve watershed health and foster stewardship.

Although the Watershed Restoration Business Plan from 2000 prioritizes aquatic restoration strategies for the six identified watersheds, some restoration activities are done routinely throughout the UNF. Old or undersized culverts are replaced during road

[108] Information in this section is from Jeff Dose, Forest Fish Biologist for the Umpqua National Forest provided for the UBWC Tiller Region Watershed Assessment and Action Plan (Geyer, 2003b, and from the Forest's August, 2000 Watershed Restoration Business Plan, and the Watershed Restoration Business Plan 2003 Update (US Forest Service, 2003).

maintenance.[109] Unnecessary roads are decommissioned, especially where doing so will improve watershed health. Road decommissioning may become more common; lack of funds makes it very difficult for the UNF to adequately maintain its extensive road system.

The UNF experienced a severe fire season on the forest in 2002, when approximately nine percent of the forest burned. In response to the change in the landscape from these fires, the UNF produced an update to the 2002 Watershed Restoration Business Plan in March, 2003.[110] This update broadened the UNF focus on upland restoration across the landscape. Although many priorities were still linked to the original six watersheds, several additional areas were selected for upland vegetation treatments. The Middle North Umpqua Watershed within the Rock Creek Region was included in several of these upland priority listings.

In the 2003 update, the UNF identified three restoration goals:

- Quality of life,
- A resilient forest,
- Clean water and healthy streams.

Linked to these goals, the UNF established seven critical terrestrial restoration priorities:

1. Restore late-successional habitat in Late Successional Reserves and associated Riparian Reserves.
2. Restore the role of fire in landscapes with historically frequent fire patterns.
3. Restore productivity and natural functions of Matrix lands and associated Riparian Reserves, including productivity of damaged soil.
4. Restore unique habitats, including meadows, oak savannahs, knobcone pine stands and hardwoods.
5. Restore big game habitat.
6. Restore habitat for native species threatened by non-native invasive species.
7. Restore habitats for non-old-growth dependent Threatened, Endangered, and Sensitive species.

The upland terrestrial strategies identified in the 2003 update that are within the Rock Creek Region are located in the Middle North Umpqua Watershed in either the Blitzen Facial or Williams Facial sub-watersheds, or both (see Map 4-1). Table 4-1 shows the strategies identified, their purpose, and the sub-watershed where they would occur.

[109] In 2001 the UNF completed a two-year inventory of potential fish passage barriers on its lands. This study indicates that there are few fish passage barriers remaining on the UNF.
[110] This update is referred to as the "Umpqua National Forest Watershed Restoration Business Plan 2003 Update."

Strategy	Purpose	Sub-watershed location
Establish fuel breaks	help to protect existing old-growth habitat	Blitzen Facial and Williams Facial
Thinning in Matrix lands	Restore productivity and natural functions	Blitzen Facial
Treatment of noxious weeds (specifically French broom)	Maintain native plant species viability and reduce the amount of displaced native communities	Blitzen Facial

Table 4-1: Upland restoration strategies within the Rock Creek Region identified in the UNF Restoration Business Plan 2003 Update.

Other Umpqua National Forest management issues

Timber management

In the Rock Creek Region, most UNF land is designated as either Matrix Area (MA) or Late Successional Reserve (LSR) (see Section 1.3.1). UNF land in the Canton Creek Watershed and the north half of the Middle North Umpqua Watershed is all LSR, while UNF lands in the south half of the Middle North Umpqua Watershed are MA. Refer to the descriptions of land use allocations in Section 4.2.4 for more on the goals for each of these management designations. At this time, the UNF has no plans for timber harvests in these areas.

The UNF's timber management goals focus on increasing species diversity and maintaining the ecological integrity of the forest and stream systems. Therefore, timber harvests are regenerated with mixed species. In newly planted units, pests, grass, and brush are controlled using manual techniques, such as mulch mats, instead of spraying herbicides or insecticides.

Fire management

The fires of 2002 have made fuel reduction and fire control important topics for the UNF. In April, 2003, the UNF published a report evaluating the effects of the 2002 fires on the National Forest.[111] This report was integral in shaping the subsequent update to the Watershed Restoration Business Plan 2003 Update. It focused attention and set priorities on areas in need of fuel treatments to maintain forest health, and to continue to meet management goals on the forest outlined in the Northwest Forest Plan.

Currently, the UNF does not receive much funding for fuel control activities. In Oregon, most fuel control funds are allocated to eastside forests, which have more lands that display a frequent, low intensity fire regime, and which have experienced better long-term success with fuel reduction. The UNF does not promote a "let burn" policy for fire management. Every reasonable effort is made to extinguish fires on UNF land.

[111] *Wildfire Effects Evaluation Project*, Umpqua National Forest, April, 2003.

Education and outreach

The UNF annually funds public education and outreach activities. These activities include participating in public events such as River Appreciation Day, the Douglas County Fair, giving presentations in public schools, and lecturing at colleges and universities. In most cases, what educational message is presented is determined by the needs of the "client."

In 1992, the UNF initiated a program to educate the public on the widespread problem of poaching over-summering adult spring chinook in the South Umpqua River and summer steelhead in Steamboat and Canton Creeks. At that time, up to 40 percent of South Umpqua River spring chinook from within the UNF were illegally harvested. The UNF partnered with the Oregon State Police, ODFW, and other organizations to simultaneously educate the public about the poaching problem and to apprehend offenders. The program has been very successful; due to increased public involvement in reporting poachers, fish poaching throughout the Umpqua Basin has been greatly reduced.

The future of the UNF

Like the BLM, the 1994 Northwest Forest Plan guides the activities of the UNF. The future of the UNF is therefore dictated by political changes that impact the Northwest Forest Plan. Current events, such as the August, 2003, settlement agreement of the American Forest Resource Council lawsuit, may result in greater timber harvesting on public lands. However, it is highly unlikely that the UNF will ever harvest timber at the same levels it has historically. Post World War II harvest levels on federal lands were mostly due to insufficient timber supplies on private lands to satisfy the demand for new housing. Currently, private industrial and private non-industrial timber supplies in the Pacific Northwest and Southeast US, as well as foreign timber supplies, are able to fulfill the US lumber demand. Plus, there are very few mills that will accept large-diameter logs, which historically was the bulk of the harvest. In the future, the UNF's management activities will probably focus on restoring and maintaining ecological functions, with less emphasis on supplying merchantable timber. Additionally, future merchantable harvests will probably consist primarily of small diameter logs from thinning existing plantations.

4.2.6. Oregon Department of Environmental Quality[112]

The Oregon Department of Environmental Quality (ODEQ) plays an important and unique role in fish habitat and water quality restoration. ODEQ's primary responsibility is to support stream beneficial uses identified by the Oregon Water Resources Department through the following activities:

- Establishing research-based water quality standards;
- Monitoring to determine if beneficial uses are being impaired within a specific stream or stream segment; and

[112] The following information is primarily from an interview with Paul Heberling, a water quality specialist for the Oregon Department of Environmental Quality in Roseburg.

- Identifying factors that may be contributing to conditions that have led to water quality impairment.

Approximately every three years, ODEQ reassesses its water quality standards and streams that are 303(d) listed as impaired. Throughout the development and reassessment of water quality standards, ODEQ attempts to keep the public involved and informed about water quality standards and listings. All sectors of the public, including land managers, academics, and citizens-at-large, are encouraged to offer input into the process. Water quality standards and 303(d) listings may be revised if comments and research support the change.

Current and future efforts

To fulfill its responsibilities into the future, ODEQ will continue to prioritize areas that are important for the various beneficial uses through their own research and the research of other groups. When these areas have been identified and prioritized, ODEQ will examine current land use practices to determine what changes, if any, will benefit preserving and/or restoring resources. Also, ODEQ will continue its efforts to work with individuals, agencies, citizen groups, and businesses to encourage them to voluntarily improve fish habitat and water quality conditions.

ODEQ hopes that education and outreach will help residents understand that improving conditions for fish and wildlife also improves conditions for people. For example, well-established riparian buffers increase stream complexity by adding more wood to the stream channel. Increased stream complexity provides better habitat for fish. It also helps downstream water quality by trapping nutrients and preventing stream warming, which can lead to excessive algae growth and interfere with water contact recreation.

Potential hindrances to water quality restoration

One hindrance to ODEQ's work is the financial reality of many water quality improvement activities. In some cases, the costs associated with meeting current standards are more than communities, businesses, or individual can easily absorb. For example, excessive nutrients from wastewater treatment plants can increase nitrate and phosphate levels and result in water quality impairments. The cost for upgrading a wastewater treatment plant can run into tens of millions of dollars, and is usually passed on to the community through city taxes and higher utility rates. Upgrading septic systems to meet current standards can cost a single family in excess of $10,000, more than many low- and middle-income rural residents can afford. People's interest in improving water quality often depends on the degree of financial hardship involved.

Budget cuts and staff reductions have also potentially hindered ODEQ's work. There are two Healthy Stream Partnership positions assigned to the Umpqua Basin, which is approximately three million acres. Without sufficient funding or personnel, it is difficult for ODEQ to conduct its basin-wide monitoring activities and reassess current water quality standards and impaired streams.

Current and potential future water quality trends

Although many Umpqua Basin streams and reaches are water quality impaired, current trends indicate that conditions are improving. In 2002, there were 1,726 streams or stream segments identified as failing to meet one or more of Oregon's water quality standards. Of these, approximately 15 percent were in the Umpqua Basin.[113] Table 4-2 shows by parameter the number of Umpqua Basin streams or stream segments failing to meet water quality standards.

Parameter	# of listed streams or reaches	Parameter	# of listed streams or reaches
Ammonia	1	Iron	4
Aquatic weeds/algae	3	Lead	3
Arsenic	4	Manganese	2
Biological criteria	7	Mercury	4
Cadmium	1	pH	15
Chlorine	2	Phosphorus	1
Copper	2	Sediment	7
Dissolved oxygen	7	Temperature	180
E. coli and fecal coliform	14	Total dissolved gas	4

Table 4-2: Number of Umpqua Basin 303(d) listed streams by parameter in 2002.

Accordingly, the focus for preservation and restoration efforts is improving stream temperature and bacterial levels to support the various beneficial uses. Improving stream temperature may provide the greatest cost-benefit ratio because temperature is a major factor in impacting or exacerbating other water quality parameters, including dissolved oxygen, pH, bacteria, and ammonia. Land management activities such as establishing functional riparian buffers to reduce the rate of stream warming can also improve other water quality parameters, such as sedimentation. Reducing bacteria levels is also a focus because of the serious human health risks associated with fecal bacteria. This is a clear rationale for activities that reduce bacteria levels, such as fixing failing septic systems and reducing the amounts of fecal wastes reaching streams from livestock, pets, and other sources.

Data from ODEQ long-term monitoring sites in the Umpqua Basin indicate that between 1989 and 1998, water quality conditions of many Umpqua Basin rivers and streams improved. The South Umpqua River at Melrose Road, Stewart Park Road, Winston, and Days Creek Cuttoff Road, as well as Cow Creek at the mouth, Calapooya Creek at Umpqua, and the North Umpqua at Garden Valley Road, are listed as sites that have shown significant improvement. From these data, ODEQ believes that continuing to support beneficial uses through water quality improvement activities will insure a bright future for fish habitat and water quality in the Umpqua Basin.

[113] See Section 3.3.1 for more information about 303(d) listed streams in the Rock Creek Region.

5. Landowner Perspectives

This chapter provides insight into the thoughts, opinions, and perspectives of landowners in the North Umpqua River sub-basin who have spent significant parts of their lives living, working, and recreating in the Rock Creek Region. These landowners have observed the streams in the Region over long periods of time through all different weather patterns. They offer their views in the hopes of providing personal insight into the dynamics of forest and stream function and change over time. The interviews also provide valuable insight into the different perspectives, opinions, and thoughts of Umpqua Basin landowners.

5.1. Landowner interviews

5.1.1. Mr. and Mrs. A

Mr. and Mrs. A moved to Roseburg in 1946. Mr. A is an avid fisherman who spent a lot of time on the North Umpqua River in the late 1940s and 1950s guiding fishing trips for the old North Umpqua and Circle H lodges while living in Roseburg. Mrs. A is a dedicated botanist who has been very active in promoting the use of native plants and the protection of rare plants. Both are passionate hikers and have spent much of their time within the forests and streams of the Rock Creek Region. In 1957, they moved to the North Umpqua River at Steamboat and began running a restaurant and inn while raising a family. For eighteen years they hosted all sorts of people at the restaurant and inn including work crews from the highway construction and Forest Service projects, fire fighters, and tourists coming mostly to fish in the North Umpqua River. They established a special “fishermen’s dinner” at the restaurant to meet the needs of fishermen eating a late meal so they could stay out angling to catch the evening bite. In 1975, they purchased eighty acres located above the North Umpqua River just east of Fall Creek where they built their home and have since lived.

Middle North Umpqua Watershed

Mr. A feels the most important aspect of this place is “its unsurpassed beauty and the addictiveness of the river.” He believes the North Umpqua River is exceptional. When asked what attributes come to mind when he says “exceptional,” both Mr. and Mrs. A comment on the structure of the river as most significant. Mr. A has seen other rivers that “… are somewhat comparable, but they are not the same. The North Umpqua is just different in its beauty, and its ability to create a strong personal love for the river within people.” Other contributing attributes are the climate and the year-round fishing of steelhead. Both Mr. and Mrs. A also feel the people of this area are an important part of what makes it special.

Mr. A used to fish for trout but does more steelhead fishing now, mostly because trout are much less abundant than they used to be. He mostly caught rainbows and some cutthroat but only occasionally catches them now while fishing for steelhead. He said that the river above Copeland Creek used to have the greatest amount of trout before the dam was built at Soda Springs.[114] Mr. A attributes most of the decline in trout to the loss of spawning gravel in the main river caused by the dam. "There is no gravel anymore, only cobble and larger stones, which the trout cannot use for spawning." In Mr. A's opinion, steelhead used areas quite a ways up Fish Creek before the dam was put in.[115] He thinks they took advantage of the early season high water runoff and made it past what many believe today are fish barriers. He remembers Forest Service employees that caught steelhead up in the area of the Big Camas Ranger Station, so he knows they made it at least that far.[116]

Mr. and Mrs. A mentioned several notable trout areas including above Baker Wayside where Mr. A caught trout over twenty inches long, and Johnson Cabin which people now call Stick Beach (located west of Honey Creek on the North Umpqua River). These were mostly rainbows with quite a few cutthroat trout. Mr. A remembers trout being planted in the late 1950s.

As early as the 1940s and early 1950s while guiding for the North Umpqua Lodge, Mr. A took advantage of his midday breaks from guiding duties to run, hike, or drive along the streams throughout the area. He did this up until they sold the inn in 1975. He regularly observed the streams on these outings. Mr. A never saw coho anywhere during all of his time spent in and near these streams. He is concerned about the expanding coho population, because he does not think coho used this area much in the past, if at all. There was an effort to expand coho use in Copeland Creek and several other tributaries. Mr. A believes this can be a problem for steelhead since coho emerge out of the gravel much earlier, allowing them to out-compete and displace steelhead. He feels the coho population is still expanding, and Copeland Creek has more coho than it used to.

Rock Creek Watershed

Mr. A has not spent as much time in Rock Creek as some of the other streams in the area. He fished there early on but noticed as early as the 1940s, that it was already deteriorating, and the trout and other salmonids were disappearing. He attributes this to the logging activity including splash dams earlier in the century that wiped out the habitat and displaced the fish. In the early 1960s, he remembers Rock Creek was in bad shape. It would turn dark brown from erosion after even the lightest of rain. This did not go unnoticed by his kids either. Mr. A remembers their comment while riding the bus past the mouth of Rock Creek on the way to school, "Chocolate Milk Creek is running again."

Canton Creek Watershed

Mr. and Mrs. A regularly hiked a trail that followed Canton Creek before the road was built in the mid 1950s. Mr. A remembers an early steelhead run in May and good holding pools all the way up the main creek. Practically every pool in Canton Creek

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[114] Copeland Creek is a tributary to the North Umpqua River above Steamboat Creek west of the assessment area.
[115] Fish Creek is a major tributary to the North Umpqua located just above the Soda Springs reservoir west of the assessment area.
[116] The Big Camas Ranger Station was located just west of Fish Creek and Camas Creek on the old road to Diamond Lake. Camas Creek is a tributary to Fish Creek.

would be holding steelhead by late summer. There were also over a thousand fish holding below Steamboat Falls.

Impacts

Harvest

In the early 1960s, Mr. A began to collect stream temperatures on many of the streams in the Region in an attempt to find out what was causing the decline in fish populations. He continued this work until 1975. He remembers collecting temperatures on most of the tributaries to Canton Creek. The general trend was that temperatures were warming. He found correlations between warmer temperatures and logging and road building. He took temperatures above and below harvested areas and found spikes in temperature attributed to the removal of vegetation. These temperatures did not immediately recede after further downstream flow through shaded reaches. The most significant effects were found in places where harvest occurred and the streams had been scoured to bedrock. "The sun would warm the rock and act as a heat source for the water as if it were on top of a stove."

The harvested riparian areas also caused a widening of the streams. Pools before logging had "tons of small fry and zeroes. However, shortly after (by the next season) they would be full of shiners and dace-trash fish." It took years to recover from these declines.

Mr. and Mrs. A have found that improved harvest regulation has helped the streams and although it will take a long time, these areas are coming back. They also believe that the placement of logs in the streams is helping significantly to improve these areas.

Building development

In the late 1950s to early 1960s on the south side of the North Umpqua River below the Mott Bridge, a timber sale occurred along the river. Mr. and Mrs. A noticed that after the roots of the stumps died in a year or so, erosion of the bank became significant. The sale was followed by the removal of huge amounts of gravel from the river to build the foundation of the Forest Service office building. This resulted in the washing out of large alders during the next high water. Today this area is a cobble beach with knapweed.

Dam construction

Before the dams and roads were built, Mr. A remembers the clarity in the North Umpqua River was exceptional. This is no longer the case in the summer. The water is "off-color and you can no longer see the bottom in the deeper places; there was, and still is, decayed algae on all of the rocks." He noticed it getting worse in the 1960s and it has continued until now. Mr. A attributes most of this to the dam construction and regulation of flows. The impoundments, especially at Lemolo, are green with algae. Slash burning may have contributed to this as well by input of nutrients into the stream promoting algae growth. These impoundments also cause an increase in temperature by holding stagnant water, allowing it to heat up before releasing it down-stream. The dam had regulated flow releases that at times caused large fluctuations in flow. These were even dangerous at times to anglers but were especially hard on fish.

Mr. A also believes that the dams have caused the river below to lose significant gravel that was so important to spawning, stream flows, and temperature. "Gravel is important in changing the flow of the river by contributing to water movement [meandering]. Water flows underneath gravel allowing it to stay cooler than water exposed at the surface, especially in smaller streams. This is not the case with cobble."

Hatchery

Mr. A remembers the first stocking of steelhead in 1958. There were problems early on because so many fish were released. He remembers catching hatchery fish the first year of their return. The fish were docile with no fight in them. The hatchery seemed to select out the fighters and promote the more docile fish. This causes more problems when the hatchery fish mate with wild stocks, creating more docile, less adapted wild stocks that can decrease survival. Mr. A remembers a lot of fish were released for the first several years as managers thought is was a positive thing. However, the amount of hatchery fish released was lowered after biologists realized that the high levels of hatchery fish may be having negative effects on native fish. Mr.A believes the hatchery fish put a lot of pressure on native populations. The hatchery stock did not always return to the hatchery but went into other neighboring systems. He caught hatchery fish past the Rock Creek Hatchery far up the North Umpqua River. He said he has caught them late into the season well past the spawning return time, so he is sure not all were going to head back downstream to the hatchery later.

He remembers a conversation with Ed Brothers, a well-known biologist who developed the otolith aging method. Ed had found that the otolith (inner ear bone) in fish does not develop the same in hatchery fish as in wild populations. They do not yet know the effect of this, but Mr. A thinks it may be significant in understanding "the fighting quality differences" between hatchery and native populations.

Mr. A believes they [ODFW] have come a long way in taking care where they plant the hatchery fish. He believes there is a place for hatcheries too, but it is very important to take care how many fish are produced in addition to where they put them. Mrs. A thinks that they should never put a "catchery" on fish where there is a native population. Wild fish should be allowed to escape and respond to their environment.

Recreation

Mr. A finds there is a lot more angling pressure on fish populations today than there used to be. He also mentioned that many anglers are not good conservationists and that they will do anything to catch that big fish, even if it means pulling it off of the spawning grounds. The "artificial fly catch-and-release-only" area designated on the North Umpqua River has been especially effective here because it allows more people to fish on a given fish population with less impact on the resource. Fish that hold in the river through the summer and on into January are caught over and over again. Mrs. A added the importance of getting the "no weighted fly" requirement that Mr. A fought so hard for. "During catch and release fly-fishing, the fish are caught many times, putting up a fight with each catch. Fishing with weighted flies would thus deplete their energy reserves more quickly."

Both Mr. and Mrs. A have noticed a lot more people swimming in the holding and spawning streams, displacing fish in the good holding pools. Although they have an effect on fish by chasing them from their holding pools, Mr. A does not think they are the primary problem. In addition to swimming, rafting on the main river is displacing fish. The effects of rafting are critical during spawning periods as it repeatedly runs fish off of the spawning grounds during the day.

Weeds

Mrs. A is a dedicated botanist who has been hiking the trails of the region throughout her life here. She's observed many kinds of non-native weed species that have become a problem in the area. Reed canary grass, lemon balm, English ivy, and scotch broom are among the worst. She observed broom being cut back along the roadsides not long ago. Those plants that were cut flush with the ground did not resprout while plants that had a little bit of a stump left after cutting resprouted the following season. Mrs. A has been diligent about removing all noxious weeds from their eighty acres.

Changes

When asked about changes that he noticed as a result of the 1964 flood, Mr. A mentioned that a lot of bank vegetation was lost during flooding. He also noticed the flood moved a lot of the bigger bedload down the channels. The biggest changes Mr. A has noticed have come in the last few years. The old Wright Creek fishing pool is unrecognizable, although Mr. A is not sure of the reasons for this. He also noted a tremendous amount of down-cutting in the channels even where there is bedrock. He estimates the bedrock has eroded 12 to 18 inches in the last 60 years. Mr. A believes that the single biggest change in sixty years is the loss of clarity in the North Umpqua River. "People say it is a clear river but not like it once was."

5.1.2. Mr. B

Mr. B has lived in Roseburg for 53 years, and his family has been in the area for generations. He spent a great deal of his childhood at his grandparent's cabin located near the confluence of Kelly Creek and Rock Creek. Their cabin was located near a group of others in the area that he believes were established with 99 year leases from the Forest Service. Higher up in the valley, there were some year around residents. As a kid, Mr. B spent months camping and fishing at the cabin with his family. He began fishing as soon as he could walk and remembers venturing on his own down to Kelly Creek and Rock Creek at age five. He stopped fishing in Rock Creek shortly after the 1964 rain-on-snow flood event caused damage to the streams and the fish were no longer there. He then spent more of his time in other areas of the North Umpqua River sub-basin. Eventually after the main road was built up the North Umpqua corridor, he began spending more time away from the main river in remote tributaries that required hiking in. He fished in part for the "experience," and there were too many people on the North Umpqua River once the road was built.

Mr. B remembers Rock Creek as a sinuous creek with deep pools prior to the flood. It was cold. "Kelly Creek was so cold it made your teeth hurt." In the 1960s to early 1970s he did some swimming in Rock Creek but mostly it was too cold. He went to Canton Creek to swim, as it had warmer clear water. Steamboat Creek was also very cold then.

Mr. B observed a lot of summer steelhead holding in the pools in Rock Creek. He does not remember seeing coho. There were a lot of rainbows, but cutthroats, probably searun, were also present. The big ones were always cutthroat. "If you caught a 14 to 16 inch fish it was always a cutthroat." Mr. B thinks the cutthroat were not as smart as the rainbows, so the larger rainbows knew how to avoid being caught.

1964 rain-on-snow flood event

Mr. B was about thirteen when the 1964 rain-on-snow flood event significantly changed Rock Creek. During the first few years following the storm, the fishing was very poor. Shortly after that Mr. B stopped going to Rock Creek since the fish were no longer there. He still goes up occasionally but mostly spends time on the North Umpqua River and other tributaries. He said the 1964 flood scoured out portions of Rock Creek. It scoured the vegetation back along the sides and filled in pools. There were piles of driftwood on the shore.

He believes that the heavy amount of logging that had recently occurred in Rock Creek prior to the flood exacerbated the damage of the flood. Mr. B said there was a lot of logging that had occurred on the slopes of Mt. Scott. Rock Creek was first entered after WWII, and there were no rules restricting logging practices then, resulting in some negative consequences. The logging and the flood produced streams plugged with wood causing miles of debris jams; bridges were plugged with debris. To "fix" this problem, wood was pulled out of streams; removal of wood was even written into logging contracts. This ended up causing more problems and made things worse for twenty years.

Mr. B saw other areas along the North Umpqua River affected by the 1964 flood event as well, but the effects were not as dramatic as in Rock Creek. He does not know all of the reasons why, but he believes it may be due to the topography as well as the amount of harvest that had occurred there. When the warm wind and rain of the storm moved in, it hit the slopes above Rock Creek first and dumped a lot of rain, before it moved on to places further east like Steamboat, which perhaps received less of the rain. Mr. B's great uncle was a business agent working with the loggers up on Mt. Scott. His great uncle remembered that from the lookout in the mid 1950s you could not see any cutting yet in the Steamboat Watershed but the Rock Creek Watershed already had quite a bit, and Steamboat Creak did not sustain as much damage from the flood event.

Another example of the 1964 storm damage that Mr. B remembers was in Calf Creek.[117] This area had no harvest as well. Before the flood, he fished Calf Creek which had a good brook trout population, even though the creek was a bedrock chute with no gravel. The water was clear and the channel was small and steep. He thinks the brook trout originated from stocking in Twin Lakes located above Calf Creek. After the flood, the fish were flushed out and some gravel was deposited at the lower reaches. There was no

[117] Calf Creek is a tributary to the North Umpqua River located east of Steamboat approximately six to seven miles east of the assessment area.

supply of brook trout to restock Calf Creek, as they were probably flushed out. Since the flood, there have only been rainbows and small cutthroat.

Mr. B believes that the flood event coupled with the intensive harvest caused stream temperatures to increase as cover was lost, and turbidity to increase in both the North Umpqua River and Rock Creek. There was always some green color in the water during the winter on the North Umpqua River, but it was clear enough to catch steelhead in December.

Vegetation history

Mr. B was lucky enough to spend a lot of time in his youth with Jesse and Perry Wright, who owned 160 acres near Glide. They had spent much of their lives packing people into the North Umpqua back country and camping, before the road [now Highway 138] was built. Mr. B was able to learn a lot about the North Umpqua from them. He considers Perry to have been the "Daniel Boone" of the area and was lucky enough to have accompanied him on hunting trips. In the 1910s to 1930s the Wrights hunted wolves for bounty. They ran cattle through the North Umpqua forest. They told him the forest was not the dense conifer and underbrush that we see today but very open with big trees. Many areas were cleared for grazing.

Rock Creek was one of the earliest areas entered for timber in the North Umpqua corridor in part because after WWII, the big trees all around Glide had already been cut and cleared for pasture. Timber harvest moved up the valley. The primary roads in the Rock Creek and Canton Creek watersheds were established early on, before the road further up the North Umpqua corridor, providing early access to timber harvest in these areas. In addition to the extensive harvest of timber in the area, Mr. B believes that in Rock Creek, vegetation was altered near the streams from the 1964 flood. In other areas, fire suppression played a key role in promoting denser stands and brush.

Fish management

Mr. B would prefer there were no hatchery in the North Umpqua River sub-basin. He remembers catching a big blunt fish with coarse scales and no fight. "It didn't feel natural." He also does not think highly of the practice of catch-and-release. He does agree, however, that given catch-and-release, fly-fishing is not as hard on the fish since they are easier to release. He understands that it extends the recreation opportunity but does not see it as a conservation method, and dislikes the idea that some people view catch-and-release as a noble thing to do. "It is not a noble thing to harass a fish." He believes that the assumption that the fish is not killed because it is released does not fully capture the losses of fish that occur from injury with this practice. He used to catch 14 to 16 inch rainbow trout in the upper North Umpqua at Dry Creek that are no longer there.[118] He believes the trout population has gone down in the upper North Umpqua below the Soda Springs Dam. Although he attributes more of this decline to the dam, he believes the catch and release policy is also hard on the fish.

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[118] Dry Creek is a tributary to the North Umpqua River located upstream from Calf Creek and below the Soda Springs dam.

Dam

In the late 1970s Mr. B had great experiences with trout fishing in the upper North Umpqua River below the Soda Springs Dam. Mr. B talked about several effects from the dam that have significantly decreased the trout population in the upper North Umpqua River.

He believes the algae bloom in the North Umpqua River is earlier than it used to be. Leaves and debris that have settled in Toketee Lake caused an increase in pH and eutrophication.[119] These changes may not show effects on fish for 15 to 25 years but at some point the threshold for insect survival is crossed and the insect population plummets. This results in the decreased trout population.

Mr. B also believes that the change in the sediment and gravel load below the dam and increases in the amount of bedrock channel has reduced the hyporheic zone and the insect population has plummeted.[120] Steelhead can survive this better than rainbow and cutthroat trout because steelhead do not have to eat in the river; spending more of their feeding time in the ocean. However, the effects on the trout population have been significant.

[119] "Eutrophication" is a condition in an aquatic ecosystem where high nutrient concentrations stimulate blooms of algae.

[120] The "hyporheic zone" is the area below the streambed where water percolates through spaces between the rocks and cobbles. It is home to many aquatic insects and is thought to provide some refuge for insects during flood events.

6. Action Plan

The action plan summarizes key findings and action recommendations from all previous chapters, and identifies specific and general restoration opportunities and locations within the watersheds. Activities within the action plan are *suggestions for voluntary projects and programs*. The action plan should not be interpreted as landowner requirements or as a comprehensive list of all possible restoration opportunities.

<u>Key Questions</u>

- Where are potential project location sites and activities in the Region?
- How does property ownership affect restoration potential?

6.1. North Umpqua Hydroelectric Project relicensing agreement[121]

In June, 2001, Pacificorp entered into a settlement agreement with the following agencies in order to meet the requirements for relicensing the North Umpqua Hydroelectric Project, located approximately 60 miles east of Roseburg:

- USDA Forest Service
- National Marine Fisheries Service
- USDI Fish and Wildlife Service
- USDI Bureau of Land Management
- OR Department of Environmental Quality
- OR Department of Fish and Wildlife
- OR Water Resources Department

The agreement establishes off-site mitigation that will be performed within the Rock Creek Region, as well as within the hydroelectric project area to offset waivers on fish passage for five of the eight dams within the hydroelectric project.

This off-site mitigation in the Rock Creek Region will be implemented by Pacificorp in conjunction with the ODFW. Funding for these projects provided by Pacificorp as part of this agreement presents an opportunity for matching funds which are often a requirement in grants sought for restoration work. This provides potential for groups such as the UBWC, DSWCD, and federal agencies to accomplish substantial restoration work in the area through partnerships.

Off-site mitigation work in the settlement agreement proposed within the Rock Creek Region includes the following:

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[121] Information presented in this section is from the Settlement Agreement (PacifiCorp *et al.* 2001). The settlement agreement can be obtained from the PacfiCorp website at: http://www.pacificorp.com/File/File16916.pdf

- Upgrade the Rock Creek diversion dam fishway to improve upstream passage for migratory fish and to allow for sorting of hatchery from wild fish.
- Add large woody debris to East Fork Rock Creek.
- Increase riparian protection through purchase of conservation easements in portions of the Rock Creek Watershed.
- Enhance resident trout habitat through instream large woody debris placement and conservation easements along riparian corridors on private land in upper Canton Creek and East Fork Pass Creek within the Canton Creek Watershed.

6.2. Rock Creek Region key findings and action recommendations

6.2.1. Stream function key findings and action recommendations

Stream morphology key findings

- Many transport streams are in areas where the landscape is fairly steep, increasing debris flow potential. Adding channel and riparian roughness from large wood and vegetation may help slow debris flows and help trap sediment in these streams.
- Rock Creek from Kelly Creek up to the confluence of Northeast Fork Rock Creek and the lower segment of East Fork Rock Creek are the only unconfined channels in the Region. These areas have relatively large meanders that regularly flood riparian areas as the streambank heights are minimal. Large overflow channels and gravel bars are common.
- Canton Creek is a mostly confined depositional stream that moves water at high velocity between step-pools. There are a few small moderately confined segments on Canton that allow some channel widening. Overall, it tends to move water at higher speeds than Rock Creek; therefore the deposited substrate tends to be larger cobble rather than smaller gravels.
- The broad, low-gradient reaches (including Rock Creek, Canton Creek and the North Umpqua River) lend themselves to complex aquatic habitat with large wood, coarse sediment, pools, bars, and side channels. However, these areas can be difficult to enhance for several reasons. The wide channels that move large volumes of water at high speed during peak flows can dislodge large wood structures placed in the streams for enhancement purposes. The wide, meandering portions can readily flood and scour riparian areas of debris and vegetation.
- The Rock Creek Region is dominated by high gradient source streams that typically provide large wood and debris to lower stream segments. Although these segments tend to be above the anadromous fish areas, riparian projects along these streams may help provide a future large wood source to lower stream segments.
- Stream habitat surveys suggest that lack of large woody material, and poor “riffles and pools” characteristics limit fish habitat in surveyed streams. The Region tends to contain high gradient streams which are not as conducive to pool and riffle development. Most streams in the Region are dependent on large wood for reducing flow velocity and providing roughness and diversity of habitat.

- Lack of winter habitat and spawning gravels are two limiting factors affecting fish habitat in the Region.
- Instream wood or boulder placement, riparian improvement and protection, and road obliteration are all restoration strategies that can increase winter habitat and spawning gravels.
- East Fork Rock Creek has been found to be limited by insufficient over-winter habitat related to a shortage of large woody debris structures and pool habitat. A large woody debris placement project is currently underway on East Fork Rock Creek by PacifiCorp in cooperation with ODFW.
- PacifiCorp and ODFW will also be identifying areas in upper Canton Creek and East Fork Pass Creek for large woody debris placement projects to benefit resident trout.
- Riparian survey ratings tend to be the most favorable, indicating that although the current levels of large woody material in the streams are limited, the future large wood source from riparian areas may be better. Exceptions include the upper reaches of Rock Creek, where current large wood levels are good but riparian attributes are limited, indicating a potential future problem to those streams.

Stream connectivity key findings

- The diversion dam at Rock Creek and fish passage barrier culverts reduce stream connectivity, affecting anadromous and resident fish productivity in the Region.
- Culverts are common obstacles or barriers to fish migration. They can be complete barriers to fish or obstacles that can wear fish out if too many have to be crossed during migration. They can also be partial barriers blocking only some fish or juveniles.
- Replacing problem culverts and redesign of the diversion dam fish ladder may be the quickest way to increase fish habitat for a number of different salmonid species by providing access to streams that meet habitat requirements.
- Culverts rated with the highest priority for replacement by UBFAT are in the Rock Creek and Middle North Umpqua watersheds on Kelly, McComas, Hill, Honey, and Williams creeks.
- Fish passage barriers on Kelly Creek and McComas Creek are also identified as high priority for replacement by the BLM and by a multi-agency group of fish biologists during a meeting to prioritize restoration within the Region. Fish passage barriers on Taylor Creek and Surprise Creek were identified during this same meeting as well.

Channel modification key findings

- There are no known permitted channel modification projects in the Rock Creek Region.
- Historical modifications include the construction and use of the Rock Creek Mill log pond diverting water from Rock Creek by use of a push up dam, and riprap placed along Rock Creek to prevent erosion into campgrounds and associated trails.
- Most modifications are related to culvert structures associated with road construction, and to roads that prevent stream meandering along portions of Rock Creek.

Stream function action recommendations

- Select and plan projects carefully in the broad, low-gradient reaches of Rock Creek, Canton Creek and the North Umpqua River. An adaptive management approach may be worthwhile to create roughness along the sides of these channels and in the riparian areas that may slowly add structure back into many segments where coarse wood is important but lacking.
- Where appropriate, improve pools and riffles while increasing instream large woody material by placing large wood and/or boulders in streams with channel types that are responsive to restoration activities and have an active channel less than 30 feet wide.[122] Adding large wood, stabilizing banks by planting trees, and improving shade along moderate gradient transport streams may be helpful in restoring some attributes of stream function such as winter habitat and spawning gravels.
- Work with landowners, ODFW, and PacifiCorp to identify riparian areas that should be protected and/or improved to insure future large woody debris to channels.
- Encourage land use practices that enhance or protect riparian areas:
    - Plant native riparian trees, shrubs, and understory vegetation in areas with poor or fair riparian areas.
    - Manage riparian zones for uneven-aged stands with large diameter trees and younger understory trees.
    - Maintain areas with good native riparian vegetation through easements on private land and education of small private landowners.
- Work with ODFW to obtain match funding to money already obtained for use in redesign and construction of a new fish ladder at the diversion dam.
- Encourage landowner participation in restoring stream connectivity by eliminating barriers and obstacles to fish passage. Restoration projects should focus on barriers that, when removed or repaired, create access to the greatest amount of fish habitat.
    - UBFAT scoring can be used to determine those of highest priority.
    - In addition to the UBFAT scoring, culverts on Kelly Creek, McComas Creek, Taylor Creek, and Surprise Creek have already been identified as high priority for replacement by fish biologists working in the area.
- Increase landowner awareness and understanding of the effects and implications of channel modification activities through public outreach and education.

6.2.2. Riparian zones and wetlands key findings and action recommendations

Riparian zones key findings

- Most effects to riparian areas are from past timber harvest, road construction, and noxious weed invasion. Peak flood events have also caused scouring away of vegetation along streambanks and within riparian areas exacerbating disturbance in these areas.
- Buffers established primarily along fish-bearing streams are currently reducing the impact of harvest near streams. Past harvest prior to buffer establishment (which began in 1972) commonly occurred up to the streambank in the more productive

[122] Thirty feet is the maximum stream width for which instream log and boulder placement projects are permitted.

valley bottom lands. These lands have recovered some of their riparian function of shade, cover, and some larger wood pieces.

- Approximately 21 percent of the riparian areas within the Region were harvested since 1972. Most of this harvest today has trees 17 to 33 years old. The majority of these areas are beginning to develop larger crowns and wider-spaced trees as some die out from competition. Approximately 34 percent of these acres are probably still in an early seral stage, with shorter trees and smaller tree crowns and diameters. They most likely have little understory vegetation and structure.
- Roads have limited the riparian areas along many stream sections. Road construction creates a more permanent loss of riparian function relative to other effects such as timber harvest.
- Roads exist within 200 feet for extended distances along several streams. Riparian functions along these streams are more likely impacted by the road. This occurs in the Canton Creek Watershed along Canton, Pass, Francis, and Mellow Moon creeks. In the Rock Creek Watershed, East Fork Rock, North Fork East Fork Rock, Wapiti, and the lower reaches of Shoup, Harrington, and Stony creeks are affected.
- Noxious weeds are an increasing problem in riparian areas. They out-compete native plants and do not provide all of the same functions.
- Noxious weeds often thrive in riparian areas since riparian zones tend to be highly productive areas where seed is readily spread from nearby roads and waterways.
- Several streams would benefit from riparian improvement or protection by reducing the rate of stream warming during peak summer temperatures or reducing the effects of peak flows. Improvement may include thinning, noxious weed removal, planting, or large wood placement in flood plain areas. The streams include Canton, Pass, Rock, Harrington, Miller, and East Fork Rock creeks.
- PacifiCorp and the ODFW are in the process of identifying riparian areas that would benefit mainstem Rock Creek, upper Canton Creek, and East Fork Pass Creek by establishing conservation easements on private land. These areas would be managed to enhance shading of these creeks to reduce stream warming and to provide a future source of large woody debris.

Wetlands key findings

- Road development, noxious weed invasion and spread, and some settlement and development have probably changed the original wetland hydrology in the Region.
- Most of the remaining wetlands mapped in the Rock Creek and west half of the Middle North Umpqua watersheds are found on private land with a few exceptions. The rest occur on a mix of private and public land.
- Landowner “buy-in” and voluntary participation must be fostered if wetland conservation is to be successful in the Region.
- Road construction probably occurred through wetlands in the 1940s to 1960s changing their hydrology.
- Noxious weeds are invading and displacing native wetland vegetation in many wetlands; thus decreasing their wetland function.
- There is opportunity for enhancement and protection of wetlands, including forested alder stands and emergent and forested wetlands, along the lower to middle segments of Rock Creek, on Canton Creek below Wolverine Creek, along the bottom of Pass

Creek, the upper reaches of Cougar and North Fork Chilcoot creeks, and many areas along the North Umpqua River.

Riparian zones and wetlands action recommendations

- Ensure riparian areas harvested prior to 1972 are regenerated and fully stocked. Incorporate a mix of appropriate riparian species to enhance diversity.
- Review younger stands for thinning options to expedite growth of tree crowns and diameters. Consider tree girdling especially right near the stream edge where areas may be sensitive to disturbance.
- Remove or control noxious weeds in recently harvested riparian areas and along roads adjacent to riparian areas. This will speed up forest establishment and growth, and maintain plant diversity in the riparian areas.
- Prioritize efforts on smaller streams with anadromous fish presence where channel widths can be more heavily shaded by riparian cover. Target areas at the junctions of tributaries with the main channels where anadromous fish use is heavy and channel width and water velocity is lower than in the main streams such as Rock Creek.
- On larger streams with unconfined sections such as Rock Creek, consider adding coarse wood within the floodplain riparian zone. Consider planting to add diversity of species including conifer back into alder dominated areas. Combine riparian work with areas where instream work may be warranted.
- Identify areas along Canton, Pass, Rock, Harrington, Miller, and East Fork Rock creeks that would benefit from riparian improvement or protection to reduce stream warming in the summer months, and reduce erosion and water velocity during peak flows.
- Work with ODFW and PacifiCorp to find matching sources of funds to help pay for conservation easements and work with landowners to develop interest in the program.
- Encourage private landowners to maintain healthy riparian and wetland sections through education and promoting land easements.
- Inventory wetlands for noxious weed problems that can be included in the programs for noxious weed control.
- Plant wetland species into areas where invasive plants have been removed to promote wetland species establishment.
- Avoid wetlands with new road construction.
- Develop opportunities to increase awareness of what defines a wetland, its functions and benefits. This is a fundamental step in creating landowner interest and developing landowner appreciation for wetland conservation.
- Identify or establish various peer-related demonstration projects as opportunities to educate stakeholders.
- Establish an approachable "one-stop shop" or clearinghouse to assist landowners in enrolling in programs that can benefit wetlands and meet landowner goals.

6.2.3. Water quality key findings and action recommendations

Although there are a number of factors that influence water quality in the Rock Creek Region, the most limiting is temperature. High temperatures cause physical stress in salmonids. Stressed fish are more susceptible to predation, disease, and competition by species tolerant of warmer temperature. The majority of streams measured in the Region do not meet the latest ODEQ 7DAM standard of 60.8°F. In addition, there are stream temperature trends within the Umpqua Basin that relate stream temperature to the distance from the headwater source. Streams that exceed both the temperature trend within the basin and the ODEQ standard are most likely to have significant problem areas related to temperature.

Arsenic levels in the North Umpqua River are the second most significant key finding related to water quality. Arsenic levels exceed the standard for "water and fish ingestion." Since the North Umpqua River is a domestic water source and food source for some people, and arsenic is a human carcinogen, this is an important toxic.

Temperature key findings

- Streams that failed to meet water quality standards and basin trend expectations included the main channels of Canton and Rock creeks, and smaller tributaries Honey and Susan creeks. Harrington Creek also measured some of the warmest temperatures although data were not available to relate it to basin trends.
- Results show that 7DAM temperatures in the Rock Creek Region were frequently above 60.8°F. All three main channels (Rock and Canton creeks, and the North Umpqua River) had 7DAM temperatures exceeding 60.8°F every day throughout the majority of the 2003 summer. Consistently high stream temperatures could limit salmonid rearing in these reaches.
- Most monitoring sites located in the tributaries had 7DAM temperatures above 60.8°F for the majority of the seasons monitored between 1992 and 2004. The consistently warmest recorded areas were middle Canton Creek and Rock Creek above East Fork Rock Creek. The coolest tributaries with 7DAM temperatures that were generally better than the standard for the majority of the years monitored were Mellow Moon Creek, Trapper Creek, Scaredman Creek, and Kelly Creek.
- Those tributaries that just exceeded the criteria but are close to meeting the standard all summer are Pass Creek above East Pass Creek, Rock Creek above Northeast Fork Rock Creek, Woodstock Creek, and Miller Creek.
- Warmer sites often lack shade. Increasing and maintaining shade on small and medium-sized streams will reduce stream warming rates and improve habitat for salmonids.
- Slowing water movement through areas with good shade cover reduces the relative time that water spends in direct solar contact. This can reduce stream warming and provide cooler water refuge areas for fish.
- Groundwater and tributary flows can contribute to stream cooling. Gravel-dominated tributaries may permit cooler subsurface flows when surface flows are low. Bedrock substrate heats up more quickly than other materials when exposed to direct solar radiation.
- Reducing downcutting on tributaries can help reduce the rapid loss of groundwater early in the summer season and help maintain a more constant groundwater inflow throughout the warm season.
- Fish may find shelter from high summer temperatures in the lower reaches and mouths of small and medium-sized tributaries and in reaches within warm streams that have proportionately high groundwater influx and shade. Concentrating efforts

to keep these important tributary connections cool can provide and maintain important resting areas during peak summer temperatures.

Surface water pH, Dissolved oxygen, Nutrients, Bacteria, and Toxics key findings

- Arsenic levels fail to meet water quality standards for "water and fish ingestion" in the North Umpqua River, which even in small amounts can be significant due to arsenic's human carcinogenic attributes. Although the source is unknown, data suggest it may be due to the local volcanic geology of the region.
- Temperature and the levels of pH, nutrients, and dissolved oxygen are interrelated. Within the Rock Creek Region, it appears that the North Umpqua River's pH levels are within the ODEQ's acceptable range. Above and below the Region, pH levels violate ODEQ standards. The USGS study found the river to have fairly high pH levels, and many measurements taken have been close to the maximum ODEQ standard even within the Region.
- Continued monitoring of pH on the North Umpqua River is recommended. Data on tributary streams for pH were not available. Steamboat Creek (to which Canton Creek is a tributary) is listed for pH, and additional monitoring of Canton Creek and Rock Creek is recommended to determine possible pH concerns.
- Many of the dissolved oxygen levels taken on the North Umpqua River failed to meet the numeric limits; however to determine whether this segment of the river is not meeting the ODEQ standards, percent saturation would have to be determined at the time of the sample. Continued monitoring of dissolved oxygen, including percent saturation, is recommended on the North Umpqua River.
- No dissolved oxygen measurements were taken on Rock or Canton creeks. However, based on intergravel measurements throughout the Rock Creek Watershed, oxygen flow through gravel where salmonid redds are expected does not appear limited.
- Nutrient levels do not appear to limit water quality in the Rock Creek Region. However, algae levels are high in the North Umpqua River while nitrogen levels appear low. There is a greater proportion of nitrogen-fixing algal species that may be related to the low nitrogen available. Small increases in nitrogen in the North Umpqua River may dramatically increase algae growth of non-nitrogen fixing species. This could create even higher algae levels in the North Umpqua River.
- Bacteria do not appear to limit water quality in the Rock Creek Region, although bacteria measurements were not available. It is unlikely with the low population and minimal agricultural and industrial development within the Region that bacteria are limiting these streams.

Sedimentation and turbidity key findings

- Turbidity data indicate that levels measured in the Rock Creek Region should not affect sight-feeding fish like salmonids. Turbidity measures related to flow seem to show a decrease in turbidity since the 1970s with a few years of elevated levels.
- Canton Creek is listed as sediment impaired. This listing appears to be based on qualitative rather than quantitative information. The US Forest Service has gathered macroinvertebrate data on Canton Creek and has requested it be delisted based on this information.

- Sediment levels in the North Umpqua River above the Region have been drastically reduced from historical levels due to effects of the Soda Springs Dam. The further down river from the dam, the more the sediment levels are increasing back toward historical conditions due to increased erosion from management activities in the erosive Western Cascade Terrain (Stillwater Sciences, 1998).
- Although there are numerous sources of sediment, rapid shallow landslides that break through debris dams and initiate debris flows contribute the predominant portion of sediment to streams.
- Steep slopes can be seen scattered across the Canton Creek Watershed with some concentrated areas up Pass Creek and Hipower Creek. In Rock Creek the steepest areas are concentrated up North East Fork Rock Creek, Zig Zag Creek, Surprise Creek and near the headwaters of East Fork Rock Creek. In the Middle North Umpqua the concentrations occur mostly in the Fairview Creek and Williams Creek drainages.
- Several features, especially when found in combination, can make areas more susceptible to landslides:
  - Concave and/or steep slopes, particularly those located just below a gentle slope or poorly managed road or harvest unit.
  - Mid-slope roads on steep ground constructed prior to 1983 when road construction techniques included more sidecast and fillslope construction.
  - Areas with tuffaceous geology rather than basaltic or igneous rock that is more tightly held to the slope.
- Runoff from impervious surfaces, including roads, parking areas, roofs, and areas burned very hot, can increase peak flows and sediment loads to streams.

Water quality action recommendations

- Identify stream reaches that may serve as “oases” for fish during the warm summer months, such as at the mouth of small- or medium-sized tributaries. Protect or enhance these streams’ riparian buffers and, when appropriate, improve instream conditions by placing logs and boulders within the active stream channel to create pools and collect gravel.
- In very warm streams, increase shade by encouraging wide riparian buffers and managing for full canopies.
- Encourage landowners to protect intact riparian areas along tributary channels that are cooler than the main channel and work with adjacent landowners to develop more contiguous riparian cover along the tributaries.
- Identify tributaries with bedrock substrate to focus riparian management and develop more gravel with instream wood placement to encourage cooler temperatures where appropriate.
- Cooperate with ODEQ as necessary to document and reduce contamination by arsenic.
- Where data show that stream sediment levels exceed established water quality standards, identify sediment sources such as failing culverts or roads, landslide debris, or excessive streambank erosion. Take action to remedy the problem or seek assistance through organizations such as the UBWC, the Douglas Soil and Water Conservation District, and the Natural Resources Conservation Service.

- o In areas with high landslide and debris flow hazards, encourage landowners to identify the specific soil types, slopes and topographic features that make their properties more susceptible to landslides, and include this information in their land management plans.
- o Encourage land managers to complete road maintenance inventories to identify problem areas that may produce more runoff and sediment.
- o Prioritize evaluation of older roads constructed prior to 1983 that are either in close proximity to streams or on steep midslope positions to target for maintenance that may include the following:
  - ➢ Remove or stabilize fillslope and sidecast material.
  - ➢ Increase cross drain culverts and/or other drainage methods (i.e. waterbars, dips) to divert runoff away from streams and disperse water and sediment on stable vegetated hillslopes.
  - ➢ Add surface rock or pavement to unsurfaced roads.
  - ➢ Fix existing drainage structure problems.
- o Encourage land managers to identify sediment producing roads that may be closed or decommissioned where such problem roads can be rerouted or are not important to future management of the area.
- o Encourage continued management of fuel loads to reduce the risk of high intensity catastrophic fire.
- o Encourage landowner practices that will maintain the Rock Creek Region's low nutrient and bacteria levels:
  - ➢ Repair failing septic tanks and drain fields.
  - ➢ Use wastewater treatment plant effluent for irrigation.
  - ➢ Reduce chemical nutrient sources.
- o Continue monitoring the Rock Creek Region for all water quality conditions. Expand monitoring efforts to include small tributaries.

6.2.4. Water quantity key findings and action recommendations

Water availability and Water rights by use key findings

- In all three Rock Creek Region WABs, instream water rights are close to or exceed average streamflow during one or more months of the year.
- During the summer, there is no "natural" streamflow available for new water rights.
- "Instream," a nonconsumptive use, is the largest water right within each of the WABs in the Region. "Fish" is the second largest water use for the Rock Creek and North Umpqua River WABs to supply water to the Rock Creek Fish Hatchery. Although a consumptive use, this water is channeled back into the streams for additional use.

Streamflow and flood potential key findings

- In August, average monthly streamflow is 14 cfs for Canton Creek and 29 cfs for Rock Creek. Within the Middle North Umpqua Watershed, the North Umpqua River's flow has dropped below 800 cfs during September and below 1,000 cfs for most of the summer months.
- No flooding trends were determined from the records to date.

- The degree to which road density and the TSZ influence flood potential in the Rock Creek Region is unknown at this time. However, the 1964 rain-on-snow event was exceptional, causing scouring of bedload and vegetation throughout the Region, most notably in the Rock Creek Watershed. The peak flow that resulted is considered a 100-year flood event.
- The North Umpqua Hydroelectric Project influences North Umpqua River flows, especially during the summer.

Water quantity action recommendations

- o Reduce summer water consumption through instream water leasing and by improving irrigation efficiency.
- o Educate landowners about proper irrigation methods and the benefits of improved irrigation efficiency.
- o Continue monitoring peak flow trends in the watershed. Try to determine the role of vegetative cover, flooding, road density, and the TSZ on water volume.

6.2.5. Fish populations key findings and action recommendations

Fish presence key findings

- The anadromous fish species in the Rock Creek Region are coho, winter steelhead, summer steelhead, spring chinook, sea-run cutthroat trout, and lamprey. Except for low numbers in the bottom reaches, coho and spring chinook are generally not found in Canton Creek. Although many Rock Creek Region medium and large tributaries are within the distribution of one or more salmonid species, salmonid ranges have not been verified for each tributary.
- Resident cutthroat and small numbers of rainbow trout are also present. Low numbers of non-natives including brown trout and brook trout may be present in the North Umpqua River and some smaller tributaries within the Middle North Umpqua Watershed. These species have emigrated from nearby stocked lakes and established stream populations.

Fish distribution and abundance and Salmonid population trends key findings

- Hatchery fish have a number of physical and behavioral differences to wild fish.
- Hatchery management has evolved over time in an attempt to minimize the effects of hatchery stock on native populations.
- In 1986, ODFW established a policy to manage for wild winter steelhead only in the North Umpqua River sub-basin.
- In most years, the number of hatchery coho exceeded wild coho in the North Umpqua River. Hatchery fish occasionally outnumber wild fish in the spring chinook and summer steelhead runs.
- The population trend for wild coho has been increasing since the late 1990s. Hatchery numbers of coho rapidly increased in the 1980s and reached theire highest levels in 2001.

- Hatchery spring chinook increased dramatically in 1969 followed by fluctuations for many years until they peaked in 2002. Wild stocks appear somewhat less variable but have had a similar trend since 1969.
- The general trend for wild summer steelhead does not appear to be increasing or decreasing. The wild winter steelhead trend also appears stable, although the 1990s was a period of low returns.
- ODFW is considering a fish trapping and sorting facility at the Rock Creek Hatchery diversion dam to monitor adult fish escapement and reduce the potential for interbreeding and competition between hatchery and wild fish in the Rock Creek Watershed.
- Annual total fish count fluctuations (of hatchery and wild fish) are similar for all anadromous salmonids except coho and cutthroat trout. Data from these species with similar trends support the theory that ocean conditions are a primary influence on annual anadromous fish runs.
- Coho follow similar trends to other anadromous species until the 1970s, when coho numbers drop and remain at very low levels until the 1980s. Their numbers then increase and again follow somewhat similar trends to other anadromous salmonids. This ten year period was characterized by high commercial and sport harvest, increased timber harvest and road building within the North Umpqua River sub-basin, and the beginning of a cycle of declining ocean productivity.[123] Beginning in 1981, coho levels have rebounded substantially.
- Cutthroat trout population numbers include wild and hatchery fish. There are a number of possible influences on the decline in cutthroat trout population but definitive causes are not known.
- Largescale sucker, northern pikeminnow, and Pacific lamprey counts have declined since the 1970s. The Pacific lamprey's decline has been the most extreme. Little is known about this species' distribution and abundance within the Rock Creek Region.
- More quantitative data are needed to evaluate salmonid and non-salmonid abundance and distribution in the Region.
- Umpqua-Basin-wide data indicate that salmonid returns have improved. Although ocean conditions are a strong determinant of salmonid run size, improving freshwater conditions will also increase salmonid fish populations and may help assure sustainability during periods of low ocean productivity.

Fish populations action recommendations

- Work with ODFW to obtain match-funding to help pay for the sorting station planned for the diversion dam above the Rock Creek Hatchery.
- Work with local specialists and landowners to verify the current and historical distribution of salmonids in tributaries.
- Support local salmonid (both wild and hatchery) and non-salmonid distribution and abundance research activities in the Region.
- Encourage landowner and resident participation in fish monitoring activities.
- Conduct landowner education programs about the potential problems associated with introducing non-native fish species into Umpqua Basin rivers and streams.

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[123] From the Middle North Umpqua Watershed Analysis, Umpqua National Forest, 2001.

- o Encourage landowner participation in activities that improve freshwater salmonid habitat conditions.

6.3. Specific UBWC enhancement opportunities

1. Actively seek out opportunities with landowner and resident groups to enlist participation in restoration projects and activities:
   - In-stream structure placement (case-by-case basis);
   - Improved irrigation efficiency and instream water leasing (all streams with water rights);
   - Riparian planting, blackberry or other noxious weed conversion, fencing, and alternative livestock watering systems; and
   - Work with ODFW, PacifiCorp, BLM, and UNF on future restoration opportunities.

2. Work with interested landowners on a case-by-case basis on the following project types:
   - Improve instream fish habitat in areas with good riparian zones and an active channel that is less than 30 feet; and
   - Enhance and/or protect riparian zones and wetlands to improve wildlife habitat, fish habitat, and water quality conditions.

3. Develop educational materials and/or outreach programs to educate target audiences about fish habitat and water quality-related issues:
   - Create educational brochures about bank erosion, the problems associated with channel modification, and the importance of riparian areas. These could be given to new landowners through real estate agents.
   - Develop public service announcements about ways of improving or maintaining riparian and instream conditions, such as the benefits of riparian fencing and how to use fertilizers and pesticides in a stream-friendly fashion.
   - Design engaging displays about fish passage barriers for community events, such as the Douglas County Fair.
   - Give presentations at citizen groups about the benefits to landowners and to fish that result from upland stock water systems, off-channel shade trees, and instream water leasing.

4. Support local fish habitat and water quality research:
   - Train volunteers to conduct fish and water quality monitoring and research.
   - Provide equipment necessary for local water quality research.
   - Survey long-term landowners and residents about historical and current fish distribution and abundance.
   - Encourage school and student participation in monitoring and research.

5. Enlist landowner participation in removing fish passage barriers as identified.

6. Educate policy makers about the obstacles preventing greater landowner participation in voluntary fish habitat and water quality improvement methods.

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Appendices

Appendix 1: Additional geologic information.

Descriptions of geologic units from Walker and MacLeod (1991).

For explanation of terms within this table, refer to Jackson (1997).

Map symbol	Rock type	Geologic Unit Description
Qls	**Landslide and debris flow deposits**	Unstratified mixtures of fragments of adjacent bedrock. Locally includes slope wash and colluvium. Largest slides and debris flows occur where thick sections of basalt and andesite flows overlie clayey tuffaceous rocks.
Tfe	**Fisher and Eugene Formations and correlative rocks**	Thin to moderately thick bedded, coarse- to fine- grained arkosic and micaceous sandstone and siltstone, locally highly pumiceous, of the marine Eugene Formation; and coeval and older andesitic lapilli tuff, breccia, water-laid and air-fall silicic ash of the continental Fisher and Colestin Formation; upper parts of the Fisher Formation apparently lap onto and interfinger with the Eugene Formation.
Thi	**Hypabyssal intrusive rocks**	Hypabyssal, medium-grained, hornblende diorite and quartz diorite in small stocks and large dikes; includes intrusions of medium- to fine-grained gabbro and plugs and small stocks of medium-grained holocrystalline, olivine andesite. Also includes medium-grained, commonly porphyritic biotite quartz monzonite and leucocratic granodiorite. Many of these intrusive bodies are moderately to intensively propylitized, as are wallrocks they intrude; locally, along shears, the rocks also are sericitized. Potassium-argon ages on several of these shallow intrusions range from about Ma to about 22 Ma (Wise, 1969; Bikerman, 1970; Sutter, 1978; Power and others, 1981a, b; Fiebelkorn and others, 1983).
Tib	**Basalt and andesite intrusions**	Sills, plugs and dikes of basaltic andesite, basalt, and andesite. Mostly represents feeders, exposed by erosion, for flows and flow breccias of units Tba and Trb. Includes a few dikes of hornblende and plagioclase porphyritic andesite, commonly altered, and aphyric basaltic andesite that probably were feeders for parts of unit Tub.
Tsv	**Silicic vent complexes**	Large, rhyolitic to dacitic vent areas in the Cascade Range that commonly include multiple intrusions and much associated silicic eruptive breccia and erosional debris and some flows.

Tub	**Basaltic lava flows**	Basaltic and basaltic andesite lava flows and breccia; grades laterally into rare bedded palagonitic tuff and breccia.
Tus	**Sedimentary and volcanislcastic rocks**	Lapilli tuff, mudflow deposits (lahars), flow breccia, and volcanic conglomerate, mostly of basaltic to dacitic composition; rare iron-stained palagonitic tuff and breccia of basaltic and andesitic composition; and ash-flow, air-fall, and water-laid tuff of dacitic to rhyolitic composition. The palagonite tuff and breccia grade laterally into peperite and into lava flows of basalt and basaltic andesite.
Tut	**Tuff**	Welded and unwelded, mostly vitric crystal and vitric ash-flow tuff of several ages. Glass in tuff locally altered to clay, zeolites, and secondary silica minerals.

Glossary of terms[124]

Alluvial: Pertaining to the environments, actions, and products of rivers or streams.

Andesite: Fine-grained volcanic rock characterized by the presence of plagioclase feldspar.

Arkosic: Containing abundant feldspar minerals.

Basalt: A fine-grained, dark, mafic, extrusive igneous rock composed largely of plagioclase feldspar and pyroxene. It is the major rock of ocean basins.

Breccia: A coarse-grained, clastic rock composed of angular and broken rock fragments in a finer-grained matrix. It is usually sedimentary in origin, but may also be igneous (volcanic breccia).

Calcareous: Any rock that has enough carbonate material so that it reacts with hydrochloric (or any other strong) acid, producing bubbles of carbon dioxide. Usually, the carbonate material is calcite.

Clay: Mineral particles less than 4 micrometers in diameter.

Conglomerate: A coarse-grained clastic sedimentary rock composed of rounded or sub-rounded fragments larger than two millimeters in diameter and cemented together.

[124] These terms are mostly compiled from Allaby and Allaby (1999), Challinor (1978), Jackson (1997), and Orr and Orr (2000).

Crust: The outermost layer of the earth. It includes the oceanic crust (about 5-10 miles thick) and the continental crust (50-75 miles thick). The bottom of the crust is the Mohorovicic Discontinuity ("Moho").

Debris avalanche: A fast downhill mass movement of soil and rock.

Deformation: Any change in shape of structure of a rock unit as a result of earth forces, on any scale.

Diorite: A coarse-grained intermediate igneous rock composed essentially of plagioclase in excess of alkali feldspar, and mafic minerals.

Erosion: The set of all processes by which soil and rock are loosened and moved downhill or downwind.

Fault: A crack or fracture in the earth's surface across which there has been relative displacement. Movement along the fault can cause earthquakes or--in the process of mountain-building--can release underlying magma and permit it to rise to the surface.

Feldspar: The most important group of rock forming silicate minerals. Feldspar constitutes 60% of the Earth's crust.

Flood plain: A level plain of stratified alluvium on either side of a stream; submerged during floods.

Fluvial: Pertaining to streams and river deposits; produced by the action of flowing water.

Formation: A body of rock identified by lithic characteristics and stratigraphic position and is mapable at the earth's surface or traceable in the subsurface.

Geomorphology: The science of surface landforms and their interpretation on the basis of geology and climate**.**

Gravel: Sediment grains with diameters between two and 60 mm.

Group: Two or more formations in a stratigraphic column that formed by similar events or processes.

Hydraulic conductivity: A measure of the ability of a rock, sediment, or soil to permit fluids to flow through it.

Hydrothermal: Of or pertaining to hot water, to the action of hot water, or to the products of this action, such as a mineral deposit precipitated from a hot aqueous solution.

Igneous: Rock or mineral crystallized from partly molten material, i.e. magma.

Intrusion: The process of emplacement of magma in pre-existing rock. Also, the term refers to igneous rock mass so formed within the surrounding rock.

Intrusive: Applied to a body of rock, usually igneous, that is emplaced within preexisting rocks.

Landslide: The rapid downslope movement of soil and rock material, often lubricated by groundwater, over a basal shear zone or along a sedimentary contact; also the tongue of stationary material deposited by such an event.

Lapilli: Small stony pieces of lava from two to 64 mm, falling as pyroclastic material, having been blown into the air in a volcanic eruption.

Lava: Magma that has reached the surface through a volcanic eruption. The term is most commonly applied to streams of liquid rock that flow from a crater or fissure. It also refers to cooled and solidified rock.

Mafic: An igneous rock composed chiefly of one or more dark-colored minerals.

Magma: Molten rock material that forms igneous rocks upon cooling. Magma that reaches the surface is referred to as lava.

Mantle: The main bulk of the Earth, between the crust and core, ranging from depths of about 40 to 3480 kilometers. It is composed of dense mafic silicates and divided into concentric layers by phase changes that are caused by the increase in pressure with depth.

Mass movement: A downhill movement of soil or fractured rock under the force of gravity.

Metamorphic rocks: Rocks altered by heat and pressure causing recrystallization and loss of original characteristics.

Micaceous: Consisting of, containing, or pertaining to mica, which is a family of silicates of aluminum and potassium that form into thin elastic plates.

Plagioclase: Soda-lime feldspar.

Pyroclastic: Applied to fragmentary materials produced by explosive volcanic action.

Relief: The vertical difference between the summit of a mountain and the adjacent valley or plain.

Runoff: The amount of rain water directly leaving an area in surface drainage, as opposed to the amount that seeps out as groundwater.

Sand: Mineral particles between 0.0625 mm and 2.0 mm in diameter.

Sandstone: A detrital sedimentary rock composed of grains from 0.0625 mm to 2.0 mm in diameter, dominated in most sandstones by quartz, feldspar, and rock fragments, bound together by a cement of silica, carbonate, or other minerals or a matrix of clay minerals.

Sedimentary rock: A rock formed by the accumulation and cementation of mineral grains transported by wind, water, or ice to the site of deposition or chemically precipitated at the depositional site.

Sedimentation: The process of deposition of mineral grains or precipitates in beds or other accumulations.

Shale: A very fine-grained, thinly layered sedimentary rock composed of clay and/or silt grains. Shales break easily along their layering, especially along weathered surfaces. They feel smooth to the touch, not gritty.

Silicic: Said of igneous rock or magma rich in silicon dioxide.

Silt: Mineral particles between four and 62 micrometers in diameter.

Siltstone: A fine-grained, layered sedimentary rock composed primarily of grains between 1/256 mm and 1/16 mm in size. Siltstones contain hard thin layers. They feel grittier than shales or mudstones.

Subduction: The process of consumption of a crustal plate at a convergent plate margin with one crustal plate descending beneath another.

Tectonism: The processes of deformation in the Earth's crust that produce its continents and ocean basins, plateaus and mountains, and major folds and faults.

Terrace: A step-like surface, bordering a valley floor or shoreline that represents the former position of a flood plain, or lake or sea shore.

Terrain: A tract or region of the Earth's surface considered as a physical feature, an ecological environment, or a site of some planned human activity.

Topography: The shape of the Earth's surface, above and below sea level; the set of landforms in a region; the distribution of elevations.

Tuff: A consolidated rock composed of pyroclastic (from a volcanic explosion) fragments and fine ash. If particles are melted slightly together from their own heat, it is a "welded tuff."

Tuff breccia: A pyroclastic rock consisting of more or less equal amounts of ash, lapilli, and larger fragments.

Tuffaceous: Composed by large amounts of tuff.

Volcano: A vent in the surface of the Earth through which magma and associated gases and ash erupt; also, the form or structure (usually conical) that is produced by the ejected material.

Volcanic: Material produced from or related to a volcano.

Volcanic rock: A generally finely crystalline or glassy igneous rock resulting from volcanic action at or near the Earth's surface, either ejected explosively or extruded as lava.

Appendix 1 references

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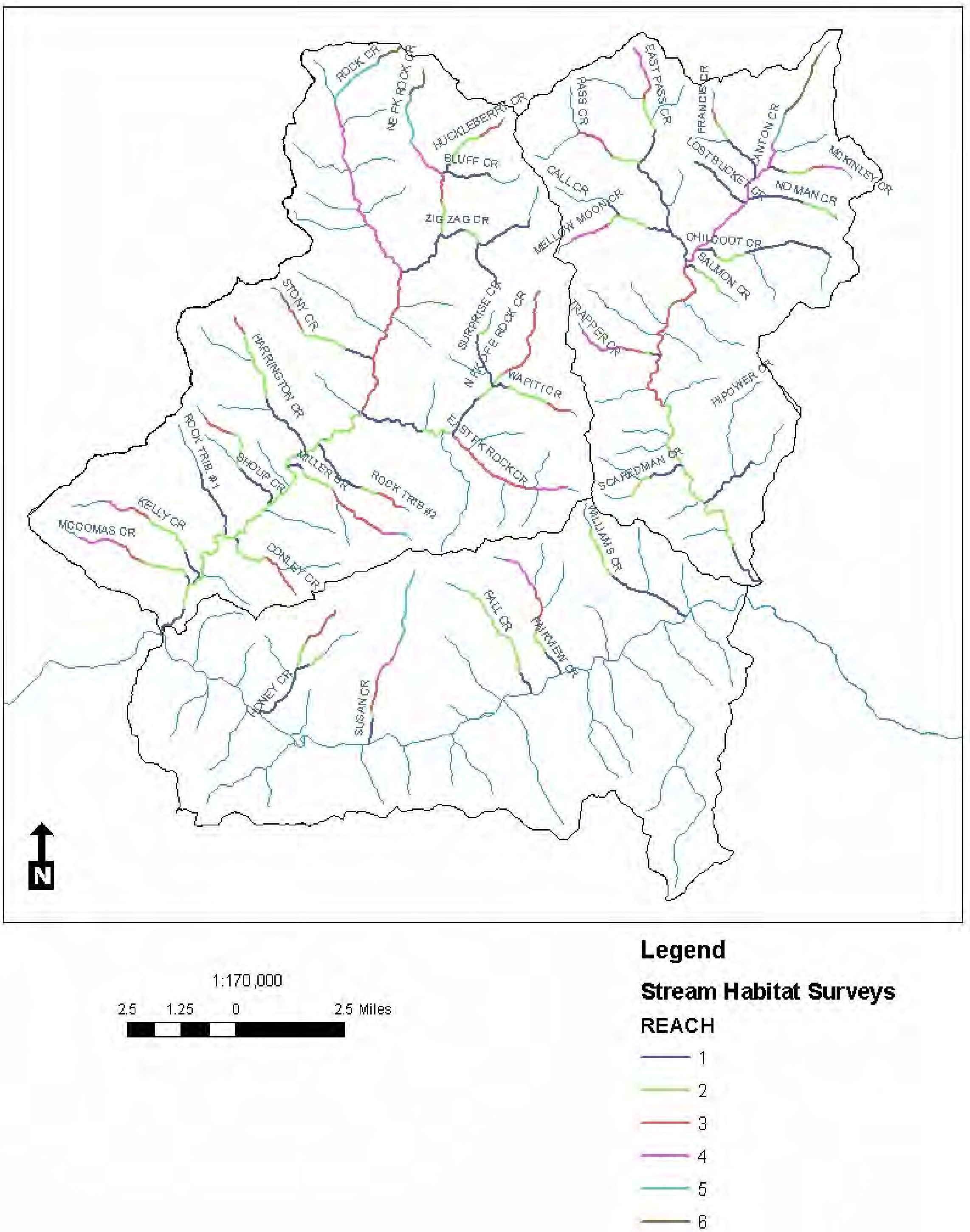
Appendix 2: Stream habitat surveys and land use classification

Stream reaches surveyed by the ODFW



Stream habitat survey ratings by stream reach

• = Poor •• = Fair ••• = Good or Excellent

Stream	Reach	Pools	Riffles	Riparian Area	Large Woody Material
Bluff Creek	1	•••	•	••	•
Canton Creek	1	•••	•	•	•
Canton Creek	2	•••	••	••	•
Canton Creek	3	••	••	••	•
Canton Creek	4	••	••	•••	••
Canton Creek	5	•	•	•••	•••
Canton Creek	6	•	•••	•••	•••
Chilcoot Creek	1	••	••	•	•••
Chilcoot Creek	2	•••	•	•••	•••
Conley Creek	1	••	•	•••	•
Conley Creek	2	•	•	•••	•••
Conley Creek	3	•	•	•••	•••
East Fork Rock Creek	1	••	•	•	•
East Fork Rock Creek	2	••	•	•	•
East Fork Rock Creek	3	••	••	•	••
East Fork Rock Creek	4	•	•••	••	•
East Pass Creek	1	••	•••	•••	••
East Pass Creek	2	•	••	•••	•
East Pass Creek	3	•	••	•••	••
East Pass Creek	4	•	•	••	••
Fairview Creek	1	••	•	•••	••
Fairview Creek	2	••	•	•••	••
Fairview Creek	3	•	•	•••	••
Fall Creek	1	••	•••	•••	•
Fall Creek	2	••	••	•••	••
Francis Creek	1	••	••	•••	•••
Francis Creek	2	••	•••	•••	••
Francis Creek	3	•	•	•••	••
Harrington Creek	1	•	••	•	•
Harrington Creek	2	•	•	•	•
Harrington Creek	3	•	•	•	•
Hipower Creek	1	•••	••	•	••
Honey Creek	1	••	•	•••	•
Honey Creek	2	•	•	•••	•••
Honey Creek	3	•	•	•	•••
Huckleberry Creek	1	•••	•••	•	••
Huckleberry Creek	2	••	•••	•••	••
Huckleberry Creek	3	•	•	•••	•••
Kelly Creek	1	•	••	••	•

Stream	Reach	Pools	Riffles	Riparian Area	Large Woody Material
Kelly Creek	2	•	•	•••	••
Kelly Creek	3	•	•	•	•
Kelly Creek	4	•	•	•••	•
Lost Bucket Creek	1	•	••	•••	•••
McComas Creek	1	•	•	••	•
McComas Creek	2	•	•	••	•
McComas Creek	3	•	•	•	•
McComas Creek	4	•	•••	•••	•
McKinley Creek	1	••	•	•••	••
McKinley Creek	2	••	••	•••	••
McKinley Creek	3	••	••	•••	••
McKinley Creek	4	•	•	•••	••
Mellow Moon Creek	1	•	•	•••	••
Mellow Moon Creek	2	••	•••	•	••
Mellow Moon Creek	3	•	•••	•••	•••
Mellow Moon Creek	4	•	•	•	•
Miller Creek	1	•	•	••	•
Miller Creek	2	••	•	•	•
Miller Creek	3	•	•	•	•
Miller Creek	4	•	•	•	•
Miller Creek	5	•	•	••	•
No Man Creek	1	••	••	•••	•••
No Man Creek	2	•	••	•••	••
North Fk of East Fk Rock Creek	1	••	••	•	•
North Fk of East Fk Rock Creek	2	•	•••	•	•
North Fk of East Fk Rock Creek	3	•	••	••	•
North Fk of East Fk Rock Creek	4	•	•	••	••
Northeast Fork Rock Creek	1	••	•••	••	•
Northeast Fork Rock Creek	2	•••	••	•••	••
Northeast Fork Rock Creek	3	•••	••	•••	•
Northeast Fork Rock Creek	4	•	••	••	••
Northeast Fork Rock Creek	5	••	••	•	••
Northeast Fork Rock Creek	6	•	•••	•••	•
Pass Creek	1	••	••	•••	•
Pass Creek	2	••	••	•••	•
Pass Creek	3	••	•	•••	••
Salmon Creek	1	•	•	••	•••
Salmon Creek	2	•	••	•••	•
Scaredman Creek	1	•	•••	•••	••
Scaredman Creek	2	••	••	•	•
Shoup Creek	1	•	••	••	•
Shoup Creek	2	••	••	•••	•••

Stream	Reach	Pools	Riffles	Riparian Area	Large Woody Material
Shoup Creek	3	•	•	•••	••
Stony Creek	1	••	•	•••	•
Stony Creek	2	•	•••	••	••
Stony Creek	3	•	•	•••	••
Surprise Creek	1	•	•	••	•
Surprise Creek	2	•	•	••	•
Susan Creek	1	•	•	•••	•
Susan Creek	2	•••	•	•••	•
Susan Creek	3	•	•	•••	•
Susan Creek	4	•	••	•••	•
Susan Creek	5	•	•	•••	••
Trapper Creek	1	•	•	••	•
Trapper Creek	2	••	•	•	••
Trapper Creek	3	••	•	••	•
Trapper Creek	4	•	•	•••	••
Wapiti Creek	1	•	•••	••	•
Wapiti Creek	2	•	••	••	•
Wapiti Creek	3	•	•	••	•
Williams Creek	1	••	••	•	•
Williams Creek	2	••	•	•	•
Zig Zag Creek	1	••	•••	••	•
Zig Zag Creek	2	•••	•••	••	•
Zig Zag Creek (North Fork)	1	••	••	••	•
Zig Zag Creek (South Fork)	1	•	••	••	•
Honey Creek Trib A	1	•	•	•••	•••
Honey Creek Trib A	2	•	•	•••	•••
Fairview Creek Trib	4	•	•	•••	•••
Rock Creek Unnamed Trib #1	1	•	•	••	•
Rock Creek Unnamed Trib #2	1	••	•	••	•
Rock Creek Unnamed Trib #2	2	•	••	••	•
Rock Creek Unnamed Trib #2	3	•	••	•••	•
Hipower Creek Trib	1	•	•	•	•••
Call Creek	1	•	•••	•	••
North Fork Chilcoot Creek	1	•	••	•••	•••
Rock Creek	1	••	••	••	•
Rock Creek	2	••	•	••	•
Rock Creek	3	•••	••	••	•
Rock Creek	4	••	•	•	•••
Rock Creek	5	•	••	•••	•••
Rock Creek	6	•	•	•	•
Total "Good" reaches (streams)		11(9)	19(16)	58(48)	22(18)
Total "Fair" reaches (streams)		41(34)	40(33)	34(28)	35(29)
Total "Poor" reaches (streams)		69(57)	62(51)	29(24)	64(53)

Land use surrounding each stream reach

The ODFW classified the land use for each reach surveyed within the Rock Creek Region. All categories have been included below, even those not applicable to the Rock Creek Region.

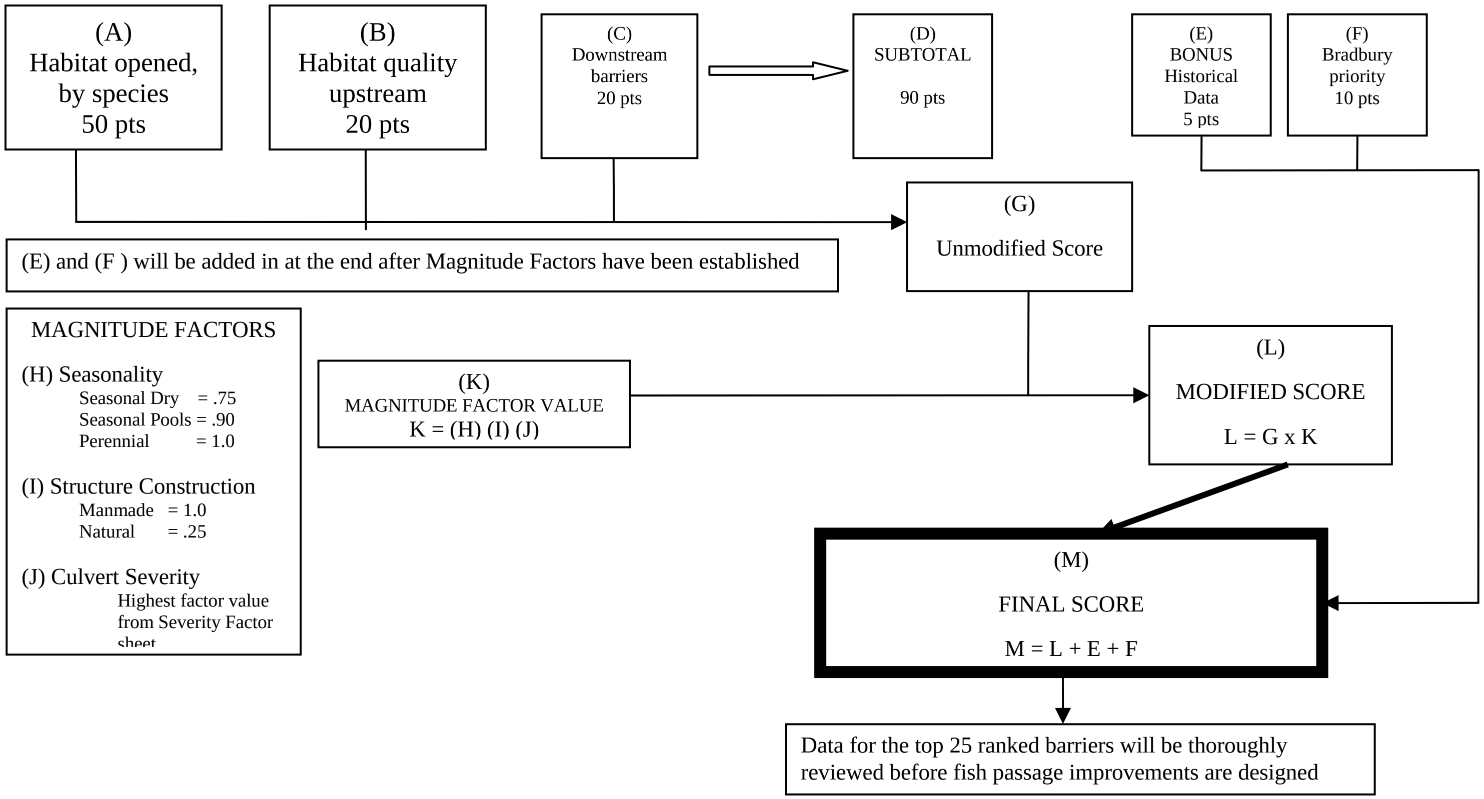
AG	Agricultural crop or dairy land.
TH	Timber harvest: active timber management including tree felling, logging, etc. Not yet replanted.
YT	Young forest trees: can range from recently planted harvest units to stands with trees up to 15 cm dbh.
ST	Second growth timber: trees 15-30 cm dbh within generally dense, rapidly growing, uniform stands.
LT	Large timber: 30 to 50 cm dbh.
MT	Mature timber: 50 to 90 cm dbh.
OG	Old growth forest: many trees with 90+ cm dbh and plant community with old growth characteristics.
PT	Partial cut timber: selection cut or shelterwood cut with partial removal of large trees. Combination of stumps and standing timber.
FF	Forest fire: evidence of recent charring and tree mortality.
BK	Bug kill: eastside forests with >60% mortality from pests and diseases.
LG	Light grazing pressure: grasses, forbs, and shrubs present. Banks not broken down, animal presence obvious only at limited points such as water crossing. Cow pies evident.
HG	Heavy grazing pressure: broken banks, well established cow paths. Primarily bare earth or early successional stages of grasses and forbs present.
EX	Exclosure: fenced area that excludes cattle from a portion of rangeland.
UR	Urban
RR	Rural residential
IN	Industrial
MI	Mining
WL	Wetland
NU	No use identified

Stream	Reach	Primary Land Use	Secondary Land Use
Bluff Creek	1	YT	
Canton Creek	1	ST	
Canton Creek	2	MT	
Canton Creek	3	ST	
Canton Creek	4	MT	OG
Canton Creek	5	MT	OG
Canton Creek	6	MT	
Chilcoot Creek	1	MT	
Chilcoot Creek	2	MT	
Conley Creek	1	LT	
Conley Creek	2	LT	ST
Conley Creek	3	MT	ST
East Fork Rock Creek	1	ST	LT
East Fork Rock Creek	2	ST	LT
East Fork Rock Creek	3	LT	MT
East Fork Rock Creek	4	ST	LT
East Pass Creek	1	ST	MT
East Pass Creek	2	MT	ST
East Pass Creek	3	MT	ST
East Pass Creek	4	MT	
Fairview Creek	1	MT	
Fairview Creek	2	MT	
Fairview Creek	3	MT	
Fall Creek	1	OG	
Fall Creek	2	OG	TH
Francis Creek	1	LT	
Francis Creek	2	MT	ST
Francis Creek	3	MT	LT
Harrington Creek	1	ST	LT
Harrington Creek	2	OG	MT
Harrington Creek	3	ST	LT
Hipower Creek	1	ST	
Honey Creek	1	LT	
Honey Creek	2	MT	
Honey Creek	3	YT	
Huckleberry Creek	1	ST	OG
Huckleberry Creek	2	OG	MT
Huckleberry Creek	3	OG	MT
Kelly Creek	1	ST	MT
Kelly Creek	2	ST	MT
Kelly Creek	3	YT	
Kelly Creek	4	OG	ST

Stream	Reach	Primary Land Use	Secondary Land Use
Lost Bucket Creek	1	LT	
McComas Creek	1	ST	MT
McComas Creek	2	MT	ST
McComas Creek	3	YT	
McComas Creek	4	OG	ST
McKinley Creek	1	MT	
McKinley Creek	2	MT	OG
McKinley Creek	3	MT	OG
McKinley Creek	4	MT	OG
Mellow Moon Creek	1	OG	
Mellow Moon Creek	2	YT	
Mellow Moon Creek	3	OG	YT
Mellow Moon Creek	4	YT	
Miller Creek	1	ST	LT
Miller Creek	2	LT	ST
Miller Creek	3	YT	
Miller Creek	4	YT	
Miller Creek	5	OG	ST
No Man Creek	1	MT	
No Man Creek	2	MT	
North Fk of East Fk Rock Creek	1	YT	
North Fk of East Fk Rock Creek	2	ST	MT
North Fk of East Fk Rock Creek	3	MT	ST
North Fk of East Fk Rock Creek	4	MT	
Northeast Fork Rock Creek	1	OG	YT
Northeast Fork Rock Creek	2	OG	MT
Northeast Fork Rock Creek	3	OG	MT
Northeast Fork Rock Creek	4	YT	OG
Northeast Fork Rock Creek	5	TH	
Northeast Fork Rock Creek	6	OG	YT
Pass Creek	1	MT	YT
Pass Creek	2	MT	
Pass Creek	3	MT	OG
Salmon Creek	1	ST	YT
Salmon Creek	2	ST	YT
Scaredman Creek	1	OG	YT
Scaredman Creek	2	ST	YT
Shoup Creek	1	ST	YT
Shoup Creek	2	OG	
Shoup Creek	3	ST	LT
Stony Creek	1	ST	MT
Stony Creek	2	MT	YT
Stony Creek	3	MT	YT

Stream	Reach	Primary Land Use	Secondary Land Use
Surprise Creek	1	OG	YT
Surprise Creek	2	MT	YT
Susan Creek	1	LT	
Susan Creek	2	ST	
Susan Creek	3	ST	
Susan Creek	4	ST	
Susan Creek	5	ST	
Trapper Creek	1	YT	
Trapper Creek	2	YT	
Trapper Creek	3	YT	
Trapper Creek	4	OG	
Wapiti Creek	1	OG	MT
Wapiti Creek	2	MT	OG
Wapiti Creek	3	MT	
Williams Creek	1	LT	
Williams Creek	2	OG	
Zig Zag Creek	1	YT	ST
Zig Zag Creek	2	OG	MT
Zig Zag Creek (North Fork)	1	YT	ST
Zig Zag Creek (South Fork)	1	YT	ST
Honey Creek Trib A	1	LT	
Honey Creek Trib A	2	ST	
Fairview Creek Trib	4	ST	
Rock Creek Unnamed Trib #1	1	MT	ST
Rock Creek Unnamed Trib #2	1	YT	MT
Rock Creek Unnamed Trib #2	2	MT	YT
Rock Creek Unnamed Trib #2	3	OG	MT
Hipower Creek Trib	1	ST	
Call Creek	1	YT	
North Fork Chilcoot Creek	1	MT	ST
Rock Creek	1	RR	LT
Rock Creek	2	RR	LT
Rock Creek	3	ST	YT
Rock Creek	4	YT	ST
Rock Creek	5	OG	MT
Rock Creek	6	OG	MT

Appendix 3: UBFAT scoring process for fish passage barriers



Culvert Severity (J)	
0.0	Not a barrier
0.5	Barrier to all juveniles
0.6	barrier to all juveniles, adult cutthroat
0.8	Barrier to all juveniles, adult cutthroat, coho
0.9	Barrier to all juveniles, adult cutthroat, coho, chinook
1.0	Barrier to all juvenile/adult species

Appendix 4: Temperature data

Roseburg BLM summary of temperature data collected since 1992

Standard = 60.8°F

Stream Name	1992	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Average	# Years
Canton Cr above Pass Cr	68.0	66.1	64.2	68.2	64.8	65.6	62.8	64.7		65.5		66.0	65.6	10
Pass Cr above East Fork Pass Cr		62.1	60.3	61.8	60.0	62.8		61.8	61.1				61.4	7
East Fork Pass Cr		64.0	61.8	63.5	62.8	62.4	61.9	60.7	64.0	63.5			62.8	9
Pass Cr				32.0		69.3	66.0	66.2		68.2		68.2	67.6	5
Call Cr	62.1	62.0					58.2						60.8	3
Mellow Moon Cr		62.5	60.6				59.5	59.6					60.6	4
Trapper Cr		64.8	61.3				58.8	59.6					61.1	4
Middle Canton Cr		74.7	70.6	72.1	72.1	73.2		71.8	72.2				72.4	7
Scaredman Cr		61.6	59.9				60.5	60.7	61.2				60.8	5
Susan Cr							63.4	64.4		65.7			64.5	3
Honey Cr								65.1		65.5			65.3	2
Honey Cr upper							60.1						60.1	1
Rock Cr above NE Fork Rock Cr			59.6	61.3	63.3	63.9	61.1	61.9		62.6			62.0	7
NE Fork Rock Cr		66.6	65.4	66.2	64.2	67.1				64.9			65.8	6
North Fork East Fork Rock Cr								59.7		61.2			60.4	2
East Fork Rock Cr		65.9	63.0	65.0	63.7	65.3	62.8					65.1	64.4	7
Rock Cr above East Fork Rock Cr		72.9		70.5	70.2	71.2						70.5	71.1	5
Woodstock Cr				63.5			61.3	62.0	62.2				62.3	4
Harrington Cr above slide					59.1	64.9	59.4						61.1	3
Harrington Creek below slide					66.9	65.2	68.8						67.0	3
Rock Cr above Miller Cr			69.2	67.6		72.0		70.6					69.9	4
Miller Cr		62.6	61.2		61.4		62.0	61.2					61.7	5
Kelly Cr		61.2	60.4			60.8			60.0				60.6	4

Forest Service temperature data collected for the UNF Middle North Umpqua Watershed Analysis, 2001

Tributary Name	1999 Temperatures (°F)		2000 Temperatures (°F)	
	7DAM	Daily change	7DAM	Daily change
North Umpqua above Wright Creek	----	----	65.3	----
Wright Creek at mouth	61.6	2.2	----	----
Thunder Creek at mouth	61.6	2.2	62.2	3.7
Williams Creek at mouth	61.5	2.0	62.6	2.9
Fairview Creek at mouth	61.6	2.2	61.8	1.9

Appendix 5: Water rights by use

There are thirteen general water use categories. The table below lists the Oregon Water Resources Department uses that are included in each category. Not all uses occur in the Rock Creek Region watersheds.

Mining
Mining

Agriculture
Agriculture
Supplemental food harvest
Cranberry harvest
Cranberries
Dairy barn
Frost protection
Greenhouse
Mint still
Nursery uses
Temperature control

Domestic
Domestic
Domestic including lawn and garden
Domestic expanded including non-commercial garden
Domestic & livestock
Group domestic
Human consumption
Restroom
School

Irrigation
Irrigation of cranberries
Irrigation, livestock & domestic
Primary & Supplemental
Irrigation & domestic
Irrigation & livestock
Irrigation
Supplemental irrigation
Out of season irrigation

Commercial
Commercial uses
Geo-thermal
Manufacturing
Laboratory
Log deck sprinkling
Shop
Sawmill

Recreation
Campsite
Recreation
Swimming

Power
Power Development

Fish
Aquaculture
Fish culture
Fish & wildlife

Livestock
Livestock
Livestock & wildlife

Municipal
Municipal
Quasi-municipal

Wildlife
Wildlife

Miscellaneous
Air-conditioning or heating
Aesthetics
Forest management
Fire protection
Groundwater recharge
Multiple purpose
Pollution abatement
Pond maintenance
Road construction
Storage

Instream (non-consumptive)
Supporting aquatic life
Best use from storage
Anadromous & resident fish hab.
Instream
Instream fishery enhancement
Fisheries enhancement
Flow augmentation for fish
Anadromous & res. fish rearing
Fish hab for res. Borax lake chub
Supporting aquatic & minimizing pollution
Anadromous. & recreational fish & recreation
Support aquatic life, recreation & aesthetics.
Support recreation & aesthetic benefits
Support recreational boating
Support aquatic life & recreation

Appendix 6: Fish data

Downstream migrant trapping data.

Rock Creek Watershed

East Fork Rock Creek (all in 1958)

Date	Steelhead			Cutthroat	Dace	Lamprey
	<2"	2" to 4"	4" to 6"	6" to 8"		
Jun 8-14	1	0	0	0	0	0
Jun 15-21	27	4	0	0	7	1
Jun 22-28	10	10	1	0	13	0
29 to Jul 4	7	5	0	0	12	0
Jul 5-11	15	4	0	0	12	0
Jul 12-18	26	2	5	0	11	0
Jul 19-25	19	10	1	0	38	0
26 to Aug 1	20	15	1	3	18	0
Aug 2-8	8	3	0	0	11	0
Aug 9-15	8	9	0	0	22	0
Aug 16-22	2	1	0	0	5	0
Aug 23-29	0	2	0	0	0	0
30 to Sept 5	1	0	1	0	3	0
Sept 6-11	3	2	0	0	30	0
Sept 12-18	5	2	0	0	0	0
Sept 19-25	5	9	0	0	16	0
26 to Oct 2	1	0	0	0	0	0
Oct 3-9	1	1	0	0	0	0
Total	**158**	**79**	**9**	**3**	**198**	**1**

Canton Creek Watershed

Francis Creek

Date	Cutthroat	Steelhead 0+	Steelhead 1+	Sculpin
3/4/69	0	0	0	0
4/5/69	129	0	0	1
5/6/69	95	0	1	0
6/7/69	8	0	1	1
3/4/70	66	0	0	0
5/6/70	105	0	0	0
Total	**403**	**0**	**2**	**2**

Canton Creek (all in 1958)

Date	Steelhead				Cutthroat			Dace
	<2”	2” to 4”	4” to 6”	>6”	4” to 6”	6” to 8”	>8”	
May 11-17	0	305	82	2	0	0	1	2
May 18-24	3	607	126	0	1	0	0	7
May 25-31	12	267	64	0	2	0	0	16
Jun 1-7	2	42	9	0	0	1	0	0
Jun 8-14	69	12	0	0	0	1	0	2
Jun 15-21	143	95	0	0	0	0	0	8
Jun 22-28	36	50	3	0	0	0	0	20
29 to Jul 5	0	37	0	0	0	0	0	12
Jul 6-12	18	36	16	0	2	2	0	27
Jul 13-19	175	52	5	0	0	1	0	17
Jul 20-26	174	33	1	1	0	0	0	9
27 to Aug 2	74	7	1	2	0	2	0	48
Aug 3-9	66	6	5	0	0	0	1	21
Aug 10-16	96	9	2	0	0	0	0	20
Aug 17-23	31	9	0	0	0	1	0	16
Aug 24-30	29	2	1	0	0	0	0	25
31 to Sept 6	15	8	2	0	0	0	0	23
Sept 7-13	113	11	1	1	0	0	1	14
Sept 14-20	34	0	0	0	0	0	0	1
Sept 21-27	39	1	0	0	0	0	0	6
28 to Oct 4	10	0	0	0	0	0	0	0
Oct 5-11	0	0	0	0	0	0	0	0
Total	**1,130**	**1,589**	**318**	**6**	**5**	**8**	**3**	**294**

Pass Creek

Date	Cutthroat	Steelhead	Coho	Sculpin
3/4/70	11	0	0	1
5/6/70	263	28	2	0
Total	**273**	**28**	**2**	**1**

Middle North Umpqua Watershed

Honey Creek

Date	**Cutthroat**	**Steelhead**		**Brown Trout**	**Coho**		**Dace**	**Sculpin**	**Lamprey**
		0+	**1+**		**0+**	**1+**			
2/3/66	2	33	0	0	9	0	0	0	0
3/4/66	21	584*	0	0	66	25	18	0	0
4/5/66	32	350	0	0	247	221	77	2	0
5/6/66	0	0	0	0	53	0	0	0	0
1/2/67	1	0	0	0	7	0	0	0	0
2/3/67	0	18	0	0	435	38	0	0	1
3/4/67	11	128	0	0	10,526*	76	2	0	0
4/5/67	29	233	0	0	202	243	7	0	0
5/6/67	31	4	60	3	140	65	20	2	0
6/7/67	1	0	0	1	51	0	9	0	0
2/3/68	3	0	9	0	0	10	0	0	0
3/4/68	16	0	83	0	0	91	0	0	0
4/5/68	34	0	90	1	0	332	2	1	0
5/6/68	15	0	27	0	0	68	3	0	0
6/7/68	0	0	0	0	0	0	15	0	0
Total	**196**	**1,350**	**269**	**5**	**11,736**	**1,169**	**153**	**5**	**1**

* Excessively high numbers of 0+ age groups are an indication of traps located below one or more redds that emerged while the trap was in operation.

Appendix 7: Summary of the Rock Creek Region fish summit meeting for prioritizing fish habitat restoration.

On November 1, 2005, the UBWC and Roseburg BLM hosted a one-day working meeting to help prioritize fish habitat restoration within the Rock Creek Region. The goal of the meeting was to have **fish biologists and other experienced users of the area share their knowledge of these watersheds in order to identify limiting factors and appropriate restoration opportunities.** By the end of the day, we hoped to have a prioritized list that identifies specific locations with recommended types of restoration projects.

Participants included fish biologists, hydrologists, and other natural resource specialists with knowledge of the streams within the Rock Creek Region. They represented six different agencies, companies, and non-profit groups. Several additional members from the public and other groups were invited but could not attend. Those that participated are listed below.

Roseburg BLM
Chip Clough, Fish Biologist
Dan Couch, Planning Coordinator
Mike Crawford, Fish Biologist
Dan Damman, Hydrologist
Scott Lightcap, Fish Biologist
Jake Winn, Restoration Coordinator

Umpqua National Forest
Jeff Dose, Fish Biologist
Ron McMullen, Fish Biologist

Stillwater Sciences
Dirk Pedersen, Fish Biologist

Pacificorp
Rich Grost, Aquatic Ecologist

ODFW
Bill Cannaday, Fish Biologist
Dave Harris, Fish Biologist
Sam Moyer, Fish Biologist
Jim Muck, Fish Biologist

UBWC
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The meeting began with a morning discussion on what each participant's interest in the meeting and the Region was, and what we hoped to accomplish by the end of the day. We then brainstormed in both small groups and together in one group, what limiting factors affect healthy fish use in the streams within the Region. Based on agreement of these factors, we discussed what restoration practices can be used that address them and which are most effective. This resulted in the following matrix (Table A-1) that shows limiting factors, and the level of effectiveness expected by each potential treatment in addressing the limiting factors.

Limiting Factors	Potential Treatments									
	Instream wood/boulder placement*	Riparian Improvement**	Riparian Protection**	Culvert replacement or removal	Road Obliteration	Road Improvement	Fish Carcass Additions	Fish passage at diversion dam	Sort station at div. dam	Hatchery policy
Winter habitat	Excellent	Good	Good	Fair	Good	Fair	N/A	N/A	N/A	N/A
Summer temperatures	Good	Excellent	Excellent	N/A	Good	N/A	N/A	N/A	N/A	N/A
Spawning gravel	Excellent	Good	Good	N/A	Good	Fair	N/A	N/A	N/A	N/A
Fish passage obstacles	N/A	N/A	N/A	Excellent	Excellent	Good	N/A	Excellent	N/A	N/A
Hatchery influences (genetics)	N/A	N/A	N/A	N/A	N/A	N/A	***	N/A	Excellent	Excellent
Peak flow increases	Good	Good	Good	***	Excellent	Fairly Good	N/A	N/A	N/A	N/A
Nutrient additions	Good	Good	Good	N/A	N/A	N/A	Excellent	N/A	N/A	N/A
Adult holding & harassment	Fair	Fair	Fair	N/A	Good	N/A	N/A	Fair	N/A	N/A

Table A-1: Effectiveness of treatment options on limiting factors within the Canton Creek, Rock Creek, and Middle North Umpqua watersheds.

* Direct short-term effects ** Indirect long-term effects *** Relationship

In the second half of the meeting, we used this matrix to help identify the highest priority streams or stream segments with specific limiting factors that should be targeted for effective restoration of fish habitat. Each participant was asked to choose five significant locations and associated limiting factors and treatments. These were written out and identified on maps.

The results from this process are summarized in Table A-2 which correlates location to limiting factors and treatments. The number of times a location, limiting factor, and treatment were identified is listed after the location if selected more than once,. This shows where there is agreement on the highest priorities of specific streams or reaches for restoration work. However, we did not rank the group's projects but instead listed the entire summary as the highest priorities within the Region. This allows for more project flexibility in implementation. For example, if a specific location in Harrington Creek is identified as the highest priority for instream wood placement to address winter habitat, we may also want to accomplish riparian improvement work there while we have an active contractor in the area, and to insure future wood for that stream section even though riparian improvement work on Harrington may have been ranked much lower than other projects. In addition, not every participant is familiar with every portion of the Region. Most have first-hand knowledge of specific areas within the Region that they are more likely to comment on. Therefore a numerical ranking of the group's selection is not valid.

The summary of projects is valuable in conjunction with the results of this watershed assessment's findings. We can use the assessment's most limiting factor results for each watershed to help target projects that are most effective in addressing those concerns. For example, in Rock Creek, the assessment identified lack of winter habitat related to peak flows and temperature as two significant limiting factors for fish, as well as fish barriers on Kelly and McComas creeks that block access to upstream habitat. The summary matrix here can be used to target projects that work toward improving those factors within the Rock Creek Watershed. These might include large instream wood placement and riparian improvement on Harrington Creek and culvert replacement on Kelly and/or McComas creeks.

Most locations identified were quite specific. However, a few were more general in nature, especially those targeting road maintenance or obliteration. Where specific roads were identified for treatment potential, they are included in the matrix. Some locations of specific road segments with the greatest impacts to streams due to road location or maintenance issues were unknown. Treatments identified that were not specific to location or limiting factors, or where some interpretation was required, are listed in notes following the matrix in Table A-2. Further clarification of these listings is necessary for project proposal and development that addresses these priorities.

Limiting Factors	Potential Treatments									
	Instream Wood/Boulder Placement*	Riparian Improvement**	Riparian Protection **	Culvert Replacement or Removal	Road Obliteration	Road Improvement	Fish Carcass Additions	Fish Passage @ Diversion Dam	Sorting Station @ Diversion Dam	Hatchery Policy
Winter habitat	Kelly Cr Pass Cr x 3 Harrington Cr x 3 Harrington Cr reach 1,2,3 Rock Cr lower main (margins) x 2 (up to E Fk Rock) Rock Cr reach 3 to 6 x 2 Rock Cr upper tribs & small main margins Rock Cr section 21 & 15 (experiment with large wood) Rock Cr main x 2 E Fk Rock Cr reach 1,2,3 E Fk Rock Cr x 4 Canton Cr upper tribs & small main margins Canton Cr main x 2 Canton Cr reach 4 to 19 Canton Cr reach 16 McComas Cr reach 1,2 Miller Cr reach 1,2,3 Miller Cr McComas Cr Shoup Cr	Pass Cr x 2 Harrington Cr E Fk Rock Cr Shoup Cr Canton Cr x 2 Rock Cr main Rock Cr reach 3-6	Canton Cr E Fk Rock Cr x 2		E Fk Rock Cr E Fk Rock Cr (valley bottom) N Fk E Fk Rock Cr (valley bottom) Rock Cr main Rock Cr main above E Fk Canton Cr main Pass Cr Harrington Cr Harrington Cr (valley bottom) Mellow Moon Cr (valley bottom)					Rock Cr reach 3-6
Summer temperatures	Rock Cr reach 3-6 Rock Cr main Canton Cr main Canton Cr reach 4 to 19 Pass Cr Harrington Cr	Miller Cr Pass Cr x 3 Harrington Cr x 2 Canton Cr x 3 Rock Cr (lower) Rock Cr (main) x 2 Rock Cr (upper) Rock Cr reach 3-6	E Fk Rock Cr Rock Cr (lower) Rock Cr (main) Rock Cr (upper) Canton Cr x 2		Rock Cr main above E Fk Rock Cr Rock Cr main Canton Cr main Pass Cr E Fk Rock Cr (valley bottom) N Fk E Fk Rock Cr (valley bottom) Harrington Cr (valley bottom) Harrington Cr Mellow Moon Cr (valley bottom)					Rock Cr reach 3-6
Spawning gravel	Rock Cr lower main (margins) Rock Cr upper tribs & small main margins Rock Cr section 21 & 15 (experiment with lg wood) Canton Cr reach 4 to 19 Canton Cr upper tribs & small main margins				E Fk Rock Cr (valley bottom) N Fk E Fk Rock Cr (valley bottom) Harrington Cr (valley bottom) Mellow Moon Cr (valley bottom) Rock Cr main above E Fk Rock Cr					
Fish passage obstacles				Taylor Cr Kelly Cr x 4 E Fk Rock Cr Surprise Cr McComas Cr x 2				Rock Cr x 4		
Hatchery influences (genetics)									Rock Cr x 4****	Rock Cr
Peak flow increases	Rock Cr lower main (margins) Rock Cr upper tribs & small main margins Rock Cr section 21 & 15 (experiment with lg wood) Canton Cr upper tribs & small main margins	Miller Cr Pass Cr Harrington Cr				Rock Cr (basin wide) Canton Cr(basin wide)				
Nutrient additions	Rock Cr lower main (margins) Rock Cr upper tribs & small main margins Rock Cr section 21 & 15 (experiment with lg wood) Canton Cr upper tribs & small main margins									
Adult holding & harrassment										

* Direct short-term effects ** Indirect long-term effects ***Relationship ****Smolt monitoring station also included on one entry

Table A-2: Summary matrix associating locations to limiting factors and treatments within the Rock Creek Region.

Notes on participant input:

- The entire Canton Creek Watershed was identified for “road obliteration” and not tied to limiting factors.
- The upper portion of the Rock Creek Watershed was identified for “road obliteration” and not tied to limiting factors.
- “Habitat complexity” was mentioned as a limiting factor. Assumed to be captured with the additional mention of “peak flow, winter survival and nutrients” as limiting.
- Canton, Kelly and McComas creeks were listed with "instream" treatment and no limiting factors. Assumed the limiting factor is “winter habitat” in all three and the treatment is “wood/boulder placement”.

In addition to the above summarized priorities, many other important points were brought out. Four of these are listed below.

1. It is also important to protect habitat that is currently in good condition before it becomes a future problem area. Canton Creek and the Middle North Umpqua watersheds have significant protection on streams due to areas identified in the Northwest Forest Plan with restricted use and levels of harvest. Valuable areas primarily within the Rock Creek Watershed that may benefit from additional protection could be addressed through conservation easements on private land and input into project planning on federal land.

2. The Rock Creek Hatchery diversion dam is a significant problem for fish. Because ODFW has a plan in place to fix the fish ladder via funding through the off-site mitigation with Pacificorp, some participants did not place their priority choices on this project, assuming it will be accomplished anyway.

3. Long-term monitoring is important in Rock Creek, especially with the diversion dam and hatchery location. Many biologists mentioned the significance of including long-term monitoring, including a sorting station that ODFW has proposed to install at the dam. Funding for the sorting station is not yet secure, but its importance was emphasized at this meeting.

4. Restoration projects that improve habitat and boost fish numbers can be a significant benefit to the recovery and long-term sustainability of anadromous fish in the Umpqua Basin. However, projects should not be implemented that do not eventually result in self-sustaining habitat. Small fixes that will need to be continually repeated to sustain salmonids in the long-run are not viable worthwhile projects. This should be considered with each project proposal.