MIDDLE ROGUE WATERSHED ASSESSMENT

Prepared by the

Middle Rogue Watershed Association

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EXECUTIVE SUMMARY

Overview: The Middle Rogue Watershed (MRW) encompasses nearly 607 square miles in the northern portion of Josephine County in southern Oregon from the just below Kelsey Creek on the border of Curry and Josephine Counties to just below Evans Creek on the border of Josephine and Jackson Counties, excluding the Illinois and Applegate Watersheds. The area is mountainous and heavily forested with hot and dry summers and mild and wet winters. It is largely rural with one urban center, Grants Pass, and a number of small communities. In this assessment, we have divided the MRW into five subwatersheds: Grave Creek, Galice Creek, Jumpoff Joe Creek, Grants Pass, and the Wild and Scenic watersheds.

Existing vegetative conditions in the watershed are a result of fire exclusion and replacing the natural disturbance pattern with human disturbances such as logging (particularly of the high-value pine species), farming, and rural development. Fire exclusion has resulted in high densities of trees and shrubs that are not sustainable over time, has caused a shift from fire-resistant white oak and ponderosa pine to the more fire-prone Douglas fir stands, and eliminated the pattern of frequent low intensity fires. Fire exclusion coupled with increased residential and industrial development has greatly increased the risk of major fires with its concomitant danger to humans and private property as well as its destruction of the natural resources and soil stability in the watershed.

Historical Conditions: Native Americans, who gathered, hunted, and fished in the watershed for 10,000 years, had a relatively low impact on the land. In less than 200 years, however, European Americans have had a dramatic impact on the land. Early trappers eliminated the beaver; miners cut down mountainsides, dug ditches, and left huge tailing piles; the railroad brought in settlers, farmers, and traders; farmers cleared land for crops and dug irrigation ditches; and logging companies felled the timber.

Channel Habitat Type: Channel habitat types (CHTs) are groups of stream channels with similar *gradients* (slopes), *channel confinement* (ratio of the width of the stream to the width of the floodplain), and *channel pattern* (from complex to simple). A channel modification is a man-made alteration that influences channel geomorphology and often disrupts biotic function. Modifications include dams, roads, bridges, riprap, ditches, culverts, in-stream mining, in-stream ponds, levees, and other bank stabilization efforts. Channel modifications can move a stream from its natural channel, affect water velocity, reduce available habitat for aquatic organisms, and change water temperature. Modifications can also confine a stream to a single channel, causing down-cutting and the reduction of channel complexity.

Almost 68% of the stream miles within the MRW have at least a moderate gradient and confined channel. Only the Grants Pass and Jumpoff Joe subwatersheds have a substantial amount of low gradient streams. It is in these two subwatersheds and in the floodplain area of Grave Creek that channel modification activity is most likely to occur.

Hydrology: The hydrology cycle, or the movement of water, of a watershed includes (1) precipitation, (2) runoff and infiltration, and (3) flow through the creek, lake, wetland, and groundwater systems. Land use practices as forestry, agriculture, grazing, irrigation, mining, residential development, ditching, and road building affect runoff and infiltration and increase the risks of higher peak flows (potential flooding) and lower low flows. Table E-1 indicates the risk of enhanced peak flows by land use practice in the five subwatersheds throughout Middle Rogue Watershed

Table E-1. Land Use Peak Flow Enhancement Risk Level

Land Use Practice	Wild & Scenic	Galice	Grave	Jumpoff Joe	Grants Pass	Total MRW
Forestry	LOW	LOW	LOW	LOW	LOW	LOW
Agriculture	LOW	LOW	LOW	LOW	LOW	LOW
Forest Roads	LOW	LOW	LOW	LOW	LOW	LOW
Rural Agricultural Roads	LOW	LOW	LOW	MODERATE	MODERATE	LOW
Rural/Urban Residential Roads	LOW	HIGH	HIGH	HIGH	HIGH	HIGH

The water rights allocated by the Oregon Water Resources Department for streams within the MRW are used predominantly for irrigation and industrial consumptive uses. Most of the 1625.94 cfs allocated in the MRW are allocated in the Galice, Grave, and Jumpoff Joe subwatersheds (Table E-2). Most streams in the watershed are over-allocated; that is, there is more water allocated to users than exists naturally in the streams. Streams with high restoration potential, especially during the summer months, are listed in Table E-3.

Table E-2. Water (cfs) Allocated by Subwatershed.

Basin	Irri-gation	Fish/ Wild	Agri-culture	Indus-trial	Muni-cipal	Do-mestic	Recrea-tional	Misc.	Total
Wild & Scenic	0.10	0.00	0.00	68.49	0.00	0.02	0.04	0.01	68.66
Galice	76.42	0.00	0.00	613.71	0.00	1.47	0.00	0.00	691.60
Grave	32.27	1.53	0.02	537.80	0.00	1.16	0.04	0.15	572.97
Jumpoff Joe	30.74	0.49	0.05	206.27	0.00	0.74	0.39	0.14	238.82
Grants Pass	9.34	0.03	1.79	40.45	0.00	1.25	0.01	1.02	53.89
Total	**148.87**	**2.05**	**1.86**	**1466.72**	**0.00**	**4.64**	**0.48**	**1.32**	**1625.94**

Table E-3. Over-Allocated Streams with High Restoration Potential

Subwatershed	Creeks				
Wild & Scenic	Little Windy				
Galice	Galice	Picket	Shan	Limpy	Dutcher
Grave	Grave	Wolf	Poorman		
Jumpoff Joe	Jumpoff Joe	Louse			
Grants Pass	Fruitdale				
Rogue River					

Fish and Fish Habitat: The Rogue River and its tributaries are the largest salmon and steelhead producer of Oregon's coastal streams south of the Columbia River and one of the most important on the Pacific Coast. A substantial portion of the five major Rogue River Basin anadromous salmonids *(spring and fall chinook, coho, and summer and winter steelhead)* utilize the MRW for migration, spawning and rearing. Human activity that changes complex stream environments can have a profound impact on salmonid survival. Fall chinook are doing relatively well in the Rogue Basin, while wild Spring chinook numbers are dwindling. Wild coho numbers are low, although they are showing minor improvement in the watershed. The wild winter steelhead population has been highly variable over the past two decades, and wild summer steelhead make up only one-third of the total population and seem to be declining.

Fish habitat condition is measured by the condition of pool habitat, riffle habitat, woody debris habitat, and riparian habitat. The overall pool and riffle habitat condition in the MRW is intermediate, the amount of standing conifers and large woody debris within the riparian zone is low, and stream temperatures are not optimal in many of the MRW streams. Overall, the major problems seem to be lack of complex habitat and stream bank instability.

Forty-four (44) fish passage barriers have been identified in the MRW. These include culverts, irrigation diversions, and Savage Rapids Dam.

Water Quality: The Oregon Department of Environmental Quality (DEQ) has set standards that are the most important for maintaining the quality of Oregon's waterbodies for all beneficial uses. Beneficial uses include quality drinking water, industrial water supply, agriculture, recreation, and fish and wildlife. The parameters used to measure water quality include water temperature, bacteria, turbidity, chemicals, modified water flow, and fish habitat modifications.

As required by federal and state laws, if a waterbody does not meet these criteria, the stream or stream segment will be listed on the 303(d) list as "water quality limited". Over 25% of the stream miles in the MRW are currently listed for exceedance of temperature during summer months. The greatest number of these are in the Grave Creek (41.2%) and Jumpoff Joe (43.17%) subwatersheds. The Galice subwatershed has 20.79% of its stream miles and the entire Rogue River within the MRW are listed for temperature. The Rogue River, from Evans Creek to Applegate, is also listed for bacteria and for Ph from Grave Creek to Applegate (Table E-4).

Thirteen Creeks and parts of the Rogue River are also under consideration for listing on the 303(d) list for a number of other water quality parameters (Table E-5). The causes for these exceedances vary from stream segment to stream segment and may include lack of riparian shading, water withdrawals, return flows, and poor groundwater recharge.

Sediment Sources: Erosional processes lead to and human activity increases the amount of sediment that reaches streams, most of which occurs during the winter months with the highest precipitation and streamflows. In the MRW, the primary causes are road runoff, road instability, and slope instability. Large amounts of water carrying debris also leads to stream bank erosion. The prevalent soils in the MRW are granitic with a high potential for erosion. Although erosion potential varies depending upon soil type, vegetative cover, and the gradient and length of the slope, over 75% of the soils in the entire watershed have a severe potential for erosion.

Road densities of over 3.5 miles per square mile (3.5mi/mi^2) are considered to have a high potential for delivering excessive amounts of sediment to the stream system. The MRW has an average density of 4.42 mi/mi^2 with Grave (5.02 mi/mi^2), Jumpoff Joe (5.46 mi/mi^2), and Grants

Table E-4. Streams in the MRW Listed on 1998 DEQ 303d List.

Subwatershed	Stream	Stream Segment	Parameter
Galice	Dutcher Creek	Mouth to RM 2.5	Temp
Galice	Galice Creek	Mouth to North/South Fork Confluence	Temp
Galice	Galice Creek, South Fork	Mouth to Chieftain Creek (RM 3)	Temp
Galice	Hog Creek	Mouth to Headwaters	Temp
Galice	Pickett Creek	Mouth to RM 4	Temp
Galice	Rogue River	Grave Creek to Applegate River	Bacteria
Galice	Rogue River	Grave Creek to Applegate River	pH
Galice	Rogue River	Grave Creek to Applegate River	Temp
Galice	Shan Creek	Mouth to Headwaters	Temp
Galice	Taylor Creek	Mouth to China Creek	Temp
Grants Pass	Bee Creek (Savage Creek)	Mouth to Headwaters	Temp
Grants Pass	Rogue River	Applegate River to Evans Creek	Bacteria
Grants Pass	Rogue River	Applegate River to Evans Creek	Temp
Grants Pass	Savage Creek	Mouth to headwaters	Temp
Grave	Big Boulder Creek	Mouth to Headwaters	Temp
Grave	Boulder Creek (Grave Creek)	Mouth to headwaters	Temp
Grave	Clark Creek (@ Grave Creek)	Mouth to Headwaters	Temp
Grave	Coyote Creek	Mouth to Headwaters	Temp
Grave	Grave Creek	Mouth to Last Chance Creek	Temp
Grave	Poorman Creek	Mouth to Headwaters	Temp
Grave	Reuben Creek	Mouth to Headwaters	Temp
Grave	Slate Creek (Grave Creek)	Mouth to Headwaters	Temp
Grave	Wolf Creek	Mouth to Headwaters	Temp
Jumpoff Joe	Jump Off Joe Creek	Mouth to Headwaters	Temp
Jumpoff Joe	Louse Creek	Mouth to Headwaters	Temp
Jumpoff Joe	Quartz Creek	Mouth to Headwaters	Temp
Wild & Scenic	Rogue River	Illinois River to Grave Creek	Temp
Wild & Scenic	Whiskey Creek	Mouth to Headwaters	Temp

Pass (6.55 mi/mi^2) having the highest densities. Ninety percent of the 3750 stream crossings in the MRW are culverts with the Grave, Jumpoff Joe, and Grants Pass subwatersheds again having the highest densities. Although mass wasting, or massive soil slumping, occurs naturally, dense and poorly designed roads on steep terrain with low vegetative cover and unstable soils exacerbate it. The Grave and Galice subwatersheds have the most area that is susceptible to mass wasting.

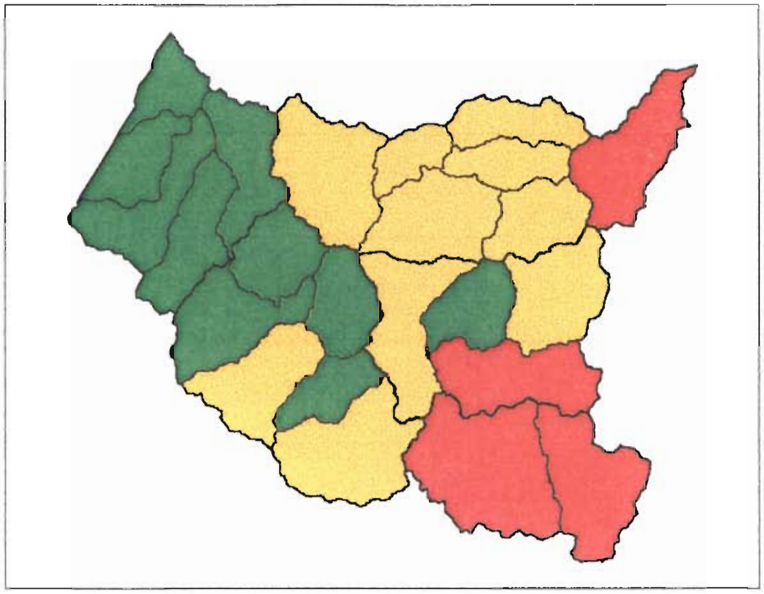
Riparian and Wetland Habitat: The area along streams and rivers is know as the riparian zone. Soils moisture and vegetation are generally higher in riparian zones than in adjacent areas. Healthy riparian vegetation functions to shade streams for temperature control, provide woody debris for fish habitat and stream complexity, dissipate stream velocity, stabilize stream banks, filter out pollutants and sediments, and provide habitat and food for many terrestrial animal species. Riparian habitat conditions in the entire MRW are poor (Map E-1).

Wetlands are marshes, swamps, or bogs defined by state and federal law as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal conditions do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Wetlands play an important role in the ecology of the watershed for the development of organisms that feed fish, amphibians, insects, birds, and terrestrial animals. They are effective at filtering out pollutants and sediments in the water, and they absorb and store storm water flows, which reduces flood velocities and stream bank erosion. Their capacity to store and slowly release water aids in recharging groundwater tables. While some wetland area has been created, much has been lost by human activity.

Table E-5. Streams in the MRW Under Consideration for DEQ 303d Listing

Subwatershed	Stream	Segment Description	Parameter
GALPIC	Galice Creek	Mouth to North/South Fork Confluence	Sedimentation
GALPIC	North Fork Galice Creek	Mouth to Headwaters	Sedimentation
GALPIC	Pickett Creek	Mouth to RM 4	Habitat Modification
GALPIC	Rogue River	Grave Creek to Applegate River	Flow Modification Nutrients Sedimentation
Grants Pass	Fruitdale Creek	Mouth to Headwaters	Flow Modification Sedimentation Temperature
Grants Pass	Rogue River	Applegate River to Evans Creek	Aquatic Weeds or Algae Flow Modification Nutrients Sedimentation
Grants Pass	Vannoy Creek	Mouth to Headwaters	Flow Modification Nutrients Sedimentation Temperature Toxics
Grants Pass	Jones Creek	Mouth to Headwaters	Flow Modification Sedimentation
Grave	Coyote Creek	Mouth to Headwaters	Flow Modification Sedimentation
Grave	Grave Creek	Mouth to Last Chance Creek	Aquatic Weeds or Algae Flow Modification Habitat Modification Sedimentation
Grave	Last Chance Creek	Mouth to Headwaters	Temperature
Grave	Rock Creek	Mouth to Headwaters	Temperature
Grave	Wolf Creek	Mouth to Headwaters	Flow Modification Habitat Modification Sedimentation
Jumpoff Joe	Jump Off Joe Creek	Mouth to Headwaters	Flow Modification Habitat Modification Sedimentation
Jumpoff Joe	Louse Creek	Mouth to Headwaters	Flow Modification Habitat Modification Sedimentation

The City of Grants Pass has identified 34 wetlands within the Urban Growth Boundary (UGB), although these do not comprise all of the wetlands in the Grants Pass subwatershed, and the Golden-Coyote Wetland in the Grave subwatershed has been restored. While perhaps hundreds of wetlands have been identified and mapped by the US Geological Survey (USGS), they have not been compiled into one listing or map, making it extremely difficult for planners to consider wetland protection into land use activity in the county.



Map E-1. Percent of riparian area that is poor condition.
Red (*Dark*) > 36%. Orange (*Light*) 15% - 36%. Green (*Medium*) < 15%.

Conclusion: The health of the Middle Rogue Watershed was rated using a combination of hydrology, fish and fish habitat, water quality, sedimentation, and riparian zone factors. In Table E-6, the five subwatersheds were rated on a scale of 1 (slightly degraded) to 5 (severely degraded). The MRW was then rated – first on the basis of the average of the ratings of all five subwatersheds and second excluding the protected Wild and Scenic subwatershed. Overall, the health of the MRW is somewhat degraded with the Grants Pass subwatershed the most and Galice subwatershed the least degraded of the five subwatersheds.

Table E-6. Overall Watershed Rating.

Subwatershed	Hydrology	Fish & Fish Habitat	Water Quality	Sediment Sources	Riparian Health
Wild & Scenic	1	2	1	3	1
Grave	3	3	3	4	3
Galice	3	3	2	3	2
Jumpoff Joe	4	3	3	4	3
Grants Pass	4	4	4	4	4
Middle Rogue	3 3.5	3 3.25	2.6 3	3.6 3.75	2.6 3

There are many gaps in data, both in general and site specific, that need to be addressed. Table E-7 indicates the general data information needs.

Table E-7. Data Gaps Information Needs

Component	Need
Historical	▪ Information of reference conditions for understanding fish population trends, riparian conditions and what the natural stream temperatures are. ▪ To a lesser extent, mapping of historical clearcutting operations would aid in the understanding of sedimentation and hydrological impacts.
Hydrology and Water Use	▪ Source and flow characteristics for each stream. ▪ Extent and location of logging and development on private lands. ▪ Private road inventory. ▪ Number and locations of wells and total domestic water use.
Fish & Fish Habitat	▪ Spawning numbers for the anadromous salmonid populations. ▪ Numbers of smolts emigrating from each stream and subwatershed. ▪ Habitat information (pools, riffles, gravel, LWD) for the salmon bearing streams in the MRW. ▪ Fish passage barrier information, including location and type.
Water Quality	▪ Range of daily water temperatures. ▪ Information explaining why streams exceed DEQ listing criteria, including land use activities, shade, background conditions and water use patterns. ▪ Water quality data such as macroinvertebrate information, flow modifications, instream habitat modifications, nutrient levels, turbidity and dissolved oxygen. This is most important for fish bearing streams.
Sediment Sources	▪ Better information on sedimentation rates, causes and trends. ▪ Site-specific data on sedimentation sources so projects can be targeted. ▪ Locations of potential mass wasting sites. ▪ Upslope sites of potential erosion, including areas of denuded vegetation. ▪ Road surveys on private lands, including driveways, for data on road density, surface type, slope, proximity to stream channel, and use pattern.
Riparian Habitat	▪ Riparian data including vegetation species profile, width of riparian zone for both banks, maturity, stream size, discontinuities, aspect, slope, channel confinement and shading potential. This is most important for fish bearing streams on private lands.
Wetlands	▪ Listing and mapping for easy accessibility and use. ▪ Survey existing wetlands to document health and mitigate impacts.
Channel Modification	▪ Location of reservoirs and artificial impoundments. ▪ Location of dikes and levees, including both historical and current. ▪ Information on those stream sections that have been channelized, straightened or hardened. ▪ Location of stream bank protection sites: riprap, pilings and bulkheads. ▪ Location of built up areas in floodplains and wetlands. ▪ Information on road crossing sites that used extensive fill (>250 feet). ▪ Location and type of push-up dams. This information is also useful for the fish habitat component. ▪ Location of sand and gravel mining operations in or near the stream channels, as well as location of current and historical tailings deposits.

ABSTRACT

This document is the *Middle Rogue Watershed Assessment* prepared for the Middle Rogue Watershed Association and funded by the Oregon Governor's Watershed Enhancement Board (OWEB). This report contains information about the Middle Rogue Watershed and follows the guidelines described in the *Governor's Watershed Enhancement Board's 1999 Draft Oregon Watershed Assessment Manual.*

The goal of this assessment was to define the current conditions within the Middle Rogue Watershed and how severely they have been impacted by human activities over the last 150 years. It was found that the overall watershed was somewhat degraded with a range of severely degraded to mildly degraded depending on the level of human activity as well as natural factors. There are considerable data gaps that will need to be addressed in the future and much work to do to improve and maintain the quality of the watershed. This assessment and its companion, *Middle Rogue Watershed Action Plan*, will direct and guide further research and watershed enhancement activity.

ACKNOWLEDGEMENTS

This assessment was compiled and written by Steve Mason and edited and formatted by Grace Zilverberg. It was, however, accomplished through the collaborative efforts of members of the Middle Rogue Watershed Association and Council; local, state, and federal agencies and their representatives including BLM, ODFW, NFS, Josephine SWCD, and Josephine County government; as well as numerous other private citizens and public and private organizations.

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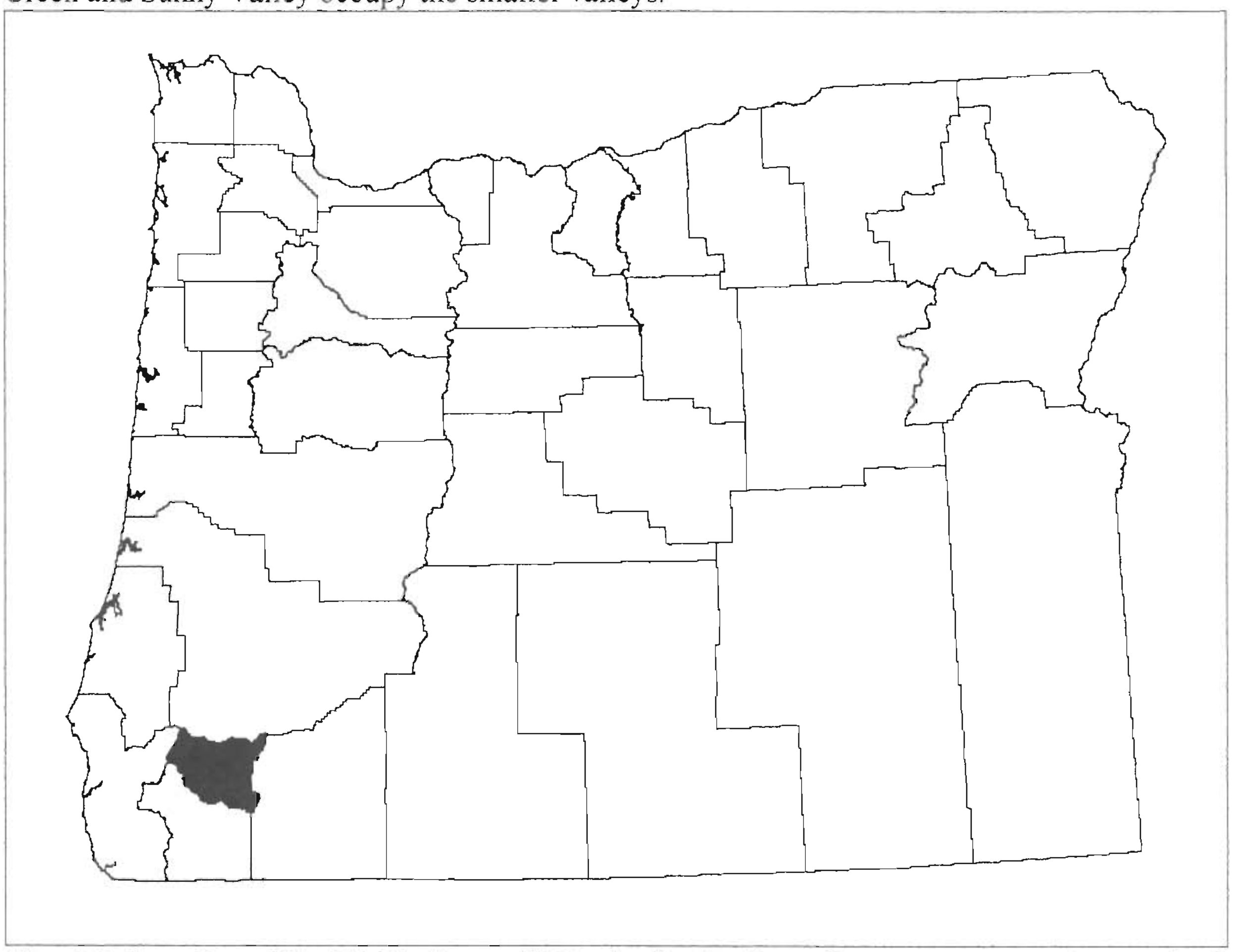
ABBREVIATIONS and ACRONYMS

BLM	US Bureau of Land Management
cfs	cubic feet per second
CHT	Channel Habitat Type
dbh	diameter at breast height
DEQ	Oregon Department of Environmental Quality
GPID	Grants Pass Irrigation District
GWEB	Governor's Water Enhancement Board (became OWEB)
HUC	Hydrologic Unit Code
MRW	Middle Rogue Watershed
MRWA	Middle Rogue Watershed Association
NMFS	National Marine Fisheries Service
NRCS	Natural Resources Conservation Service
ODFW	Oregon Department of Fish and Wildlife
OWEB	Oregon Water Enhancement Board (formerly GWEB)
OWRD	Oregon Water Resources Department
RBFAT	Rogue Basin Fish Access Team
RRB	Rogue River Basin
SWCD	Josephine Soil and Water Conservation District (SWCD)
USGS	United States Geological Survey
WAB	Water Availability Basin
WPN	Watershed Professional Network
USFS	United States Forest Service

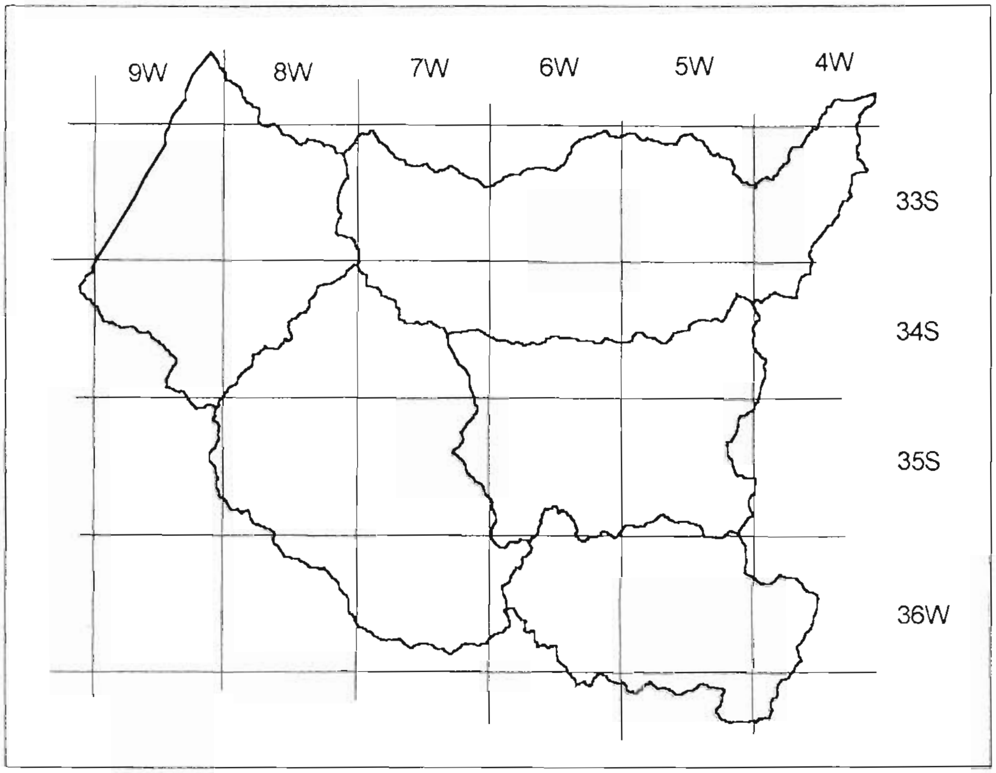
Chapter I - OVERVIEW

The Middle Rogue Watershed (MRW) encompasses 606.57 square miles (388,205 acres) in the northern portion of Josephine County in southern Oregon (Maps I-1 and I-2). It includes the entire drainage area of the middle Rogue River and tributaries except for the Illinois and Applegate Watersheds; between river mile 54.8, just below Kelsey Creek (the border between Josephine and Curry counties), and river mile 110.8, just down from the mouth of Evans Creek. The watershed lies within the Klamath Mountain region characterized by mountains, a few broad valleys, and numerous smaller valleys. Elevations range from 500 to 5200 feet with and average elevation of 2509 feet. Precipitation varies from 30-150 inches depending on elevation and falls mostly during the winter months. Therefore, winters are cool and wet and summers are hot and dry.

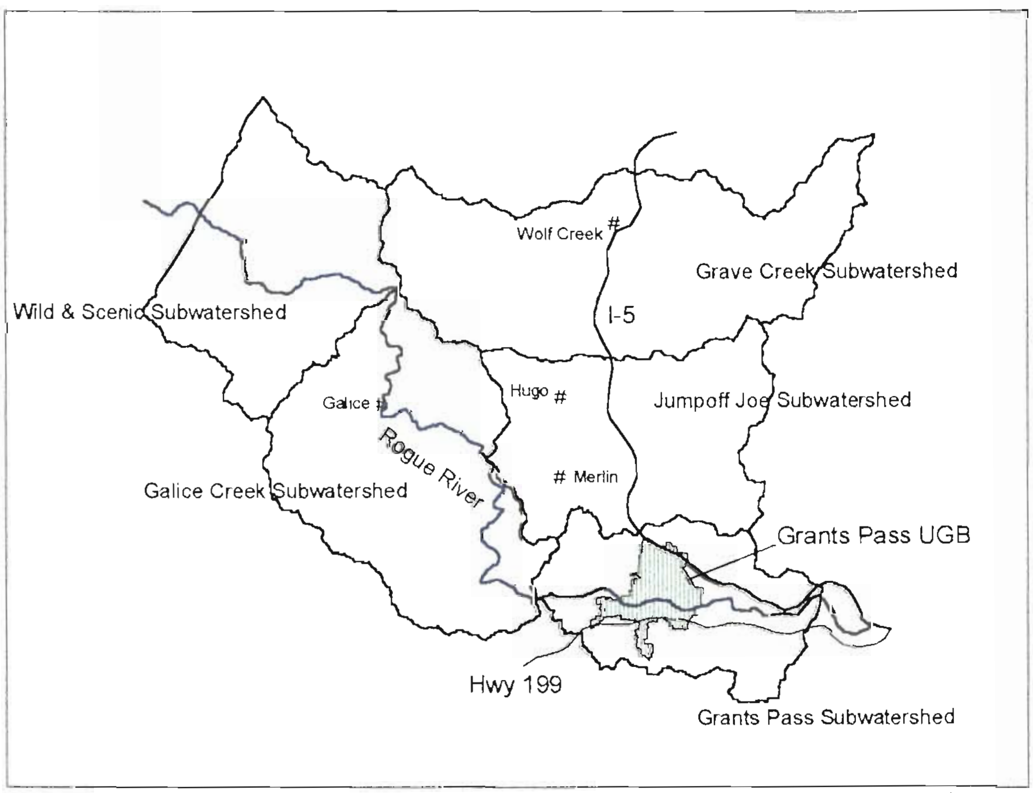
The area is largely forested and rural, characterized by the checkerboard pattern of public and private land ownership typical of much of the Oregon and California (O&C) railroad lands of western Oregon (BLM 1999a). The City of Grants Pass is the main urban center and county seat, while the surrounding communities of Merlin, Hugo, Galice, Shan Creek, Leland, Wolf Creek and Sunny Valley occupy the smaller valleys.



Map I-1. Location of the Middle Rogue Watershed in Southern Oregon encompassing much of northern Josephine County



Map I-2 Section and Range location of the Middle Rogue Watershed



Map I-3. The Five Subwatersheds of the Middle Rogue Watershed

The watershed is made up of five subwatersheds (Map I-3): Wild & Scenic River, Grave Creek, Jumpoff Joe Creek, Galice Creek, and the Grants Pass area. Each of these subwatersheds is different from the other in ownership patterns, stream conditions and topography. Grants Pass is the only city in the watershed and houses the County Seat. There are other small communities scattered throughout the watershed including Hugo, Merlin, Galice, Shan Creek, Leland, Wolf Creek and Sunny Valley.

CLIMATE AND WEATHER

The MRW is situated 30 to 40 miles inland from the Pacific Ocean and the prevailing winds are from the west. Thus, air masses moving across the watershed are generally marine in origin. However, they are significantly modified by their ascent over the Siskiyou Mountains and the Coast Range. As the air rises from sea level to an elevation between 4000 and 5000 feet, its temperature drops 3 – 5 degrees F for each thousand-foot gain in elevation. This cooling causes much of the moisture in the air to precipitate as rain or snow. Therefore the air reaching the lower slopes and valley floor east of the Coast Range is much drier than the original marine air. The relatively mild winter temperatures and persistent cloudiness reflects the marine influence during the winter months.

The MRW falls within three distinct climatic zones associated with landform and elevation. They are the valley floor and lower slopes, which includes land below 1,800 feet elevation; the middle slope area, which includes land between 1,800 feet and 4,500 feet elevation; and the upper slopes region, which includes all lands above 4,500 feet in elevation.

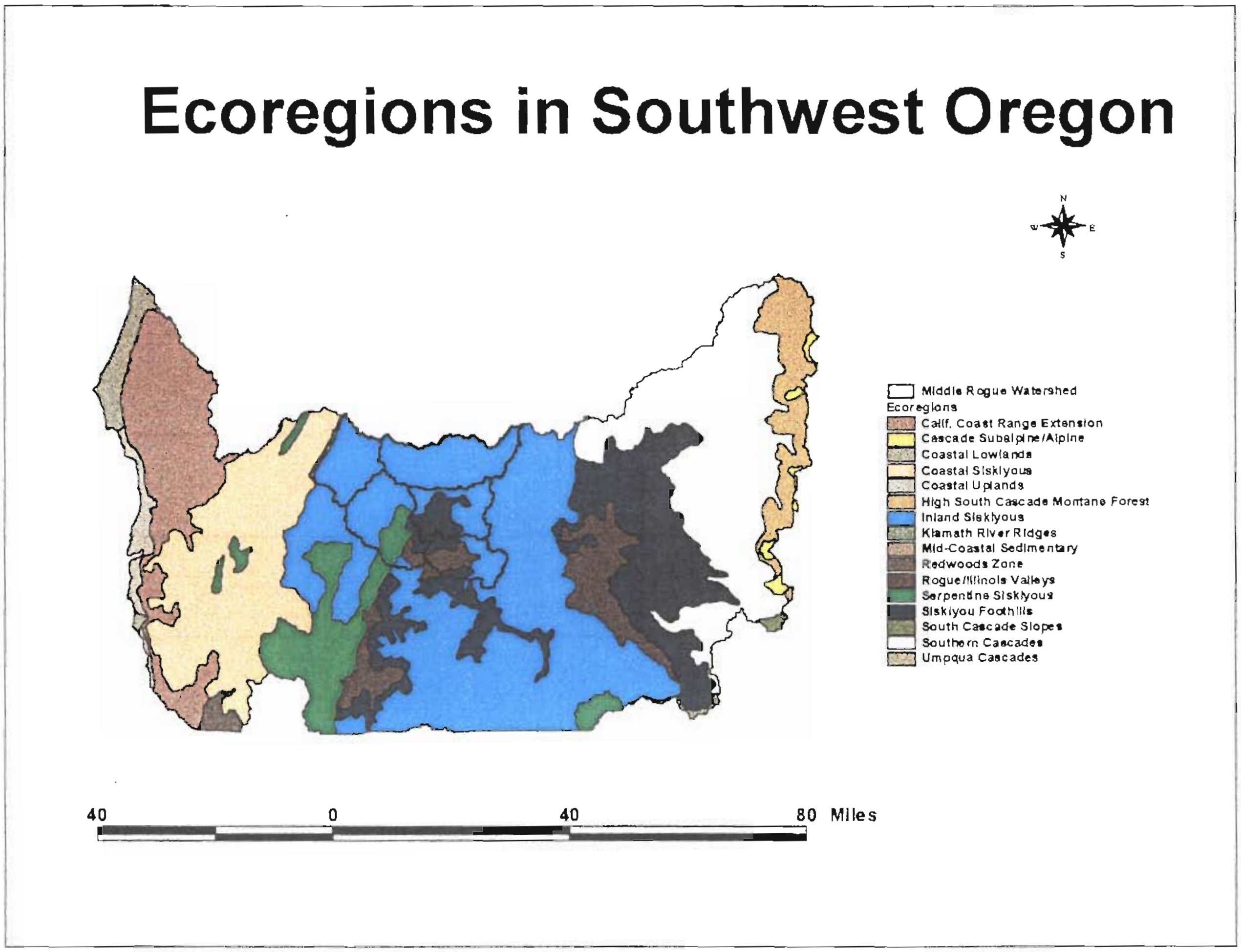
The three climatic zones encompass four ecoregion types (see Map I-4). Most of the MRW is within the Inland Siskiyou ecoregion, while the remaining area falls within the Serpentine Siskiyou, Siskiyou Foothills, and Rogue/Illinois Valley ecoregions. These ecoregions are characterized by a Mediterranean-type climate of cool wet winters and hot dry summers.

Most precipitation occurs from late October through April. Precipitation ranges from 30.5 inches in Grants Pass to over 150 inches in the Big Windy Creek in the northwest part of the watershed. The amount of precipitation generally increases as the elevation increases. Winter temperatures are relatively moderate, ranging from 20 to 40 degrees in the valleys, and rarely drop below zero. Snow pack is usually light and short lived in the valleys and southern aspect slopes. There is often snow on King Mountain from December through April.

During the long, dry summers, precipitation averages less than 1 inch with extended drought periods commonly of 60 to 90 days. Summer temperatures average in the high 80s and 90s, occasionally reaching 100 degrees with low humidity. Summer thunderstorms do occur occasionally.

GEOLOGY

The Middle Rogue Watershed lies in the northwestern part of the Klamath Mountains Geomorphic Province of southwestern Oregon and northern California. The area is underlain by north to northeast trending arcuate bands of regionally metamorphosed, Mesozoic sedimentary and volcanic rocks of predominantly marine and island-arc origin. These formations have been tightly folded, faulted and intruded by igneous rocks ranging from ultramafic (serpentinite), through intermediate (gabbro and diabase) to granitic composition.



Map I-4. Ecoregions in Southwest Oregon. The areas other than the valley floor fall within the Inland Siskiyou ecoregion.

Formations to the east of Grants Pass belong to the older Applegate group of Triassic age, from 190 to possibly 250 million years in age. These older rocks override upper Jurassic marine sedimentary and volcanic rocks of the Galice and Rogue formations along an east dipping thrust fault that may be interpreted as an ancient subduction zone. The Grants Pass granitic pluton was intruded along this contact zone as were narrow bands of serpentine and gabbro. The Grants Pass pluton has a radiometric age of 136 million years (Hotz, 1971).

The Galice formation is exposed from the west edge of the Grants Pass pluton to the Almeda mine on the Rogue River about three miles north of Galice. It is made up largely of salty siltstone with interbedded sandstone, volcanoclastic layers and altered lavas (greenstone). The Rogue formation underlies the Galice Formation and is exposed from the Almeda mine downstream to a point about 1.2 miles below Whiskey Creek. The Rocks include altered tuffaceous sediments, meta chert and altered lavas that are intruded by small siliceous dikes, minor grabbo and diorite as well as narrow bands of serpentinite along fault zones. The Rogue Formation is more abundantly mineralized that the other formations. Both volcanogenic submarine massive sulfides and gold bearing quartz veins are found in the Rogue.

The younger western late Jurassic belt of Dothan Formation is composed of marine greywacke sandstone and siltstone with minor conglomerate, chert and pillow basalt. The Dothan has been thrust under the Rogue and Galice formations along a northeast trending, east dipping fault that crosses the Rogue River just downstream of Whiskey Creek. This thrust fault may also be interpreted as an old subduction zone. The Middle Rogue Watershed has youthful topography resulting from recent regional uplift and rapid stream erosion. Steep stream gradient has produced narrow canyons and ridges with steep slopes subject to mass wasting. Soil depth is generally shallow and rocky. Stormflow during rain and rain-on-snow events brings increased stream turbidity. The highest turbidity usually occurs during the first major storm of the season when litter fall accumulated in the stream is flushed out. This storm is typically in late fall.

The more readily weathered granitic rocks of the Grants Pass pluton have produced a broad valley with gentle rolling hills surrounded by the more rugged terrain. Many of these low areas have a thin cover of stream deposited alluvium and colluvium from the surrounding hills. This area of decomposed granite and overlying alluvium is the best aquifer. Most other areas have relatively poor groundwater prospects. (Ramp & Peterson, 1979)

VEGETATION

Trends in vegetation in the watershed include increasing densities of trees and shrubs within stands and a shift from historically dominant species to species that were historically a lesser component of the landscape or found primarily in the understory. Species such as ponderosa, Jeffrey, and sugar pine, California black oak, Oregon white oak, Douglas-fir and Pacific madrone have historically been important components of the forests in the watershed. Except for Douglas-fir, these species require less dense, more open canopy conditions that were more prevalent in the forests of the watershed prior to fire exclusion. As stand densities increase beyond the range of natural conditions, these species drop out and the forests become dominated by Douglas-fir. Douglas-fir is now a dominant tree species within this watershed, followed by ponderosa pine, Jeffrey pine, white oak and white fir.

The existing vegetation conditions in the watershed today are a result of fire exclusion and replacing the natural disturbance pattern with human disturbances such as logging (particularly of the high-value pine species), farming and rural development.

Existing vegetation composition and pattern generates two areas of concern:

1) Fire exclusion has resulted in many of the forests in the watershed reaching densities of trees and shrubs that are not sustainable over time. In addition, fire exclusion has shifted Douglas-fir onto what were formerly ponderosa pine and white oak sites.

1) Past harvest patterns in the watershed have resulted in removal of economically and biologically valuable tree species such as ponderosa and sugar pine.

The vegetative and structural conditions of the forests in the watershed have seldom been constant and have changed frequently with historic disturbance patterns. Disturbance has played a vital role in providing for a diversity of plant series, seral stages and their distributions, both spatially and temporally. The presence of fire, insects, disease, periods of drought and the resultant tree mortality have always been components of ecosystem processes and occurred within a range of natural conditions.

Maintaining vegetative diversity and densities that are sustainable over time are important terrestrial and riparian ecosystem processes. These mechanisms have been impacted by the shift from primarily frequent, low-intensity fire to settlement-related disturbances and fire exclusion. When forest density, species composition, structure (variety of tree sizes, presence of snags and large down logs, etc.), populations of insects, presence of disease, incidence of fire events of varying intensities, and tree mortality occur outside the range of natural conditions, components of the ecosystem process are impacted. This is the current trend for the watershed.

The previous timber harvest patterns in the watershed have tended to simplify forest structures while the increase in fire exclusion has driven forest structure towards a higher level of complexity. This is happening particularly on sites where it is not sustainable, such as those areas that historically supported the ponderosa pine and white oak series. Plant communities within these two series have consequently developed another tree component, primarily Douglas-fir. Depending on the stage of stand development, this influx of Douglas-fir onto sites where historically fire events had kept Douglas-fir stocking low has added to stand complexity by providing another canopy layer beyond what would occur without fire exclusion. This additional canopy can modify the environment by providing additional shading and structure.

A high percentage of the ownership in the watershed exists in small (5-11 inch DBH) and large (11-21 inch DBH) pole size classes and hardwood dominated lowsite lands. Fire exclusion this century has permitted dense pole stands to develop over much of the watershed, crowding out important mid-seral species less tolerant to shade such as ponderosa and sugar pine, Pacific madrone, California black oak and Oregon white oak. Stands consisting of dense poles or of small diameter are more vulnerable to stand replacement wildfire.

When forests remain at unsustainably high densities for too long, a number of trends begin to occur that effect stand health. Species composition, relative density, percent live crown ratio, and radial growth are all indicators of how forests are responding to environmental stresses.

Vegetative Series and Ecological Influences

The Douglas-fir series has increased from 1920. A decrease in non-forest and Jeffrey/ponderosa pine is shown over the same time period. The total percent decrease in those species requiring more open stand conditions associated with frequent, low-intensity fire, is close to the increase in Douglas-fir. Non-forest in 1920 was described by no timber volume listed on the inventory sheets. 1996 inventory data describes non-forest as non-vegetated, non-forest, and grass. The correlation is a rough one but useful for our purposes. Douglas-fir filling in previous stands, added an additional structural component. This component was not present previously due to the shorter interval between fire disturbances. Repeated low-intensity fires did not allow for the establishment of Douglas-fir at the rate now seen in the watershed.

Percent live crown ratio and radial growth are physiological indicators of the trees' abilities to produce food and defensive compounds. Healthy live crowns are essential for healthy trees. When the average live crown ratios of forests drop much below 33%, the canopy's ability to support vital processes in the tree becomes diminished. Live crown ratios begin to recede (foliage on lower branches dies due to shading) as forests remain in an over-dense condition for too long. When live crown ratios are reduced too far, trees are unable to quickly respond to the release provided by density management thinning. Partial cutting management prescriptions may no longer be a forest management option.

The capability of the ecosystem to restore the watershed's vegetation to natural conditions, as we understand them, using natural processes would be through fire, insect, disease or other types of disturbance events that create growing space. These processes would lower densities and clear out competing understory vegetation.

Fire is the primary process that would lower densities and clear out competing understory vegetation. In the absence of fire, insects and disease often become the processes that reduce stand density. Because of densities in the forest stands (live fuels) in the watershed, the buildup of dead and down fuels, the checkerboard ownership of private and government lands and the rural residential interface, it is impossible to allow the natural fire regime to control forest densities at this time. At the present time, a naturally occurring fire, such as caused by lightning, would have a high potential to be intense stand replacement fires and threaten human lives and property.

Present indications are that the watershed will require extensive density management (thinning) in both natural and planted stands. General objectives for the thinning include reduction of the total number of stems, species selection to provide a species mix that more closely resembles that which was thought to occur prior to fire exclusion and logging, and fuels management (prescribed fire) to reduce the activity fuels (slash) created via the density management.
Due to past fire suppression serpentine openings in the watershed are being encroached upon by surrounding trees and shrubs and invaded by exotic annual grasses. Surrounding trees and shrubs as well as exotic grasses appear to be filling in these openings, reducing potential habitat for this special status species.

Some of the subwatersheds within the Middle Rogue Watershed Assessment area are dominated by mixed conifer and mixed conifer/hardwood forests. The watershed is characterized by high fire frequencies both historically and to a lesser extent in the present. Fire exclusion has resulted in significant increases in densities (more stems per acre), shifts in species composition (*e.g.*, increases in fire intolerant, shade tolerant species) and changes in stand structure. These transformations have made the forests more susceptible to large, high-severity fires and to epidemic attack by insects and disease.

An additional effect on the plant communities in the watershed has been the result of more direct human influences. Mining, logging, agriculture, road building and residential development have reduced the amount of late-successional forest within the watershed while increasing the amount of early seral stages.

The watershed contains at least six plant series: white oak, Ponderosa pine, Douglas-fir, Jeffrey pine, white fir, and western hemlock. (Plant communities (associations) with the same climax dominant(s) are referred to as plant series. The Jeffrey pine series, for example, consists of associations in which Jeffrey pine is the climax dominant (Atzet and Wheeler 1984).)

Douglas-fir is the most common tree species in southwestern Oregon. Sites within the Douglas-fir series average 254 square feet of basal area / acre (Atzet and Wheeler 1984). Douglas-fir tends to produce conditions that favor fire wherever it occurs. This species is self-pruning, often sheds its needles and tends to increase the rate of fuel buildup and fuel drying (Atzet and Wheeler 1982).

The Jeffrey pine series is confined to areas of ultrabasic (serpentine and serpentine-influenced) soils (Atzet and Wheeler 1982). Serpentine areas dominated by Jeffrey pine may have the lowest productivity of any conifer series in the Klamath Province with an average basal area per acre of 83 square feet (Atzet and Wheeler 1984). While not considered important in terms of timber production, these sites are floristically diverse supporting many special status plants. They also have value as unique habitats for a variety of wildlife species.

Forests in the ponderosa pine series average approximately 170 square feet of basal area. This series is relatively rare as ponderosa pine does not often play the role of a climax dominant (Atzet and Wheeler 1984). This series tends to occupy hot, dry aspects that burn frequently. Ponderosa pine regeneration is restricted by reducing the number of fire events. Due to the success of fire suppression over the last 70-80 years, overall cover of this series has decreased (Atzet and Wheeler 1982).

Western hemlock is present within this watershed. This species grows in cool, moderate environments where moisture stress occurs late in the growing season (Atzet and McCrimmon 1990). Evapotranspirational demands are low. The average basal area for this series is 295 square feet. The fire regime is one of infrequent, high-intensity fires.

Sites in the white fir series are also considered productive with basal area averaging over 341 square feet (Atzet and Wheeler 1984). The white fir series is widespread, diverse and productive (Atzet and McCrimmon 1990). White fir's thin bark provides little insulation during low-intensity underburns until tree diameter reaches at least eight inches. Moreover, the tolerant nature of white fir, which allows branches to survive close to the ground, makes the lower crown a ladder to the upper crown (Atzet and Wheeler 1982). Due to the success of fire suppression efforts over the last 70 years, white fir occupancy has increased.

The white oak series occurs at low elevations and is characterized by shallow soils. Although Oregon white oak is usually considered a xeric species, it also commonly occurs in very moist locations - on flood plains, heavy clay soils, and on river terraces. On better sites, white oak is out competed by species that grow faster and taller (Stein 1990). Average basal area is 46 square feet. Water deficits significantly limit survival and growth (Atzet and McCrimmon 1990).

White oak has the ability to survive as a climax species as it is able to survive in environments with low annual or seasonal precipitation, droughty soils, and where fire is a repeated natural occurrence (Stein 1990). Fire events in this series are high frequency and low intensity (Atzet and McCrimmon 1990). Due to the effectiveness of fire suppression over the last 70 years, the prominence of this series has declined.

Major plant series is an aggregation of plant associations with the same climax species dominant(s). The Jeffrey pine series, for example, consists of plant associations in which Jeffrey pine is the climax dominant. It defines the potential natural vegetation that would exist on the site at the climax stage of plant succession, or the end point of succession where neither the plant composition nor stand structure changes. Net productivity in terms of biomass production is considered to be zero (Atzet and Wheeler 1984).

Landscape Vegetation Patterns

Several conclusions can be made regarding the historic landscape vegetation patterns:

a. Fire events occurred throughout the watershed with higher occurrences taking place at low elevations and warmer southern aspects in the watershed.

b. A majority of the ponderosa pine series was in the areas that are now farm lands, urban and rural development. These sites occurred primarily in the west half of the watershed.

c. The Douglas-fir series occurs primarily in the upper elevations in the watershed. There was also some Douglas-fir found in the surrounding areas that are now farm lands, urban and rural development.

d. The Jeffrey pine series is often situated on serpentinite soils derived from ultramafic (volcanic) parent material. This series is commonly found on southerly aspects at midslopes.

e. Plant series with infrequent high-intensity fires has a much higher percentage of mature/late-successional structure than those with a shorter fire return interval.

Anthropogenic Prairies or Pastures

Valley bottoms and adjacent south slopes were often not forested. The potential natural vegetation was difficult to ascertain, but small, relatively mature groves existed on roadsides. These groves indicated that most of the area was in the grand fir or Douglas-fir series, and the areas were mapped accordingly.

These prairies were probably created by Native Americans, using fire, as is documented for the Willamette Valley. The prairies are currently maintained by grazing and other human activity. These areas are used as pastures and rural residential areas. Droughty soils on the slopes, saturated soils in the valley bottoms, and competition from dense grass cover may further inhibit tree establishment. Oregon white oak and ponderosa pine are prominent on the drier edges. Riparian forests of big-leaf maple, alder and ash can occur in the middle of these pastures; these forests are highly variable, and influenced by disturbance.

FIRE

Fire Regimes

Fire regimes of the Pacific Northwest are a function of the vegetation growth environment (temperature and moisture patterns), ignition pattern (lightning, human,) and plant species characteristics (fuel accumulation, adaptations to fire). Effects of forest fires can be more precisely described by grouping effects by fire regimes. Agee (1981) describes three broad fire regime categories (these can and often do overlap considerably with one another):

> *High-severity regimes*: Fires are very infrequent (more than 100 years between fires); they are usually high-intensity, stand replacement fires.
>
> *Moderate-severity regime*: Fires are infrequent (25-100 years); they are partial stand replacement fires, including significant areas of high and low severity.
>
> *Low-severity regime*: Fires are frequent (1-25 years); they are low-intensity fires with few overstory effects.

Fire regimes are the manifestation of the biological, physical, climatic and anthropomorphic components of an ecosystem as reflected in the frequency, size, and seasonality of fires (Pyne 1982). This is a relationship that perpetuates itself in a circular and stable pattern. The biotic components are an expression of the fire regime, and in turn maintain the pattern and occurrence of fire. However, when any components of the ecosystem are modified, the fire regime is prone to change.

The persistence of certain species in southwestern Oregon through the millennia can be attributed to their adaptations to fire (Kauffman 1990). Adaptations for fire survival are adaptations to a particular ecosystem and its specific fire regime. If the regime is altered, the capacity for that species to survive in the environment may be greatly changed.

A major difference between existing vegetation and reference condition is the change in the fire regime. The historical fire regime of the watershed was dominated by a low-severity regime. The low-severity fire regime is characterized by frequent (1-25 years) fires of low intensity (Agee 1990). Fires in a low-severity regime are generally associated with ecosystem stability, as the system is more stable in the presence of fire than in its absence (Agee 1990). Frequent, low-severity fires keep sites open so that they are less likely to burn intensely even under severe fire weather. Limited overstory mortality occurs. The majority of the dominant overstory trees are adapted to resist low-intensity fires because of thick bark developed at an early age. Structural effects of these fires are on the smaller understory trees and shrubs. These are periodically removed or thinned by the low-intensity fire along with down woody fuels. The understory density was low, open, and "park-like" in appearance. Areas of grasslands, grass/shrub, and oak savanna plant communities were more prevalent. These were maintained by the frequent fires that prevented encroachment by conifer tree species.

Fire Disturbance

The advent of fire suppression/exclusion 80-100 years ago has eliminated the pattern of frequent low-intensity fires. Previously, fire has occurred frequently and burned with low intensity, and functioned largely in maintaining the existing vegetation. Both live and dead fuels were generally in a low hazard condition. High hazard fuel accumulation was localized and not a predominate condition. The watershed has gone from a low-severity to a high-severity fire regime. Currently, fire is infrequent, burns with high intensity, and causes high degrees of mortality, replacing vegetation rather then maintaining it. This has resulted from nearly a century of fire suppression and exclusion. The change in vegetation conditions, fuel profile, and amount of fuel present is now such that the impacts from a large wildfire will produce severe effects on vegetation, erosion, habitat, and water quality.

Stand replacement from wildfire impact was a low percentage in the reference condition. Dead and down fuel and understory vegetation are no longer periodically removed. Species composition changes with thinner bark and less fire resistant species increase in numbers and site occupancy. Grasslands and oak savanna are encroached upon by tree and shrub species. Shrub lands increase in density and cover. This created a trend toward an ever increasing buildup in the amounts of live and dead fuel. The understory of stands becomes dense and "choked" with conifer and hardwood reproduction. The longer interval between fire occurrence allows both live and dead fuel to build up. This creates higher intensity, stand replacement fires rather than the historical low-intensity ground fire that maintained stands.

Fire Risk

Human actions greatly influence the pattern of fire occurrence and number of fires in the watershed. The watershed as a whole has a high level of risk of human caused ignition. Human uses that create ignition risk include residential, industrial (light manufacturing, timber harvest, mining/quarry operations), recreational, tourist and travel activities. Human use within the watershed is high. The human caused fire occurrence pattern for the watershed would generally be a fire starting on private lands at low elevations and burning or reaching the uppermost ridgetops. Lightning occurrence in the watershed has been high. The watershed typically experiences at least one lightning storm event each summer. Multiple fire starts often result from these storms.

The current trend is for increasing fuel hazard build up and increasing risk for fire ignition due to population growth and human use within the watershed and adjacent region. The magnitude of this change is widespread throughout the entire watershed. Vegetation in many parts of the watershed are at a high degree of risk for mortality and stand replacement from wildfire. The existing and future trend in fuel and vegetation conditions is the predominant factor that will adversely effect the ability to achieve most management objectives for the watershed. The capability of the watershed to achieve and meet management objectives is low in the long term (20-years plus).

If vegetation in the watershed is left without treatment, fire hazard will increase. Potential of an extensive severe fire correlates directly to potential loss of vegetative cover and litter/duff, which could result in increased erosion, stream sediments, and loss of soil productivity. An extensive severe burn would also cause an increase in peak stream flows due to increased open areas. This could, in turn, affect stream channel stability.

The potential for a large fire is high to extremely high for this watershed. This is due to the buildup of fuels, both live and dead, overstocking of conifers and hardwoods, and the presence of less fire resistant species which have invaded in the absence of frequent fire occurrence and past management practices that created but did not treat slash.

There is a high potential for a large scale, high-severity wildfire within the watershed. Mixed land ownership, rural interface area and proximity to population centers increase the complexities of fire protection, fuels management and hazard reduction programs.

Fire exclusion has created vegetation and fuel conditions with high potential for large, destructive and difficult to suppress wildfire occurrence. The watershed has a large amount of high values at risk of destruction and loss from wildfire. High-severity, stand replacement wildfire presents a threat to human life, property, and nearly all resource values within the watershed. Management activities can reduce the potential for stand replacement type fires through hazard reduction treatments. Public acceptance of hazard reduction management activities will be critical for the long-term health and stability of the forest ecosystem within the watershed.

Fire and Wildlife

Historical fire, both prescribed (Native American) and wild, played a crucial role in maintaining a mosaic of habitat types in the watershed. Deer winter range was burned, meadows were maintained and oak and pine sites remained free of Douglas-fir encroachment. With the advent of fire exclusion, many of these sites were altered due to plant succession. Species diversity was reduced due to competition in the herbaceous layer.

The subsequent accumulation of fuels and shift to less fire tolerant plant species has increased the potential of high-intensity fire in the watershed. This in turn threatens species diversity and special status plants in the watershed. Increased erosion, the subsequent increase in sediment loads to streams, and the potential for affecting stream channel stability caused by an extensive severe burn would have a negative impact on fisheries and aquatic life as well.

Management Implications

Historical fire frequencies may be determined as a related to plant association. This knowledge may then be used to determine desirable prescribed fire regimes. Timber productivity is also related to plant association. Plant associations might also be used to determine the potential for wildlife habitat.

Watershed Function

A watershed includes all the land from ridge top to ridge top in which the water flows into a stream system. Boundaries will follow the ridgeline around the watershed and meet at the mouth of the stream. Watershed delineations may vary dependant on the analytical purposes of the project or agency. For the purposes of this Assessment, the MRW has been divided into five subwatersheds: Grave Creek, Jumpoff Joe Creek, Galice Creek, Wild and Scenic, and Grants Pass. While the Grave and Jumpoff Joe areas are complete subwatersheds from ridgetop to the Rogue River, the Wild and Scenic subwatershed is a political designation; the Grants Pass subwatershed is a socio-political delineation encompassing both complete and partial stream systems; and the Galice subwatershed encompasses stream systems on both sides of the Rogue River.

Connectivity refers to the physical connection between tributaries and rivers, groundwater and surface water, between wetlands and these water sources, and between upland and lowland areas. This connectivity of the stream systems is the major reason why this assessment has been conducted. Because water moves downhill, all activities and conditions upstream affect the watershed condition downstream.

Document Organization

This assessment is divided into eight sections: Historical Conditions, Channel Habitat Type, Hydrology and Water Use, Fish and Fish Habitat, Water Quality, Sediment Sources, Riparian/Wetlands, and Conclusion. Each chapter gives an introduction to the specific subject before analyzing the data. At the end of each chapter is a discussion about how human development has impacted the specific habitat condition. This includes a brief outline of the data gaps that exist for this chapter.

The historical conditions component (Chapter II) describes the history of the area as well as the natural conditions before European settlement. The third chapter details the stream types that exist in the MRW. This includes describing both the gradient and channel formation type for most of the streams in the watershed. The hydrology and water use chapter (IV) analyzes the impacts of human development on the hydrological cycle. This includes the impact of roads, agriculture, and forestry practices. The fifth chapter details the distribution of salmonids in the MRW as well as population trends and the quality of different fish habitat indicators. The water quality chapter (VI) describes the condition of the streams in the MRW with respect to water quality indicators such as temperature, sedimentation, and flow. The sediment sources chapter (VII) examines the main sources of sedimentation to the streams in the MRW, including mass wasting, roads and stream crossings. The next chapter (VIII) defines the condition of riparian and wetland conditions throughout the MRW. Included in this chapter is a brief discussion about the location and condition of wetlands within the watershed. The final chapter (IX) summarizes the results of the analyses in each of the previous chapters, giving an overall assessment of the Middle Rogue Watershed. A summary of the data gaps from each of the previous chapters is also included.

The Oregon Watershed Enhancement Board (OWEB) manual that was used to conduct this assessment was developed for fifth field watersheds, of which there are five in the MRW. Because of the large size of the MRW, this assessment has been more general in nature, detailing areas of potential concern rather than specific sites. One component in the OWEB manual, channel modification, was not included in this assessment. This was due to a lack of data at the time this document was generated. What data was available, such as irrigation diversion, has been included in other chapters. The data gaps for this component are detailed in the conclusion.

Chapter II - HISTORICAL CONDITIONS

During the 10,000 years of human occupation in southwest Oregon, the Middle Rogue Watershed was minimally impacted by Native Americans, who hunted, fished, gathered, and occasionally burned the valley floors and forest underbrush. In less than 200 years of European-American occupation, the land has been dramatically altered by trapping, mining, farming and irrigation, logging, and residential development.

The first known Europeans to visit the Rogue Valley passed through in early 1827. This was a group of Hudson Bay Company trappers led by Peter Skene Ogden. Hudson Bay Company kept up a presence in the Rogue Valley for several more decades until the beaver was effectively eradicated by 1850. Other trappers and explorers, using the north-south trail that connected the Willamette Valley with California and crossed Grave Creek near Leland, periodically visited the area up to the discovery of gold in Jackson County.

The earliest gold strikes were in the Illinois and Applegate Valleys previous to 1851. However, the discovery of gold on Jackson Creek, near present day Jacksonville, in late 1851 brought an influx of thousands of miners into the Rogue Valley. This influx led to extremely bitter fighting between the newcomers and the Native Americans. The clashes occurred between 1851 and 1856. By the spring of 1856, the Native Americans were defeated and were removed to reservations in the north of the state.

After the removal of the native peoples, the lands in the Rogue Valley were publicly owned by the United States and administered by the General Land Office. With the aim of further developing the west, Congress passed numerous laws, including the Donation Land Claim patents, the Homestead Acts, and military and mineral patents. Additionally, land was deeded to the Oregon & California Railroad, some of which was in turn sold to private individuals.

The northern portion of what is now Josephine County, all but the Illinois Valley, was initially part of Jackson County. It was set up as the Perkinsville voting district in 1853. The first post office was built in Grants Pass in 1865 and was named to honor a civil war victory of General Grant's. In 1868, the area became the Grants Pass voting district. In 1886, Grants Pass became the county seat, which had previously been located in Kerbyville and, before that, Waldo.

By the end of the nineteenth century, land use practices in the Rogue Valley had changed dramatically. Mining, the advent of the railroad, agriculture, settlement, and logging all had a tremendous impact on the watershed.

Mining was an early and major occupation within the Middle Rogue Watershed. Placer mining was the dominant method but there were several lode (hard rock) mines. By the 1880's, the most common method of mining was hydraulic mining. Tailing piles from this activity still exist at some of the old mine sites. Throughout the watershed, extensive ditches and flumes were built in order to get water to the sites for hydraulic mining with Chinese workers digging most of the ditches.

Historically, almost all of the mining activity occurred in the Galice Creek, Grave Creek and Jumpoff Joe Creek subwatersheds. Some of the earliest mining in the Middle Rogue Watershed was centered around the town of Galice, named after the French placer miner, Louis Galice. One of the largest mining sites in the watershed was the Almeda Mining Company in the Galice area. The mine operated continuously until 1916, then operated periodically, but is no longer in operation. Mining in the Grave Creek subwatershed started at around the same time as in the Galice area. It helped support numerous towns such as Golden, Leland and Placer; it employed large numbers of men; and it continued to be important in the Grave Creek subwatershed through the First World War. Mining started somewhat later in the Jumpoff Joe Creek subwatershed and was predominately hard rock mining. The Lucky Queen Mine was located on Jumpoff Joe Creek about two miles east of present Interstate Five. The area around the mine was the Lucky Queen voting district and had its own post office. Mining was also prevalent in the Wild and Scenic subwatershed.

One of the most prominent reminders of the mining history of the MRW is the extensive ditch system that still exists in varying states of decay. These ditches were used to channel water for hydraulic mining activities that took place in various locations in the watershed. These remnant ditches are still playing a role in the hydrologic cycle for the MRW. As explained in the Hydrology chapter, ditches increase peak flows and reduce summer low flows.

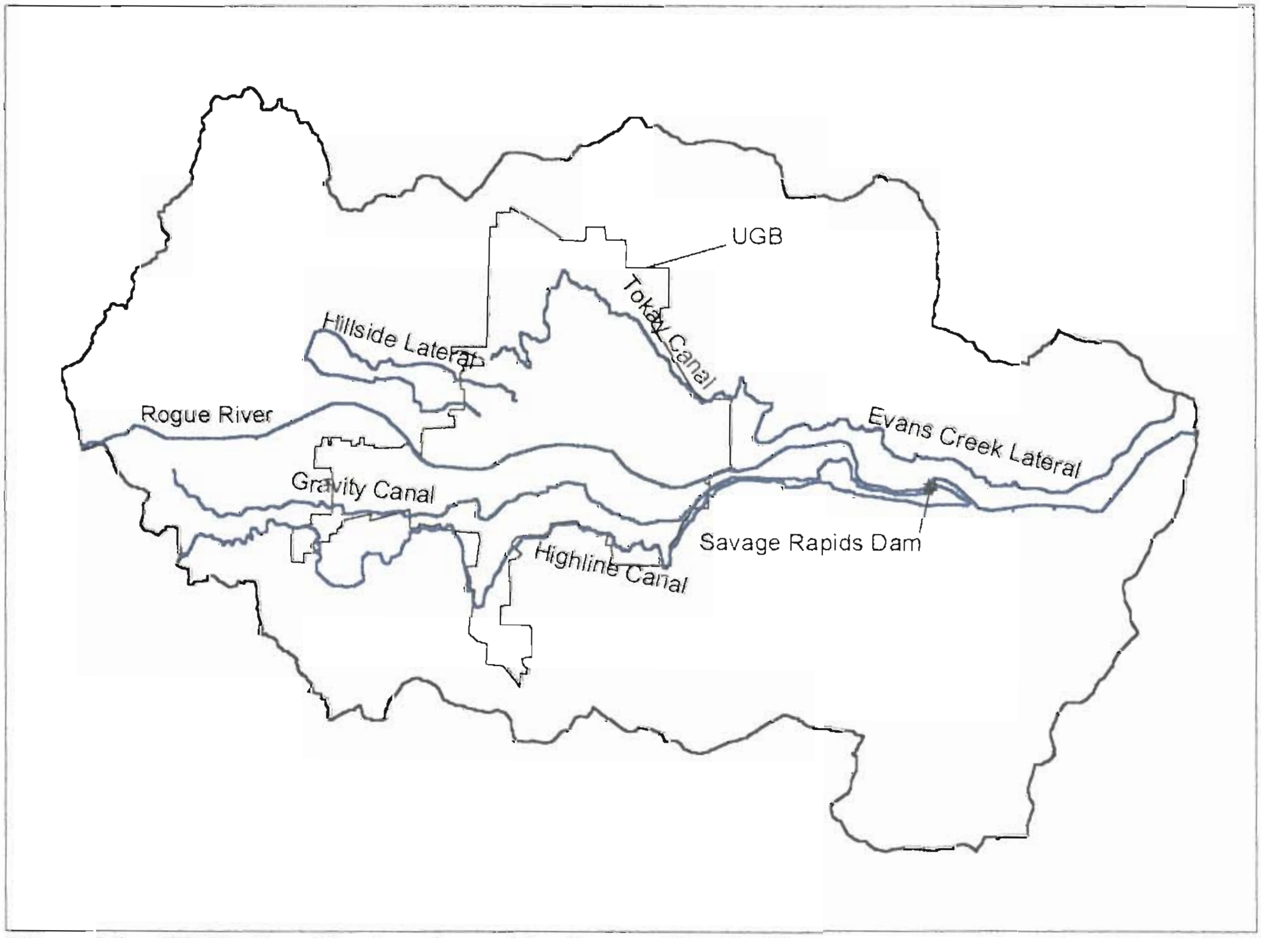
The coming of the railroad fully opened up the area, connected it to the populations and markets of California and northern Oregon, intensified land use, and profoundly affected the local economy, settlement, and wildlife. In the 1870's and '80's grizzly bear were common with 22 recorded kills during this time. Salmon runs were exceedingly large and other large animals, such as wolves, coyotes, bobcats, and cougars, were still abundant. Local settlers relied on hunting for subsistence, but deer herds were severely affected with the coming of the railroad and the subsequent opening of trade in antlers, hides, pelts and dried meat. The Oregon & California Railroad into Josephine County was constructed in the late 1800's, providing a link with northern Oregon. The first train pulled into Grants Pass in 1883. Four years later the railroad was connected to California.

Farming began in the Middle Rogue Watershed around the late 1850's, and as the mining industry died out near the end of the 19^{th} century, it became more important. Most agricultural activity has concentrated around the Rogue River, particularly around the Fort Vannoy area, from its onset. By far still, the most farming activity occurs in the Grants Pass subwatershed with much smaller amounts in the Hugo (Jumpoff Joe Creek) and Sunny Valley (Grave Creek) areas. A variety of crops have been grown in the area, but the production has been cyclical.

By 1883, apples were the major crop of the area, and were concentrated in the Fort Vannoy area and Grants Pass. With the coming of the railroad apples were exported out of the region, but by 1910, they had dwindled in importance. Grapes were a major product from 1883 through the 1920's; grown in Grants Pass on the Tokay Heights as well as the Fruitdale and Jones Creek areas. Other major crops included hops (1875 - 1930's), gladiolas (1920-1950's) and sugar beets (1916-17).

Ament dam was constructed in 1909 for purposes of irrigation. At around this time, the larger farms were being subdivided into smaller plots. Cattle and other livestock were never very important in the Middle Rogue Watershed although dairy production began around 1890 for local consumption. There are still dairies active in the watershed today.

The Grants Pass Irrigation District (GPID) was formed in 1917 (Newton, 1994). In 1929, GPID was issued a water right for diversion of 230 cubic feet per second (cfs). Savage Rapids Dam, completed in 1921, was built for this purpose and diverts water into GPID's 160-mile network of canals (see MapII-1). The main canals are South Highline Canal, Savage Lateral, Gravity Canal, Tokay Canal, and Evans Creek Lateral, which serve only in the Grants Pass subwatershed.



Map II-1. GPID Canal System Served by Savage Rapids Dam

In the 1880's, timber started to become an important industry. With the coming of the railroad, logs began to be exported from the region. Sugar pine was the most important tree and was heavily harvested. The first major lumber company in the watershed, the Sugar Pine Door & Lumber Company (SPD&L), opened a mill in Grants Pass in 1885 and operated continuously until they sold out around 1904. They had numerous small mills throughout the watershed. Spalding, opening around 1904 in Sweet Subwatershed, and the Williams Brothers, who opened a mill in Wolf Creek in 1898, were also large operations. The Three Pines Lumber and Planing

Mill operated near Hugo and had a lumber flume that stretched from the upper reaches of Jumpoff Joe Creek to the railroad at Three Pines.

Logging has been the major industry of the Middle Rogue Watershed since the turn of the century. After the Second World War, with the extensive road building throughout the forests, logging intensified, but during the 1980's, it suffered locally, concurrent with a nation-wide recession. Since then, the service and tourism industries have become the most important industries in the watershed.

Fishing has been a popular industry in the MRW since the beginning of the twentieth century. There was a commercial salmon fishery for much of the first half of the century but sportfishing has been the more important fishing industry in the MRW. The Rogue River has long been a popular destination for sportfishers and still draws thousands of fishermen, who represent a large portion of the tourist industry in the MRW and who favor steelhead and chinook salmon.

Historical Impacts on the Middle Rogue Watershed

The eradication of beavers by the early trappers affected riparian areas, changing the course of streams and riparian vegetation. After this, miners' hydraulic mining practices rechanneled streams, eliminated riparian vegetation, and increased sediment loads to fish-bearing streams. The miles of ditches and flumes built dramatically changed the hydrology of the watershed. Mining even changed local topography in some places such as the entrance to the Coyote Creek Canyon where hill slopes were replaced by flat acreage. One toxic legacy of the early miners is the presence of mercury in some streams. Mercury was used as an amalgam to attract gold.

Farmers brought changes as well. The lowland forests were cleared, transforming the lowland prairies and woodlands into farmland. Additionally, new species were introduced into the region to replace native root crops and grasses. Unscreened irrigation ditches channeled salmon out of the streams and onto the fields.

Initially logging practices were small scale and occurred only on small slopes in easy to reach areas. But with industrialization and road building, logging intensified throughout the watershed, affecting the condition of upland forests, and increasing erosion and sedimentation into the streams as well as changing the local hydrology.

Chapter III - CHANNEL HABITAT TYPE

INTRODUCTION

Channel habitat types (CHTs) are groups of stream channels with similar gradient, channel confinement, and channel pattern. Channel gradient is the slope of the stream channel (or water surface) measured in the direction of flow. Channel confinement is the ratio of the channel (or bankfull) width to the width of the modern floodplain; that is, channel confinement is a description of how much a channel can move within its valley before it is stopped by a hill slope or terrace (WPN 1999).

There are six channel gradient classes (Table III-1) and three channel confinement classes (Table III-2), which, together, generate fifteen different channel habitat types (Table III-3) ranging from estuarine and floodplain to headwaters. Each of these CHTs has a response rating based on how they are affected by various conditions: large woody debris, fine sediment, coarse sediment, and peak flows (WPN 1999).

Table III-1. Channel Gradient Classes

Channel Gradient Classes					
<1%	1 – 2%	2 – 4%	4 – 8%	8 – 16%	>16%

Table III-2. Channel Confinement Classes

Unconfined	Moderately Confined	Confined
>4x bankfull width	<4x bankfull width >2x	<2x bankfull width

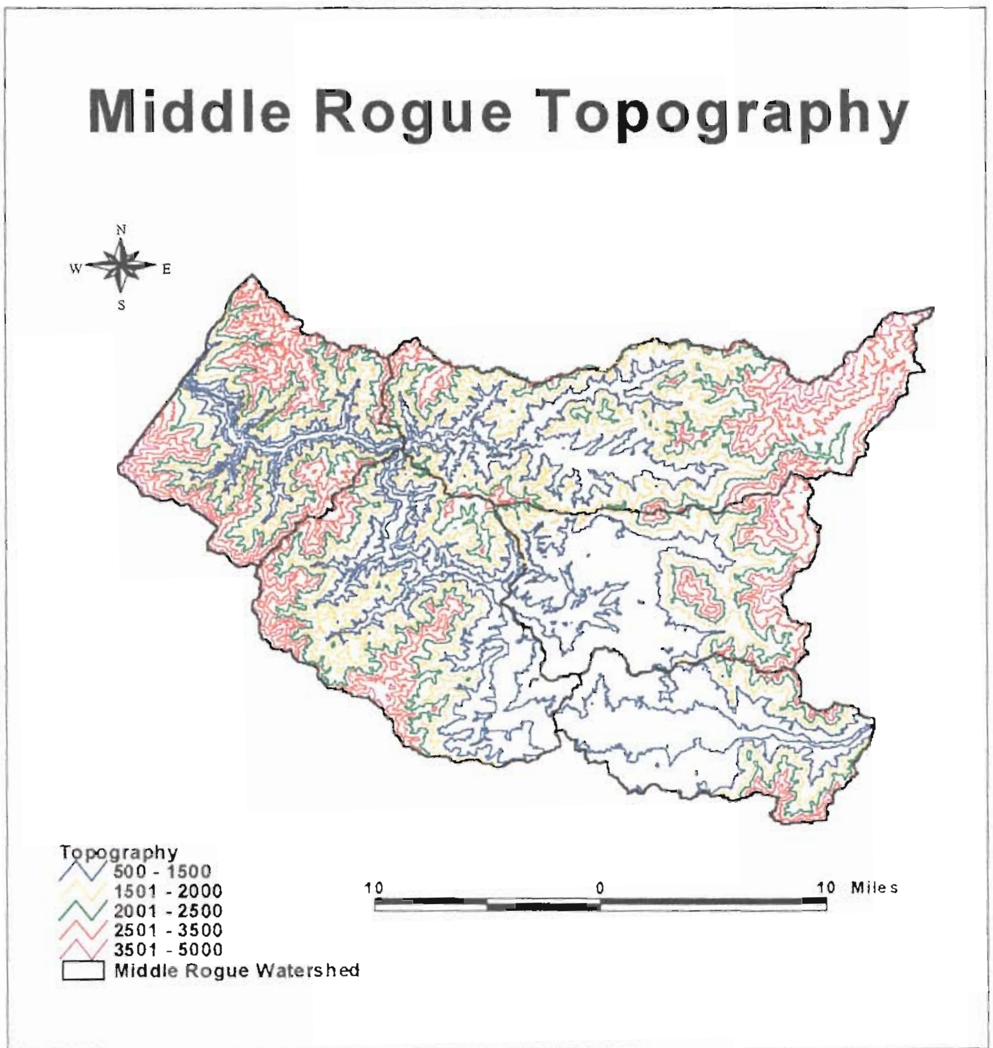
Table III-3. Channel Habitat Types *(CHTs found in the MRW are in bold type.)*

CODE	CHT Name	Gradient	Channel Confinement	Size
ES	Small Estuary	<1%	Unconfined to Moderately Confined	Small to Medium
EL	Large Estuary	<1%	Unconfined to Moderately Confined	Large
FP1	**Low Gradient Large Floodplain**	**<1%**	**Unconfined**	**Large**
FP2	Low Gradient Medium Floodplain	<2%	Unconfined	Medium to Large
FP3	**Low Gradient Small Floodplain**	**<2%**	**Unconfined**	**Small to Medium**
AF	Alluvial Fan	1-5%	Variable	Small to Medium
LM	**Low Gradient Moderately Confined**	**<2%**	**Moderately Confined**	**Variable**
LC	**Low Gradient Confined**	**<2%**	**Confined**	**Variable**
MM	**Moderate Gradient Moderately Confined**	**2-4%**	**Moderately Confined**	**Variable**
MC	**Moderate Gradient Confined**	**2-4%**	**Confined**	**Variable**
MH	**Moderate Gradient Headwater**	**1-6%**	**Confined**	**Small**
MV	**Moderately Steep Narrow Valley**	**3-10%**	**Confined**	**Small to Medium**
BC	**Bedrock Canyon**	**1->20%**	**Confined**	**Variable**
SV	**Steep Narrow Valley**	**8-16%**	**Confined**	**Small**
VH	**Very Steep Headwater**	**>16%**	**Confined**	**Small**

A channel modification is a man-made alteration that influences channel geomorphology and often disrupts biotic function. Modifications include dams, roads, bridges, riprap, ditches, culverts, in-stream mining, in-stream ponds, levees, and other bank stabilization efforts. Channel modifications can move a stream from its natural channel, affect water velocity, reduce available habitat for aquatic organisms, and change water temperature. Modifications can also confine a stream to a single channel, causing down-cutting and the reduction of channel complexity.

MIDDLE ROGUE WATERSHED CHANNEL HABITAT TYPES

In the MRW, much of the area consists of relatively steep slopes and terrain (Map III-1). This means that very few of the streams miles in the watershed are on low gradient plains (Map III-2). Some areas do have low gradient streams such as the middle reach of Grave Creek, and the lower reaches of Jumpoff Joe Creek and Limpy Creek.

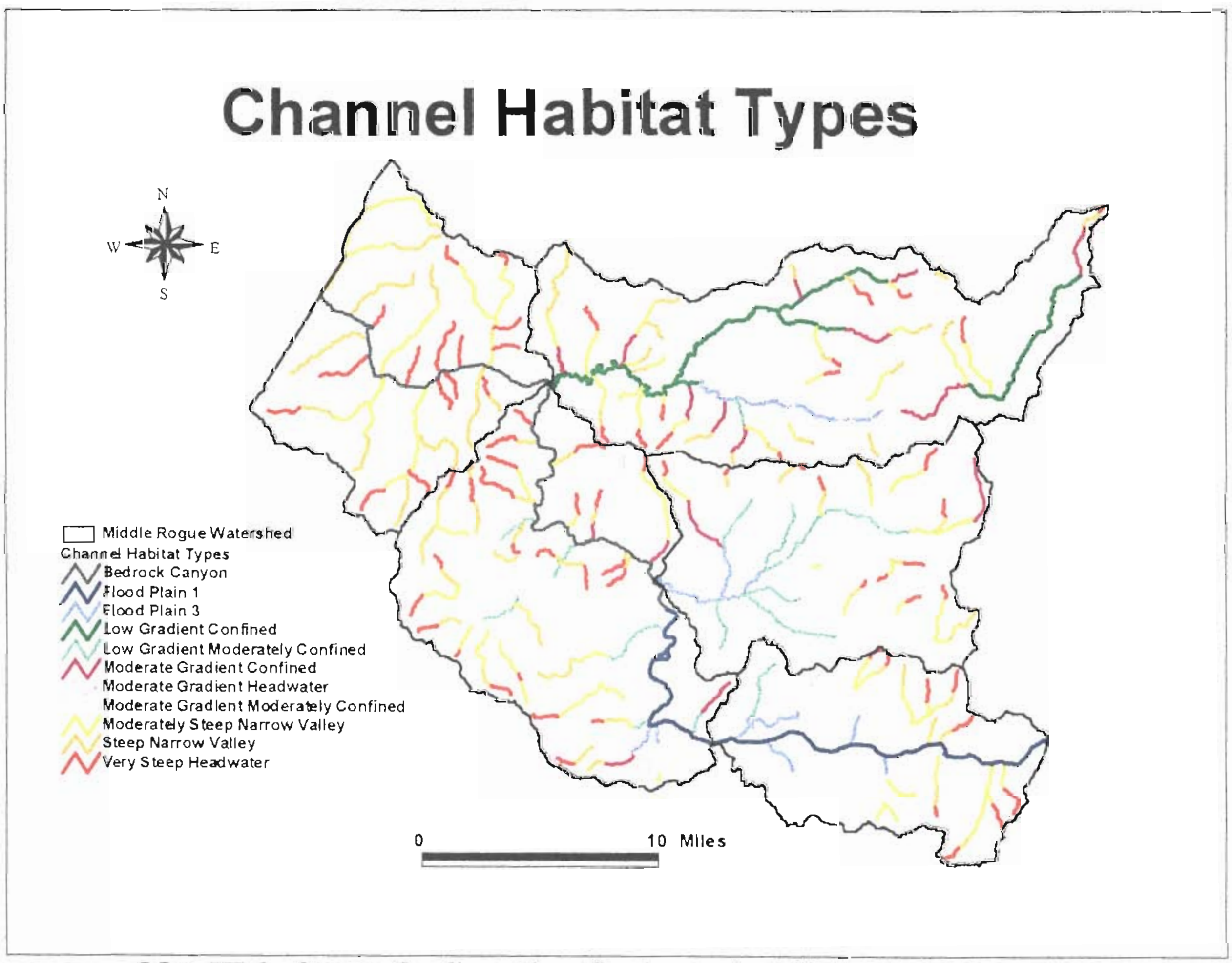


Map III-1. Topography of the Middle Rogue Watershed (500-foot intervals)

Almost 68% of the streams miles within the MRW have at least a moderate gradient and confined channel (see Table III-4). These CHTs generally have a low to moderate responsiveness to the supply of sediment, wood and high flows (WPN, 1999). The Grants Pass and Jumpoff Joe subwatersheds are the only ones in the MRW with a substantial amount of low gradient streams. It is in these two subwatersheds, and in the floodplain area of Grave Creek that channel modification activity is most likely to occur.

Table III-4. Channel Habitat Types in the Middle Rogue Watershed

CHT	Stream Miles	% of Stream Miles	CHT	Stream Miles	% of Stream Miles
BC	30	6.01	MV	115	23.09
FP1	27	5.31	LC	35	7.05
FP3	29	5.82	LM	40	7.91
MC	30	6.01	SV	77	15.44
MH	8	1.69	VH	67	13.33
MM	42	8.34			



Map III-2. Stream Gradient Classification in the Middle Rogue Watershed

Chapter IV - HYDROLOGY and WATER USE

INTRODUCTION

The purpose of this chapter is to evaluate the potential impacts on the hydrology of the Middle Rogue Watershed from land and water use practices. The hydrologic cycle is simply the movement of water through a system, in this case a watershed. A brief outline of the hydrologic cycle would be (1) precipitation, (2) runoff and infiltration, and, finally, (3) flow through the creek, lake, wetland and groundwater systems. The natural watershed characteristics that affect this cycle include local climate, topography, soil types, slope, vegetative cover and geology.

The second and third stages of this cycle, runoff and infiltration and streamflow, can be impacted and affected by land use practices such as forestry, agriculture, grazing, irrigation, road building, ditching, mining, and urban development. These practices change the timing and quantity of streamflow and cause higher peak flows and lower low flows. Indirectly, energy transfer, soil transfer and nutrient cycling are also affected.

Forestry practices have affected the greatest percentage of lands in the Pacific Northwest and result in the removal of vegetative cover, compaction of soils, road building and culvert installation (WPN, 1999). The removal of vegetation usually leads to a reduction of water loss from evapotranspiration until new stands get established. This results in an increase in the amount of water reaching the streams. However, forestry practices have changed greatly over the last century, and riparian areas are much less impacted by current logging practices.

Grazing often results in the removal of natural vegetation and alteration of the floral community composition as well as impacting soil characteristics (WPN, 1999). Cattle and other grazing animals tend to eat preferred vegetation types until they are virtually removed from the plant community. This provides an opportunity for nonselected (undesirable) plant species to proliferate. This also tends to produce areas of bare ground where trampling compacts soils. These effects are especially critical in the riparian zone where livestock tend to aggregate. Stream incision can also occur in areas of grazing, resulting in a lowering of the water table, which results in the stream channel being disconnected from the floodplain. This can alter the plant community by reducing the amount of hydrophilic vegetation, thereby reducing species complexity as well.

Water use practices associated with agriculture affect seasonal streamflow patterns resulting in increased high flows, lower water tables and reduced summer base flows. Although agriculture does not cover as much area as forestry in the Middle Rogue Watershed, the impacts may be more severe and longer lasting. Most agricultural practices lead to permanent alterations in soil characteristics, resulting in increased runoff and reduced infiltration. Another major impact of agricultural practices is contamination from the nutrients and pesticides that are commonly, and often extensively used. These products make their way into the streams reducing water quality.

Irrigation and water withdrawals from streams can cause changes in seasonal flow patterns, including reductions in summer flows, stream velocities and stream discharge. Drawdowns in streams channels reduce the habitat area for fish and aquatic invertebrates that can lead to increased predation and disease. Return flows from irrigation are typically high in sediment load, turbidity, pesticide and nutrient levels and have higher temperatures. Stream temperatures are also affected by irrigation practices as lower stream flows and increased width-to-depth ratios result in increased water temperatures to lower dissolved oxygen content; a further source of fish habitat degradation.

Mining activities have had a substantial effect on watershed hydrology. The most obvious impacts are the morphological changes to the stream channel from extraction and excavation. In addition, mining can increase stream channel erosion and alter substrate composition. Downcutting and stream channel simplification resulting from mining leads to increased flood peaks, increased sediment transport, increased stream water temperatures and reduced base flows. Although hydraulic mining is less common today, it played a major role in the mining practices in the Middle Rogue Watershed during both the 19^{th} and 20^{th} centuries. Much of this degraded habitat has still not recovered and exhibits high levels of sediment transport, downcutting and stream instability. In addition to this is the potential for acidification and pollution from extant and closed mine sites and wastes, reducing water quality in affected streams.

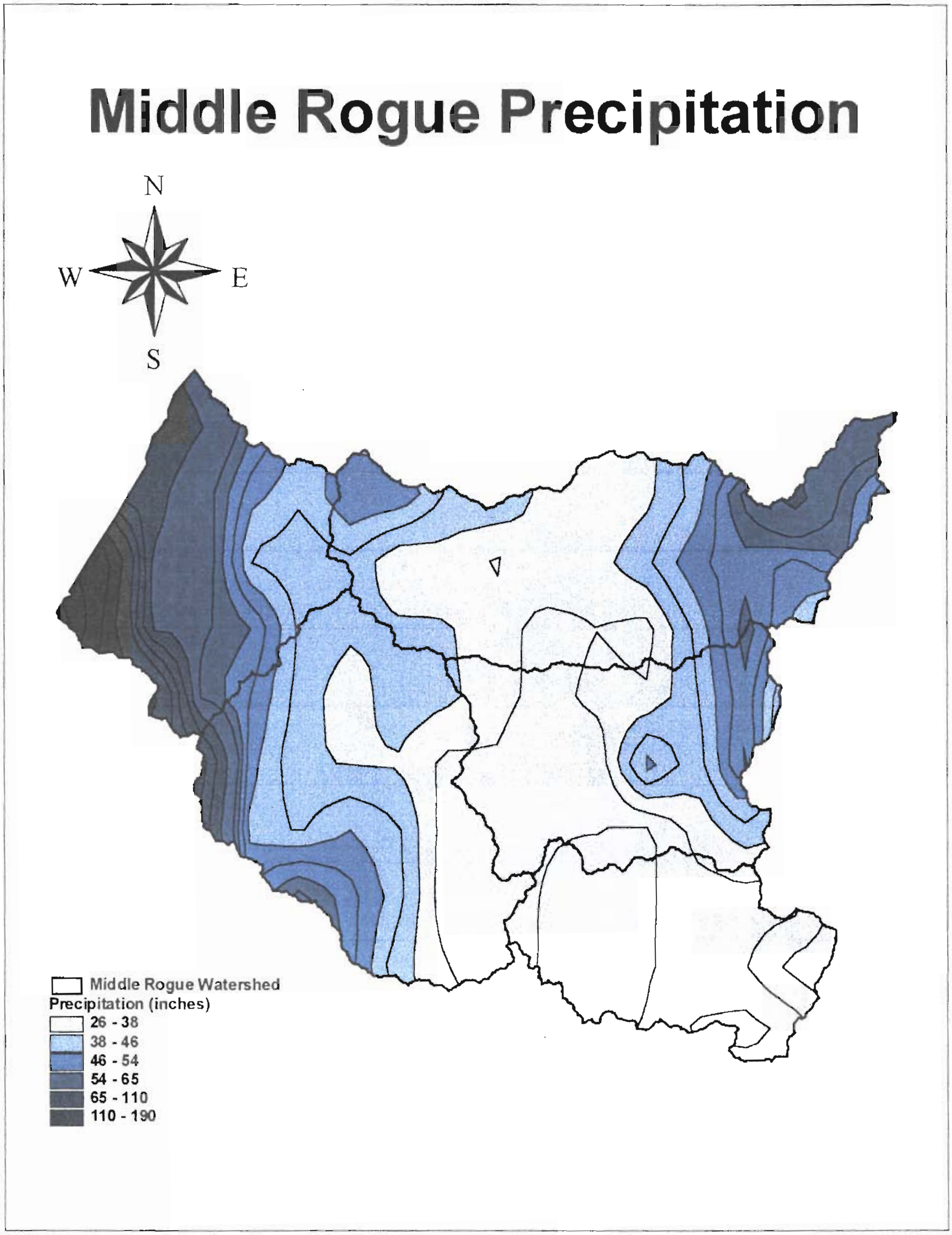
Urbanization and development affect an increasing amount of land in the Middle Rogue Watershed with severe and long lasting effects. Development leads to increased amounts of impervious areas, reduced infiltration and increased surface runoff. Parking lots, storm drains, ditches, gutters and roads divert and channel precipitation quickly to the streams. All of these changes result in increased frequency and magnitude of peak streamflows and reduced summer flows. Additionally, stream channel simplification, or loss of channel complexity, usually accompanies urban development, often as a result of channelization. This is a result of the increased erosive capability of streams from increased peak stream flows (WPN, 1999). Stream channelization exacerbates this problem, especially bank reinforcement using concrete and rip-rap.

ELEVATION AND PRECIPITATION

The elevation within the Middle Rogue Watershed ranges from 500 feet to 5200 feet with an average elevation of 2509 feet (Table IV-1). The mean annual precipitation is 63 inches but varies widely across the five subwatersheds (Map IV-1).

Table IV-1. Area, Elevations, and Precipitation in the Middle Rogue Watershed

Subwatershed	Subwatershed Area (mi^2)	Mean Elevation (feet)	Minimum Elevation (feet)	Maximum Elevation (feet)	Mean Annual Precipitation (inches)
Wild & Scenic	104.90	2629	500	4900	91
Galice	145.81	2474	700	4400	58
Grave	163.15	2550	700	5200	49
Jumpoff Joe	108.90	2449	800	4100	45
Grants Pass	83.81	2194	900	3899	33
Total	606.57	2509	500	5200	63



Map IV-1. Precipitation Pattern in the Middle Rogue Watershed

Peak stream flows can be a result of three precipitation regimes: rain, rain-on-snow, and spring snowmelt. In the Middle Rogue Watershed, precipitation is the predominant precipitation type, with rain-on-snow making up the remainder of the precipitation (Table IV-2). The elevation in the Middle Rogue Watershed does not reach high enough to permit spring snowmelt.

Table IV-2. Precipitation Regime within the Middle Rogue Watershed

Subwatershed	Area (acres)	Rain		Rain-on-Snow		Spring Snowmelt	
		Acres	%	Acres	%	Acres	%
Wild & Scenic	67138.60	35562.28	52.97	31576.32	47.03	0.00	0.00
Galice	93316.77	69234.92	74.19	24081.85	25.81	0.00	0.00
Grave	104417.10	69990.76	67.03	34426.34	32.97	0.00	0.00
Jumpoff Joe	69698.39	50917.97	73.05	18780.42	26.95	0.00	0.00
Grants Pass	53636.65	47662.16	88.86	5974.49	11.14	0.00	0.00
Total	388207.50	273368.08	70.42	114839.42	29.58	0.00	0.00

Approximately 80-90 percent of the annual precipitation occurs from December through May (Figure IV-1). The average annual precipitation in Grants Pass from 1961-1999 was 31.35 inches with a high in 1996 of 55.64 inches and a low in 1985 of 12.72 (Figure IV-2). Precipitation is greater in the other four subwatersheds, increasing as you move to the north and west (Map IV-1). Though the amount of precipitation varies across the subwatersheds, the pattern of very wet months from December through May is uniform across the Middle Rogue Watershed.

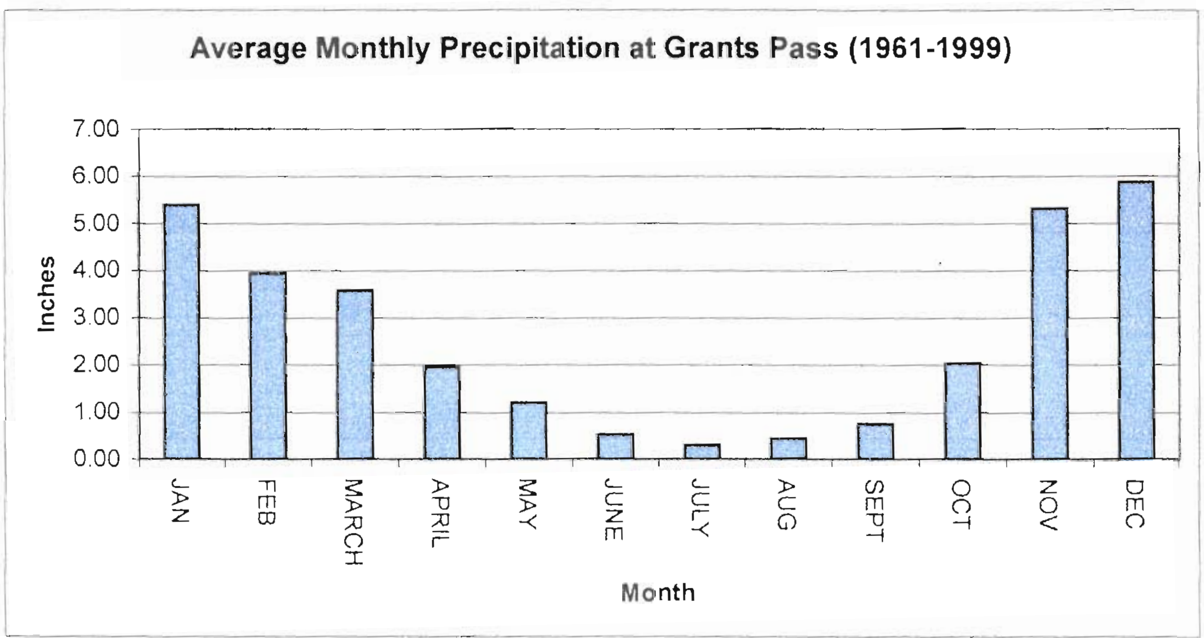


Figure IV-1. Average Monthly Precipitation (Inches) at Grants Pass Monitoring Station (1961-99)

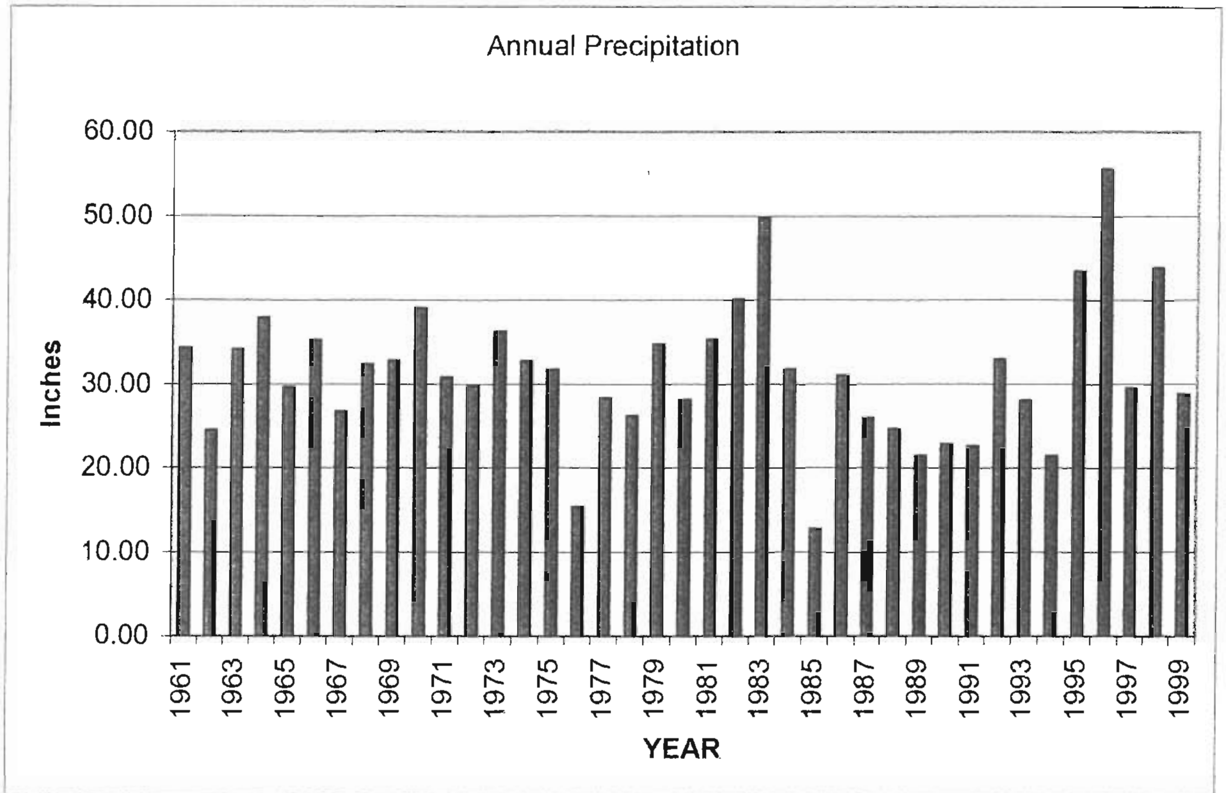
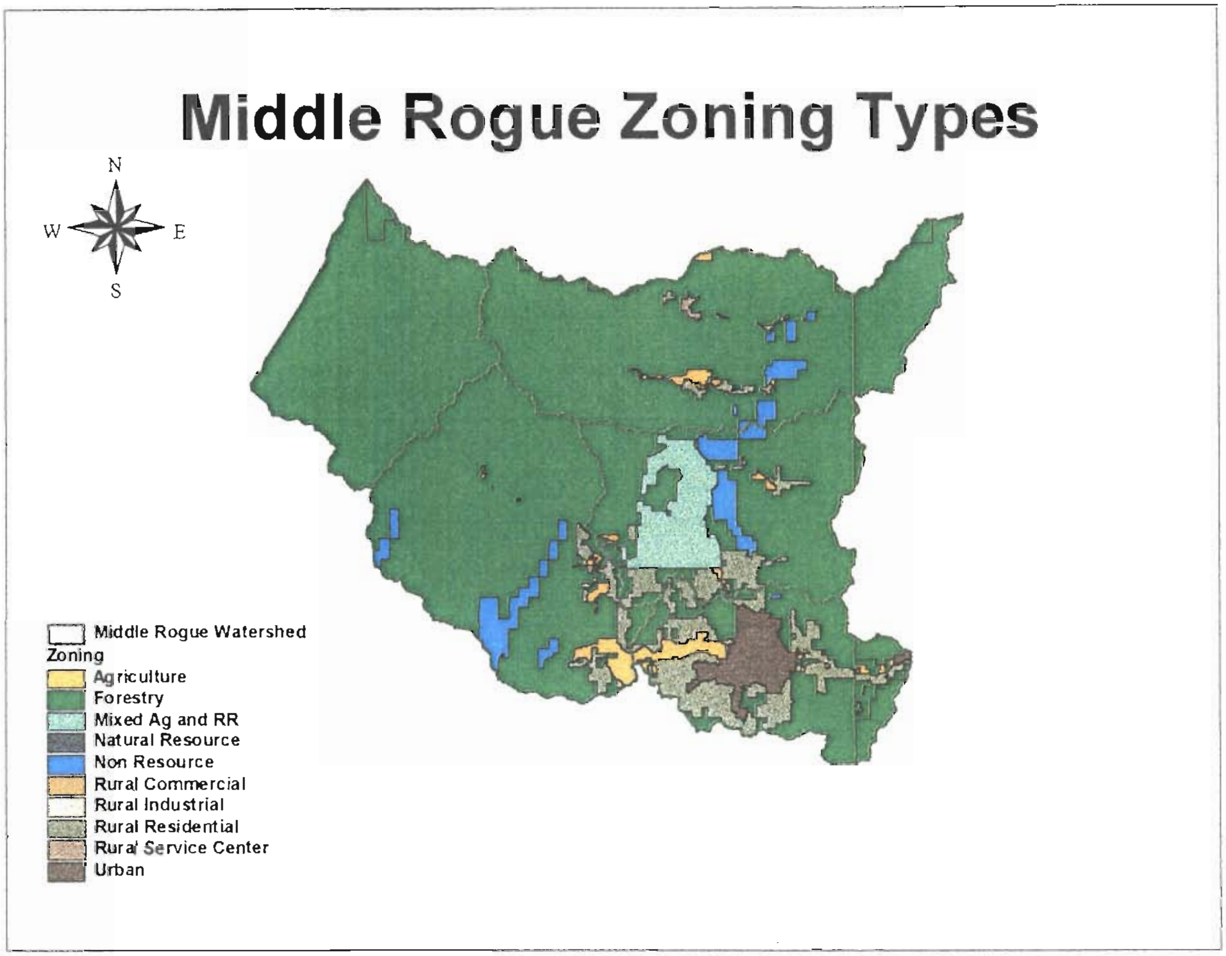


Figure IV-2. Annual Precipitation (Inches) at the Grants Pass Monitoring Site

LAND USE

By evaluating the impacts from the land use practices that occur within the Middle Rogue Watershed we can determine the degree to which the hydrological processes are impacted. More importantly, it will aid in the development of strategies and recommended management practices for restoring degraded areas or minimizing the impacts from the land use practices. This chapter characterizes the hydrology of the Middle Rogue Watershed as a whole, but also breaks it down into five (5) sub-watersheds where the data are available. The locations and types of potential impacts within the watershed are assessed. Additionally, the consumptive water uses within the watershed are identified both by location and type.

There is a variety of land use zoning types within the Middle Rogue Watershed (Map IV-2). The three zoning types that are assessed to determine the hydrologic risk potential are Forestry, Agriculture and Urban/Rural Residential. The major zoning type in the Middle Rogue Watershed is Forestry comprising 81.61% of the land area (Table IV-3). Agriculture makes up a relatively small percentage (1.82%) of the land use zoning and the only truly Urban zoning is the City of Grants Pass. After Forestry, Rural Residential zoning makes up the largest land use type in the watershed.



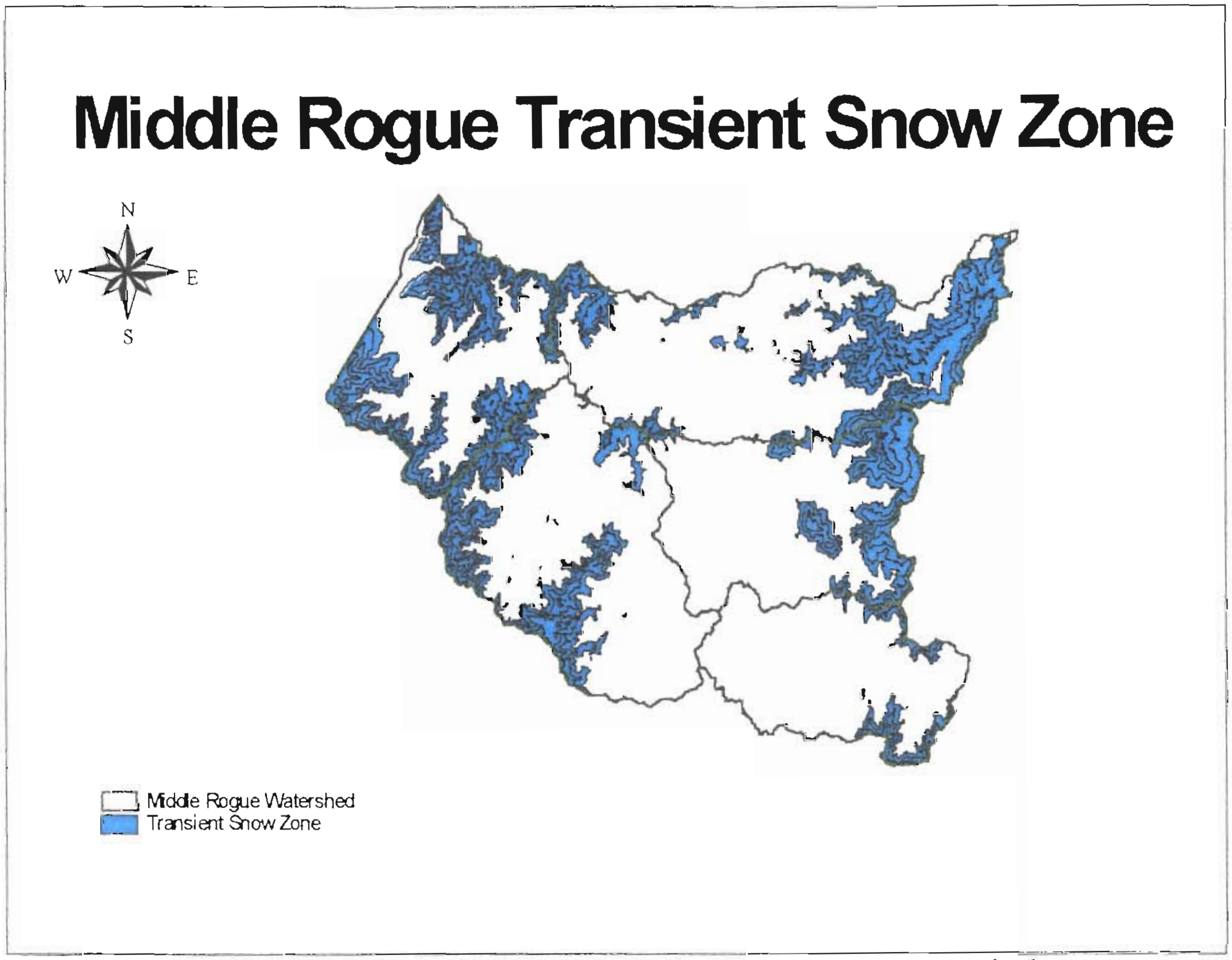
Map IV-2. Zoning Types in the Middle Rogue Watershed

Table IV-3. Land Use Zoning in the Five Middle Rogue Subwatersheds

Subwatershed	Area (acres)	Forestry		Agriculture Land	
		Acres	%	Acres	%
Wild & Scenic	67139	67139	100	0.00	0.00
Galice	93317	80456	86	2647	2.84
Grave	104417	98264	94	1240	1.19
Jumpoff Joe	69698	45265	65	457	0.65
Grants Pass	53637	25676	48	2722	5.07
Total	388208	316800	82	7065	1.82
Subwatershed	**Area (acres)**	**Urban**		**Other *(Includes Rural Residential)***	
		Acres	**%**	**Acres**	**%**
Wild & Scenic	67139	0.00	0.00	0.00	0.00
Galice	93317	0.00	0.00	10214	10.95
Grave	104417	0.00	0.00	4914	4.71
Jumpoff Joe	69698	0.00	0.00	23977	34.40
Grants Pass	53637	8742	16.30	16497	30.76
Total	388208	8742	2.25	55602	14.32

Forestry

As mentioned above, Forestry zoning comprises the majority of the land in the Middle Rogue Watershed. The two main mechanisms through which forestry practices impact hydrologic processes are (1) the removal and disturbance of vegetation and (2) the road system and related harvesting systems. The greatest likelihood of hydrologic problems arising from forestry practices is through increases in peak flows associated with rain-on-snow events (Harr, 1981). Rain-on-snow events occur at intermediate elevations where the snowpack does not get too deep. For the Middle Rogue Watershed this zone lies between 3500' and 5500 feet' (Map IV-3).



Map IV-3. Transient Snow Zone in the Middle Rogue Watershed

The potential for peak flow enhancement due to forestry practices is considered low for the Middle Rogue Watershed as well as each of the five subwatersheds (Table IV-4). The Wild & Scenic subwatershed has the greatest potential for rain-on-snow events to increase peak flows though it is still considered a low risk. The impact of forest roads will be considered later in this chapter.

Table IV-4. Risk of Peak Flow Enhancement Due to Forestry Practices*

Subwatershed	Historic Crown Closure in Rain-on-Snow Areas (%)	Percent of subwatershed in Rain-on-Snow Areas (%)	Percent of Rain-on-Snow Areas with <30% Current Crown Closure (%)	Risk of Peak-Flow Enhancement (Potential, Low, or Unknown)
Wild & Scenic	78.83	47.03	21.17	LOW
Galice	67.22	25.81	32.78	LOW
Grave	78.95	32.97	21.05	LOW
Jumpoff Joe	84.64	26.95	15.36	LOW
Grants Pass	91.99	11.14	8.01	LOW
Total	**78.06**	**29.58**	**21.93**	**LOW**

* Data are extrapolated from the SWOP cd digital database.

Agriculture

Agricultural practices have been predominantly implemented along the valley floor on floodplains and other adjacent low gradient lands. The conversion to agriculture has changed the vegetative cover from the historical forested woodland and grassland. Irrigation ditches have accompanied agricultural development in the Middle Rogue Watershed as well as channelization of streams. Agricultural practices have most likely resulted in increased velocities of surface water flows and subsurface flows that correspondingly decrease infiltration opportunities since the stream water flows quickly through the system.

The impact of agriculture on the hydrologic cycle depends on the specific practices being implemented, as well as the characteristics of the soil being farmed. The practices that alter the rate of infiltration are most important in causing changes to the hydrology of the area. In areas where soils have a high infiltration rate, agricultural practices have the greatest impact on the local hydrology.

The Natural Resource Conservation Service (NRCS) has characterized and mapped the soils throughout Oregon. As part of this process, soils are classified into one of four hydrologic soil groups as a function primarily of their minimum infiltration rate on wetted bare soil ranging from A (least runoff potential) to D (greatest runoff potential). Most of the soils in the Middle Rogue Watershed are in soil class B (Table IV-5).

Table IV-5. Soil Groups within the Middle Rogue Watershed

Subwatershed	Area of Subwatershed in Agriculture or Range-Land Use	Hydrologic Soil Groups in Agricultural Lands or Grazed Range Lands (%)			
		A	B	C	D
Wild & Scenic	0.00				
Galice	2.84	11	51	19	19
Grave	1.19	13	61	16	10
Jumpoff Joe	0.65	2	61	32	5
Grants Pass	5.07	7	66	14	13
Total	1.82	4	60	27	8

The runoff potential for the watershed can be computed using runoff curve numbers generated by NRCS, which are based on (1) soil type, (2) cover type, and (3) treatment or farming practice. Comparing the current runoff curve numbers and how they have changed from the runoff curve numbers before agricultural practices were implemented, the potential risk of peak flow enhancement can be estimated. The average change of current curve numbers from background curve numbers indicate that the potential for peakflow enhancement due to agricultural practices in the Middle Rogue Watershed is low (Table IV-2). Furthermore, the overall impact of agriculture within the Middle Rogue Watershed on the hydrologic cycle should be minimal due to the small amount of land being farmed.

Residential Urban Development

The population in Josephine County is increasing. Residential development in the Middle Rogue Watershed ranges from none in the Wild and Scenic subwatershed to mixed urban-rural development in the Grants Pass subwatershed. Grave, Galice, and Jumpoff Joe subwatersheds have varying combinations of small community-rural residential development. Impervious surfaces such as parking lots and roads, ditches, and vegetation removal increase peak flows from storm runoff. At the same time, increased residential development increases the "interface" between forested and developed areas. Increased human activity increases the fire risk and danger to life and property. In addition, fires increase the potential for erosion and soil runoff.

ROADS

Roads along stream channels restrict lateral movement and can cause a disconnect between the waterway and its floodplain. Restricting lateral movement can result in downcutting of the channel and decreased accessibility of floodwaters to overbank storage, resulting in decreased flood peak attenuation.

Forest Roads

Road networks associated with forestry can alter the rate of infiltration on the road surface, potentially impacting the hydrologic cycle, ultimately increasing peak flows. The surface of most roads is compacted soils that greatly restrict infiltration of precipitation. Forest roads generally increase streamflows by replacing subsurface with surface runoff pathways, the latter of which operates on a greatly shortened timescale.

Roads can impact peak flows during all three precipitation regimes, rain, rain-on-snow and snowmelt. Therefore the determination of the percent of the forestry lands occupied by roads can provide an indication of the relative impact of forestry roads on the hydrologic cycle.

The relative potential impact of forest roads on the hydrologic cycle in the Middle Rogue Watershed is low (Table IV-6). Though the vast majority of the watershed is in forest zoning, the percent of the forestlands in roads is only 2% for the entire watershed with a maximum of 2% in the Jumpoff Joe subwatershed. The potential only increases to moderate at a percentage of >4% and a percentage of >8% indicates a high potential for peak flow enhancement.

Table IV-6. Potential Impact of Forest Roads on Peak Flow Enhancement.

Subwatershed	Area (mi^2)	Area Forested (mi^2)	Total Linear Distance of Forest Roads (miles)	Roaded Area (mi^2)	Percent Area in Roads	Relative Potential Impact
Wild & Scenic	104.90	104.90	230	1.08	1.03	LOW
Galice	145.81	125.71	399	1.88	1.49	LOW
Grave	163.15	153.54	724	3.40	2.22	LOW
Jumpoff Joe	108.90	70.73	369	1.73	2.45	LOW
Grants Pass	83.81	40.12	137	0.64	1.60	LOW
Total	**606.57**	**495.00**	**1859**	**8.74**	**1.77**	**LOW**

Rural Roads Associated with Agriculture and Rangelands

Rural roads associated with agricultural and rangelands can have the same impacts on the hydrology of an area as forest roads. Rural roads are generally accompanied by roadside ditches and can significantly affect the hydrologic cycle as the ditches extend the stream network density, as their presence is additional to the stream channel.

The relative potential impact of roads in rural agriculture areas on the hydrologic cycle is low for the Middle Rogue Watershed (Table IV-7). The overall percentage of roads on agriculturally zoned lands is 3.60%, nearing the cutoff of 4%. However, the potential impact in the Grants Pass subwatershed (4.35%) and the Jumpoff Joe subwatershed (4.49%) is moderate. The Grave subwatershed (3.88%) is close to the 4% cutoff. However, this information must be looked at in conjunction with the small amount of land in agricultural zoning. Additionally, not all land zoned for agriculture is actually being farmed or grazed.

Table IV-7. Potential Impact of Rural Agricultural Roads on Peak Flow Enhancement.

Subwatershed	Area (mi^2)	Ag Area (mi^2)	Total Linear Distance of Ag Roads (miles)	Roaded Area (mi^2)	Percent Area in Roads	Relative Potential Impact
Wild & Scenic	104.90	0.00	0.00	0.00	0.00	LOW
Galice	145.81	4.14	16.00	0.11	2.55	LOW
Grave	163.15	1.94	11.40	0.08	3.88	LOW
Jumpoff Joe	108.90	0.71	4.85	0.03	4.49	MODERATE
Grants Pass	83.81	4.25	28.00	0.18	4.35	MODERATE
Total	**606.57**	**11.04**	**60.25**	**0.40**	**3.60**	**LOW**

Residential Roads

The relative potential impact of roads in rural residential and urban areas on the hydrologic cycle is high for the Middle Rogue Watershed (Table IV-8). The overall density is 12.38 mi/mi^2. Anything greater than 5.5 mi/mi^2 is considered to have a high potential for peak flow

Table IV-8. Potential Impact of Rural Residential Roads on Peak Flow Enhancement.

Subwatershed	Area (mi²)	Urban - Rural Residential Area (mi²)	Total Linear Distance of Rural Roads (miles)	Road Density	Relative Potential for Peak Flow Enhancement
Wild & Scenic	104.90	0.00	0.00	0.00	LOW
Galice	145.81	6.34	44.60	7.03	HIGH
Grave	163.15	3.20	35.30	11.03	HIGH
Jumpoff Joe	108.90	30.53	203.46	6.66	HIGH
Grants Pass	83.81	13.66	382.00	27.97	HIGH
Total	**606.57**	**53.73**	**665.36**	**12.38**	**HIGH**

enhancement. Of the five subwatersheds, all except the Wild & Scenic (which has no rural or urban zoning) also have a high potential for peak flow enhancement, particularly the Grants Pass subwatershed (27.97 mi/mi²) and the Grave subwatershed (11.03 mi/mi²). Unlike Agriculture, Rural Residential and Urban zoning make up a substantial portion of the watershed and, thus, road density in these zones further enhances the peak flow potential.

WATER USE

Water rights have been granted as far back as 1840. There are a number of consumptive uses including irrigation, agriculture, industrial, municipal, and domestic uses. Water rights are managed by the Oregon Water Resources Department (OWRD). Water rights operate on a prior appropriation doctrine that means that the most senior (older) water right has first access to the water and then progressing towards the most junior water right. ODFW has in-stream water rights that require minimum flows be left in streams for fish use. However, all of these in-stream rights are very junior with most having a 1990 priority date.

A total of 1625.94 cfs are allocated within the Middle Rogue Watershed (Table IV-9). Most of the water is allocated within the Galice, Grave and Jumpoff Joe subwatersheds. The water rights for the streams within the Middle Rogue Watershed are predominantly for irrigation and industrial consumptive uses (Tables IV-10 through IV-14).

Table IV-9. Water (cfs) Allocated by Subwatershed.

Subwatershed	Irri-gation	Fish/ Wild	Agri-culture	Indus-trial	Muni-cipal	Do-mestic	Recrea-tional	Misc.	Total
WILD & SCENIC	0.10	0.00	0.00	68.49	0.00	0.02	0.04	0.01	68.66
Galice	76.42	0.00	0.00	613.71	0.00	1.47	0.00	0.00	691.60
Grave	32.27	1.53	0.02	537.80	0.00	1.16	0.04	0.15	572.97
Jumpoff Joe	30.74	0.49	0.05	206.27	0.00	0.74	0.39	0.14	238.82
Grants Pass	9.34	0.03	1.79	40.45	0.00	1.25	0.01	1.02	53.89
Total	**148.87**	**2.05**	**1.86**	**1466.72**	**0.00**	**4.64**	**0.48**	**1.32**	**1625.94**

Table IV-10. Water (cfs) Allocated in the Grants Pass Subwatershed.

Creek	Irri-gation	Fish/ Wild	Agri-culture	Indus-trial	Muni-cipal	Do-mestic	Recrea-tional	Misc.	Total
VANNOY	2.83	0.02	1.52	0.00	0.00	0.00	0.00	0.00	4.37
Gilbert	1.55	0.00	0.01	0.00	0.00	0.07	0.01	0.00	1.64
Skunk	0.04	0.00	0.00	0.16	0.00	0.01	0.00	0.00	0.21
Jones	1.06	0.01	0.01	29.09	0.00	0.03	0.00	0.05	30.25
Bloody Run	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
Fall	0.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.54
Greens	0.31	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.33
Hamlin Gulch	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.10
Fruitdale	1.74	0.00	0.00	10.20	0.00	0.83	0.00	0.00	12.77
Allen	0.51	0.00	0.25	1.00	0.00	0.01	0.00	0.00	1.77
Sand	0.74	0.00	0.00	0.00	0.00	0.18	0.00	0.97	1.89
Total	**9.34**	**0.03**	**1.79**	**40.45**	**0.00**	**1.25**	**0.01**	**1.02**	**53.89**

Table IV-11. Water (cfs) Allocated in the Jumpoff Joe Subwatershed.

Creek	Irri-gation	Fish/ Wild	Agri-culture	Indus-trial	Muni-cipal	Do-mestic	Recrea-tional	Misc.	Total
JUMPOFF JOE	17.72	0.25	0.01	143.70	0.00	0.59	0.19	0.09	162.55
Quartz	3.60	0.00	0.04	1.00	0.00	0.00	0.00	0.00	4.64
Bummer	1.90	0.00	0.00	0.00	0.00	0.03	0.00	0.04	1.97
Louse	6.23	0.24	0.00	61.57	0.00	0.02	0.01	0.01	68.08
Harris	1.29	0.00	0.00	0.00	0.00	0.10	0.19	0.00	1.58
Total	**30.74**	**0.49**	**0.05**	**206.27**	**0.00**	**0.74**	**0.39**	**0.14**	**238.82**

Table IV-12. Water (cfs) Allocated in the Grave Subwatershed.

Creek	Irri-gation	Fish/ Wild	Agri-culture	Indus-trial	Muni-cipal	Do-mestic	Recrea-tional	Misc.	Total
GRAVE	26.48	0.53	0.01	406.57	0.00	0.55	0.00	0.02	434.16
Wolf	3.61	1.00	0.00	64.98	0.00	0.25	0.04	0.13	70.01
Coyote	2.18	0.00	0.01	66.25	0.00	0.36	0.00	0.00	68.80
Total	**32.27**	**1.53**	**0.02**	**537.80**	**0.00**	**1.16**	**0.04**	**0.15**	**572.97**

Table IV-13. Water (cfs)Allocated in the Wild & Scenic Subwatershed.

Creek	Irri-gation	Fish/ Wild	Agri-culture	Indus-trial	Muni-cipal	Do-mestic	Recrea-tional	Misc.	Total
RUM	0.00	0.00	0.00	10.00	0.00	0.00	0.00	0.00	10.00
Wildcat	0.00	0.00	0.00	30.00	0.00	0.00	0.00	0.00	30.00
Little Windy	0.04	0.00	0.00	17.50	0.00	0.01	0.00	0.00	17.55
Meadow	0.00	0.00	0.00	1.99	0.00	0.01	0.00	0.01	2.01
Whiskey	0.00	0.00	0.00	9.00	0.00	0.00	0.04	0.00	9.04
China Gulch	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
Total	**0.10**	**0.00**	**0.00**	**68.49**	**0.00**	**0.02**	**0.04**	**0.01**	**68.66**

Table IV-14. Water (cfs)Allocated in the Galice Subwatershed.

Creek	Irrigation	Fish/Wild	Agri.	Indust.	Municipal	Domestic	Recreational	Misc.	Total
Shan	1.28	0.00	0.00	55.00	0.00	0.04	0.00	0.00	56.32
Pickett	3.50	0.00	0.00	54.50	0.00	0.11	0.00	0.00	58.11
Rich	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21
Madams	1.74	0.00	0.00	0.00	0.00	0.01	0.00	0.00	1.75
Little Pickett	0.40	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.41
Sanders Gulch	0.50	0.00	0.00	2.03	0.00	0.01	0.00	0.00	2.54
Taylor	50.74	0.00	0.00	34.10	0.00	0.02	0.00	0.00	84.86
Yew Wood	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.02
Bailey	4.00	0.00	0.00	3.30	0.00	0.01	0.00	0.00	7.31
Smith	0.24	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.25
Centennial Gulch	0.00	0.00	0.00	11.00	0.00	0.00	0.00	0.00	11.00
Ash Gulch	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.02
Belknap Gulch	0.00	0.00	0.00	18.00	0.00	0.00	0.00	0.00	18.00
Maple Gulch	0.04	0.00	0.00	2.00	0.00	0.00	0.00	0.00	2.04
Paint	0.11	0.00	0.00	2.00	0.00	0.00	0.00	0.00	2.11
Delta	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01
Stratton	0.38	0.00	0.00	41.00	0.00	0.00	0.00	0.00	41.38
Hog	1.17	0.00	0.00	4.01	0.00	0.02	0.00	0.00	5.20
Grade	0.24	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.26
Pass	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38
Zigzag	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	2.00
Cooksie Gulch	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01
Spangler Gulch	0.13	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.24
Rich Gulch	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
Rocky Gulch	6.40	0.00	0.00	90.30	0.00	0.11	0.00	0.00	96.81
Hooks Gulch	0.00	0.00	0.00	17.50	0.00	0.06	0.00	0.00	17.56
Galice	0.24	0.00	0.00	251.97	0.00	0.54	0.00	0.00	252.75
Limpy	3.08	0.00	0.00	25.00	0.00	0.27	0.00	0.00	28.35
Dutcher	1.53	0	0	0	0	0.07	0	0	1.60
Total	**76.42**	**0.00**	**0.00**	**613.71**	**0.00**	**1.47**	**0.00**	**0.00**	**691.60**

Table IV-15. Water Availability for the 27 Water Availability Basins (WABs) in the Middle Rogue Watershed.

Water Availability Basin	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
					Wild & Scenic Subwatershed WABs							
Jenny Creek	3.70	12.20	3.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Windy	0.00	4.90	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	0.00	0.00	0.00
Big Windy	85.00	120.00	84.00	38.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.00
Howard	58.20	85.00	57.10	23.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
Kelsey	32.90	52.80	31.30	8.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.50
Whiskey	1.40	12.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Meadow	0.00	4.90	-0.01	0.00	-0.02	-0.10	-0.09	-0.06	-0.02	-0.05	-0.02	0.00
Rogue above Meadow	1760.00	2600.00	1390.00	1370.00	1660.00	-56.80	-722.00	-1480.00	-1355.00	-164.00	-1364.00	1930.00
					Grave Creek Subwatershed WABs							
Poorman	-0.01	5.59	-0.01	-0.05	0.00	-0.08	-0.05	-0.02	-0.06	-0.03	-0.04	-2.01
Grave @ Mouth	228.00	342.00	202.00	78.60	-49.80	-4.61	-4.85	-1.48	-3.54	-1.48	-0.57	118.00
Grave above Wolf	57.60	119.00	47.60	-1.71	-2.55	-21.70	-4.56	-3.81	-38.20	-34.30	-49.30	-0.34
Grave above Burgess Gulch	125.00	164.00	124.00	85.50	38.90	13.70	3.31	1.09	1.58	4.79	24.40	88.70
Grave above Boulder	0.00	18.80	2.89	-0.63	-1.18	-1.66	-2.23	-1.84	-1.20	-0.38	0.00	0.00
Wolf	66.50	96.30	60.30	27.20	5.07	-6.85	1.57	0.14	0.20	-15.40	-5.02	37.60
					Galice/Pickett Subwatershed WABs							
Galice	48.90	80.90	43.90	3.08	-0.13	-0.13	-0.14	-0.14	-0.13	-0.12	-0.11	-0.11
Taylor	19.00	47.00	16.80	-0.07	-0.10	-0.09	-0.16	-0.17	-0.08	-0.09	-0.01	-0.02
Pickett	2.28	9.88	0.98	-0.09	-0.14	-0.19	-0.25	-0.21	-0.14	-0.06	-0.02	-0.02
Shan	0.00	1.50	0.00	-0.04	-0.05	-0.07	-0.10	-0.08	-0.05	-0.02	0.00	0.00
Limpy	-0.07	3.83	-0.07	-0.29	-0.42	-0.56	-0.73	-0.61	-0.42	-0.18	-0.07	-0.07
Dutcher	0.02	-0.02	-0.24	-0.19	-0.22	-0.27	-0.41	-0.34	-0.20	-0.13	0.00	-0.01
Rogue above Grave	1180.00	1820.00	772.00	879.00	1320.00	-221.00	-801.00	-1532.00	-1423.00	-280.00	-1602.00	1350.00
					Jumpoff Joe Subwatershed WABs							
Jumpoff Joe @ Mouth	90.00	137.00	111.00	-0.05	-3.01	-4.06	-5.29	-4.43	-3.05	-1.29	-0.52	57.10
Jumpoff Joe above Louse	69.60	94.50	82.60	24.40	-1.28	6.11	0.66	0.53	0.22	-0.59	-0.28	52.30
Louse @ Mouth	-0.34	7.11	2.70	-0.50	-0.69	-0.91	-1.16	-0.99	-0.70	-0.34	-0.20	-0.31
Louse above Soldier	15.10	22.60	20.00	2.95	-0.23	-0.32	-0.43	-0.36	-0.23	-0.08	-0.01	9.69
					Grants Pass Subwatershed WABs							
Fruitdale	2.87	4.84	3.85	-7.16	-11.70	-15.70	-21.40	-17.80	-14.90	-7.23	-3.22	1.23
Rogue above Applegate	3520.00	3150.00	2780.00	3760.00	3930.00	2200.00	1170.00	931.00	982.00	1260.00	1840.00	3240.00

Table IV-16. Restoration Potential for WABs Based on Percentage of Water That Is Allocated to Consumptive Uses.

Water Availability Basin	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wild & Scenic Subwatershed WABs												
Jenny Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Windy	0.00	0.00	0.00	0.00	0.29	0.90	3.85	11.11	16.67	0.00	0.00	0.00
Big Windy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Howard	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
Kelsey	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Whiskey	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Meadow	0.00	0.00	0.00	0.31	1.34	3.54	12.35	19.05	14.71	2.99	0.00	0.00
Rogue above Meadow	13.24	25.91	27.47	19.29	4.38	13.62	27.81	32.35	25.41	7.37	7.13	5.28
Grave Creek Subwatershed WABs												
Poorman	0.06	0.04	0.06	0.34	1.27	3.40	11.29	17.65	14.29	5.13	0.51	0.09
Grave @ Mouth	0.26	0.24	0.28	1.10	3.95	12.27	37.73	53.20	42.19	11.85	1.01	0.31
Grave above Wolf	0.20	0.19	0.21	1.43	5.04	15.92	51.29	74.85	59.54	15.28	1.03	0.25
Grave above Burgess Gulch	0.04	0.05	0.05	1.09	3.69	13.23	45.74	67.94	49.03	9.62	0.20	0.06
Grave above Boulder	0.00	0.03	0.00	1.24	4.13	15.23	45.05	59.74	50.63	12.62	0.00	0.00
Wolf	0.60	0.56	0.61	1.10	3.92	11.70	35.10	50.86	40.89	13.00	1.67	0.68
Galice/Pickett Subwatershed WABs												
Galice	0.10	0.08	0.11	0.19	0.54	1.26	4.27	9.46	11.93	4.90	0.50	0.14
Taylor	0.02	0.02	0.02	0.13	0.47	1.60	5.33	8.92	6.38	1.51	0.06	0.03
Pickett	0.09	0.07	0.10	0.75	3.24	9.74	34.72	58.33	51.85	12.82	0.82	0.13
Shan	0.00	0.00	0.00	0.53	1.82	6.42	27.03	44.44	35.71	9.09	0.00	0.00
Limpy	0.39	0.29	0.42	3.06	13.55	36.13	146.00	277.27	323.08	85.71	3.93	0.58
Dutcher	0.21	0.16	0.23	2.95	13.21	28.43	102.63	177.78	200.00	53.33	1.96	0.32
Rogue above Grave	14.62	28.62	30.24	21.03	4.45	13.92	28.22	32.71	26.04	7.71	7.86	5.84
Jumpoff Joe Subwatershed WABs												
Jumpoff Joe @ Mouth	0.55	0.56	0.55	2.01	8.53	18.04	55.70	66.07	64.35	17.89	1.82	0.58
Jumpoff Joe above Louse	0.42	0.37	0.39	1.58	6.37	14.32	45.04	54.60	51.39	14.53	1.73	0.45
Louse @ Mouth	0.86	1.01	0.89	2.28	8.93	21.51	67.05	81.15	72.16	21.52	3.32	0.97
Louse above Soldier	0.03	0.03	0.03	0.88	3.63	11.31	38.74	46.75	32.86	6.45	0.21	0.04
Grants Pass Subwatershed WABs												
Fruitdale	0.15	0.11	0.13	187.29	908.33	2109.59	6088.24	6538.46	5550.00	1296.30	1.27	0.19
Rogue above Applegate	18.86	34.59	33.58	15.80	4.03	13.81	25.78	28.41	23.81	7.04	9.41	8.05

Key: Those Months with the Greatest Restoration Potential.

STREAMFLOW

The Oregon Water Resources Board has divided the state into Water Availability Basins (WABs). There are 27 WABs within the Middle Rogue Watershed: Wild & Scenic (8), Grave (6), Jumpoff Joe (4), Galice (7) and Grants Pass (2). OWRD has generated models to determine natural streamflows for these basins as well as to determine the net water available.

Water run-off in the Middle Rogue Watershed generally follows the seasonal precipitation pattern, being driven by precipitation. Low flows normally occur from July through October, which is the period of least precipitation and heaviest irrigation use.

Currently, most streams in the Middle Rogue Watershed are over allocated, meaning that there is more water allocated to users than exists naturally in the streams (Table IV-15). Those basins that have a larger percentage of the water being used as consumptive uses represent those that have the greatest opportunity for restoration. If the percentage of consumptive use is greater than 10% there is potential for streamflow restoration (Table IV-16).

DISCUSSION

The land use practices within the Middle Rogue Watershed do not appear to represent a great potential for impacting the hydrologic cycle (Table IV-9). However, since forestry lands cover over 80% of the Middle Rogue Watershed, practices on these lands could be operated using best management practices to improve the current hydrologic condition of the watershed. This is particularly true on private forestlands that make up a significant portion of the watershed.

Roads do represent a potential factor for affecting the hydrologic cycle. In particular, roads in agricultural areas (moderate) and roads in urban and rural residential (high) represent the most important land use activity in regards to impact the hydrologic cycle. Once again, though forest roads do not appear to represent an important factor, the fact that the total amount of forest roads is the greatest portion of roads in the watershed shows that there is potential for impacting the hydrology of the Middle Rogue Watershed.

Most of the streams in the Middle Rogue Watershed are over allocated, meaning there are rights for more water than exists in the streams. Ten of the 27 WABs in the Middle Rogue Watershed are State Flow Restoration Priority WABs indicating that resources are available for restoration projects within the indicated WABs. During most of the summer months on almost all of the streams, there is potential for stream flow restoration based on the fact that greater than 10% of the flow is used by consumptive water rights.

The overall condition of the hydrological cycle in the Middle Rogue Watershed is somewhat moderate. However, there is potential for restoration, through in-stream projects, up-slope projects and landowner education.

Table IV-17. Hydrologic Issue Identification Summary.

Subwatershed	Timber Harvest		Agriculture	
	Result	Risk	Result	Risk
Wild & Scenic	21.17	LOW	<0.50	LOW
Galice	32.78	LOW	<0.50	LOW
Grave	21.05	LOW	<0.50	LOW
Jumpoff Joe	15.36	LOW	<0.50	LOW
Grants Pass	8.01	LOW	<0.50	LOW
Middle Rogue	**21.93**	**LOW**	**<0.50**	**LOW**

Subwatershed	Forest Roads		Ag. Roads	
	Result	Risk	Result	Risk
Wild & Scenic	1.03	LOW	0.00	LOW
Galice	1.49	LOW	2.55	LOW
Grave	2.22	LOW	3.88	LOW
Jumpoff Joe	2.45	LOW	4.49	MODERATE
Grants Pass	1.60	LOW	4.35	MODERATE
Middle Rogue	**1.77**	**LOW**	**3.60**	**LOW**

Subwatershed	Rural/Urban Roads	
	Result	Risk
Wild & Scenic	0.00	LOW
Galice	7.03	HIGH
Grave	11.03	HIGH
Jumpoff Joe	6.66	HIGH
Grants Pass	27.97	HIGH
Middle Rogue	**12.38**	**HIGH**

Chapter V - FISH AND FISH HABITAT

There are five native anadromous salmonids populations that spawn or migrate within the Middle Rogue Watershed (MRW): spring chinook, fall chinook, winter steelhead, summer steelhead, and coho. In addition to these species, there are numerous other fish that live within the MRW including anadromous fish such as pacific lamprey, green sturgeon, and American shad, as well as resident fish such as rainbow trout, cutthroat, and sculpins.

Salmonid Life History Pattern

The life history of anadromous salmonids varies between species and even runs but the general characteristics are the same (Figure V-1). The adults make their way up stream, generally to the waters where they were hatched themselves. There is a small amount of straying, return migration to a stream other than the natal stream, that occurs which provides protection for the species in case of a catastrophic event such as a landslide or flood destroying all of the rearing or spawning habitat in a stream for a year or more. The females then dig redds (nests) made of clean gravel in which they lay their eggs. Males fertilize the eggs as they are being laid. After spawning, the adults die. (Searun cutthroat and steelhead do not always die after spawning.) The number of eggs laid is dependant upon the species and size of the individual female. Incubation of the eggs depends upon the species and is temperature dependant. The eggs then hatch, becoming alevin in which the yolk sac is still attached to the young fish. The alevin stay within the gravel until the yolk sac is completely absorbed. At this point they emerge from the gravel as developed fry. Fry stay in fresh water from six months to three years depending on the species. These young fish use the slower waters near the shore and instream structures for protection against predation and strong currents. Eventually, the fingerlings begin to show parr marks (dark stripes on their sides) and are commonly known as parr. After this stage smoltification begins. The young fish begin making their way down towards the mouth of the river. Once they reach the brackish waters of the estuary they finish going through a physiological change in preparation for moving from fresh water to the salt water of the ocean. After the smoltification process is complete, the fish make their way into the ocean where they will live from one summer up to six years depending on species and life history strategy.

Spring Chinook

Spring chinook generally begin entering the Rogue River in mid-March and have passed through the Middle Rogue Watershed (MRW) by the end of July, with the peak migration period occurring during May/June. They spawn in the mainstem and lowest reaches of the larger streams, with most spawning between Gold Ray Dam and Cole M. Rivers Hatchery at Lost Creek Dam (upstream of the MRW). Spawning occurs from September through mid-November with a peak normally during early October (ODFW, 1991). Spring chinook fry complete their emergence from redds by mid-May (Satterthwaite et. al., 1992).

Fall Chinook

The fall chinook run in the Rogue River is the largest in Oregon excluding the Columbia River stocks (Nicholas and Hankin, 1988). Fall chinook begin entering the Rogue River in mid-July and support a Middle Rogue sport fishery during August and September. In contrast to spring chinook, fall chinook runs in the Rogue River are not supported through hatchery production. This population appears somewhat stable.

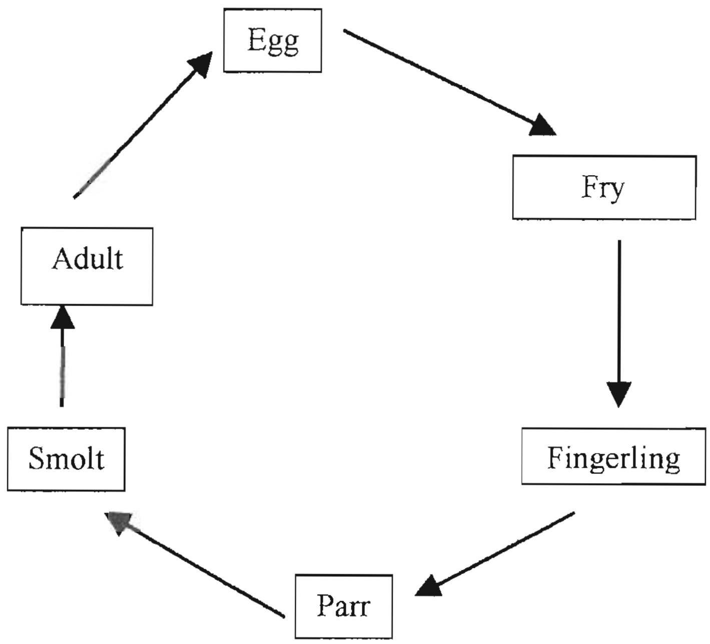


Figure V-1. Salmonid Life History

An average of 2,300 fall chinook spawn annually in the three miles of the Rogue River between Lathrop Park (just down river of Grants Pass) downstream to the mouth of the Applegate River. Another 5,400 spawn in the river between the Applegate River and Hog Creek (ODFW, 1992a). There is relatively little spawning habitat in the 14.1 miles between Hog Creek and Grave Creek. Spawning in the Rogue River and lower reaches of the major tributaries occurs from mid-October to December with the peak spawning occurring from late October through mid-November. Fall chinook fry emerge from redds in the MRW between late February and May (ODFW, 1992b). Most chinook spend 3-4 years in the ocean before returning to fresh water. Some will return after only 1.5 years at sea and some will stay in the ocean for up to six years.

Coho

Adult coho salmon enter the Rogue River in mid-September and pass through the MRW in October and November. Wild adults remain in the river until flows in the tributaries are sufficient for them to enter. Spawning and rearing occurs mostly in the tributaries. Adults, which average about seven pounds and produce approximately 2,500 eggs per female spawn in the low gradient riffle areas over small gravel. Fry emerge from the gravel between late March and early June (ODFW, 1991). After hatching, most coho spend up to 15 months in their fresh water, preferring pools and slack water areas associated with woody debris, undercut banks and overhanging vegetation. Emigration to the river and ocean occurs during March through early

Fish Habitat

Streams are complex environments subject to many physical, chemical and biological influences. All stream organisms must constantly adapt to changing environmental conditions. Because salmonids live in streams during their most critical and vulnerable life stages, stream habitat conditions are critical to survival and population strength. Any disruption caused by human activity has a profound impact on salmonid survival. Three factors influence streams as habitat for salmonids: water quality (temperature, turbidity/sedimentation, chemistry/pH balance), water quantity (low stream flow, diversions), and physical structure (pool habitat, riffle-pool-glide ratio)

Water Quality – Temperature

For salmonids, water temperature is critical. Although survival is possible between 42°F and 77°F (5.6°C-25°C), they are very sensitive to changes in water temperature. Salmonid rearing becomes seriously impaired when water temperatures exceed 64°F. Temperature has a direct relationship to oxygen content in water and higher temperatures can make fish more susceptible to pathogens present in water.

Water Quality – Turbidity/Sedimentation

Water clarity is the most visible characteristic of water quality and is affected by suspended sediment (turbidity). Steep stream gradients throughout the MRW have produced narrow canyons and ridges with steep slopes subject to mass wasting. Soil depth is generally shallow and rocky. Periods of winter and spring high run-off are often accompanied with high turbidity due to readily weathered granitic rock.

A major source of stream sedimentation is road construction. Logging and the concomitant road building have caused extensive upland erosion, in some cases causing or exacerbating landslides. This results in sedimentation of streambeds and consequent loss of spawning and rearing habitat. Salmonids require clean well oxygenated gravels for their redds and the survival of alevins. Much of the upland road system consists of natural or unpaved roads that are a major source of surface erosion.

Grazing practices allowing unmanaged livestock in riparian zones, overgrazing that removes substantial vegetative cover, and residential clearing in and outside of the riparian zone have also contributed to increases sedimentation.

Water Quality – Chemistry/pH Balance

The proper chemical balance is crucial to fish survival in the dynamic stream environment. Salmonids require highly oxygenated water, a condition that varies dramatically with flow rates, water temperature, and biological activity. Salmonids also prefer water with a neutral pH balance. Dissolved solids such as calcium and magnesium have a direct impact on aquatic plants and animals. Calcium acts to make heavy metals less toxic to fish. Phosphates and nitrates affect the entire food chain. Their over-abundance makes algae and other aquatic plant life bloom rapidly. This can be harmful to fish as decomposing organic material consumes dissolved oxygen.

Low flows and elevated water temperatures can stimulate various diseases that can significantly affect fish. *Columnaris* and *dermocystidium* have killed thousands of RRB salmonids in the past throughout the MRW. Chinook are the species that is primarily affected. Low flows from drought and water withdrawals reduce stream flows and lead to an increase in stream temperatures. Logging, drought caused mortality of conifers and residential and agricultural development have degraded riparian vegetation. This has reduced the ability of the riparian vegetation to provide shade, exacerbating the problem.

Water Quality – Low Stream Flow and Diversions

Water needs are greatest during the summer months when water is in high demand for irrigation, recreation, domestic use, and road construction. This is also the time of lowest water yield. Low flows are the combined result of naturally low seasonal flows and withdrawals for irrigation and domestic use. Low flows can lead to higher stream temperatures and lower oxygen levels.

Water Quantity – Soil compaction

Soil has a large infiltration and storage capacity for water. Water from this storage reservoir is released slowly back to the stream, usually cooler than the water already flowing in the stream, and is a major source of stream flows during the summer months. Compacted soils often result from road construction and logging activities as well as intense livestock grazing. This consequently reduces the systems capacity to store water for later releases.

Water Quantity– Low Stream Flow and Diversions

The quality of stream habitat for salmonids is closely related to its structure – the number and arrangement of pools, riffles and glides as well as woody debris and barriers.

Pools can offer deep water, shade, the protective cover of boulders and logs, and reduced current and turbulence. In pools, fish can expend relatively little energy as drifting food comes to them and offer resting areas while migrating upstream to spawn. Downed logs in the stream are crucial to the formation of pools and "stepped pools" as habitat.

Riffles and glides are habitat for aquatic insects and important sources of oxygen. Many insect forms thrive in the rocks of riffles. For coho, cutthroat, and steelhead juveniles, the number of feeding stations often determines fish density: the more boulders and greater diversity of bottom textures, the more fish.

Water Quantity – Barriers

Fish passage barriers have the most obvious structural impact on salmonid habitat in streams. Poorly designed dams and culverts make it more difficult or even impossible for fish to use otherwise useful habitat. Barriers to fish passage can prevent salmonids from reaching spawning habitat and can prevent juveniles from finding safe rearing areas or safely migrating to the ocean. Barriers can be both man-made and natural and can change the flow regimes of the stream system. Unscreened or improperly screened ditches cause direct and indirect juvenile salmonid mortality. The fish can be shunted through turbulent water and rough structures. Additionally, fish can become trapped in warm water areas and face predation by warm water species such as large mouth bass.

Fish Distribution

Each of the five anadromous salmonid populations (searun cutthroat are not included in this discussion due to a lack of data) use at least some portion of the MRW during their life. Fall chinook use the waters of the MRW for spawning and migration only, as the young fish rear in waters lower in the Rogue River (Table V-1, Map V-1). Spring chinook only use the section of the Rogue River in the MRW as a migration corridor (Table V-2, Map V-2). All spring chinook spawning occurs upstream of the MRW.

Table V-1. Current Estimated Fall Chinook Distribution in the Middle Rogue Watershed*

STREAM	LENGTH (km)	LENGTH (mi)
Galice Creek	3.22	2.00
Grave Creek	35.40	21.98
Jumpoff Joe Creek	4.83	3.00
Taylor Creek	2.41	1.50
Rogue River	90.12	55.96
Total	**135.98**	**84.44**

* Distance measured from mouth of creek.

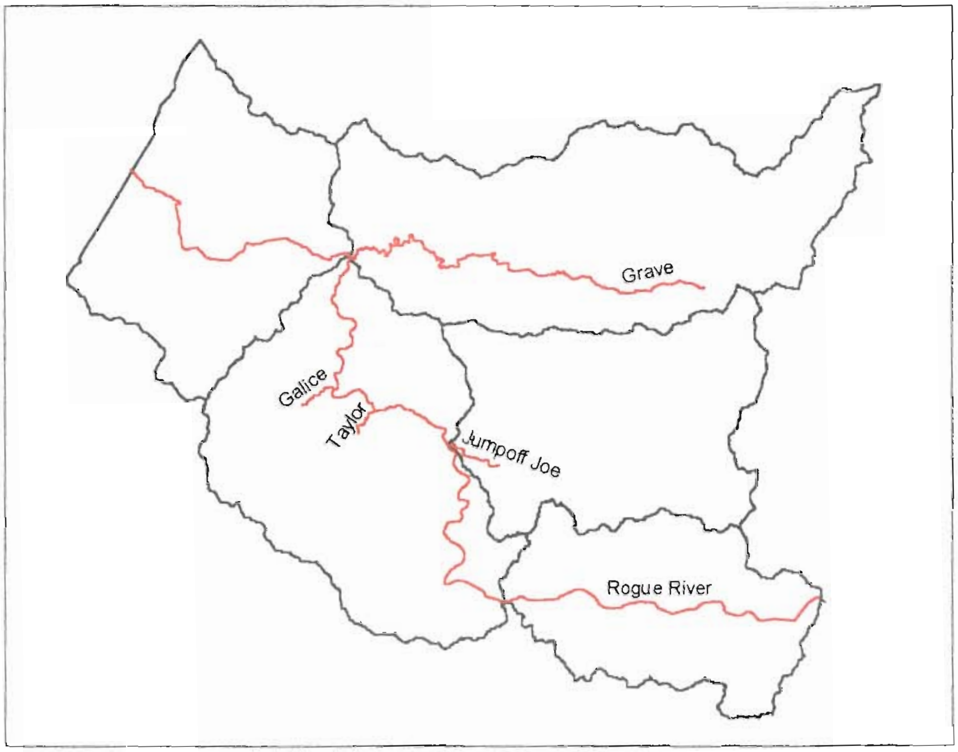
Table V-2. Current Estimated Spring Chinook Distribution in the Middle Rogue Watershed*

STREAM	LENGTH (km)	LENGTH (mi)
Rogue River	90.12	55.96

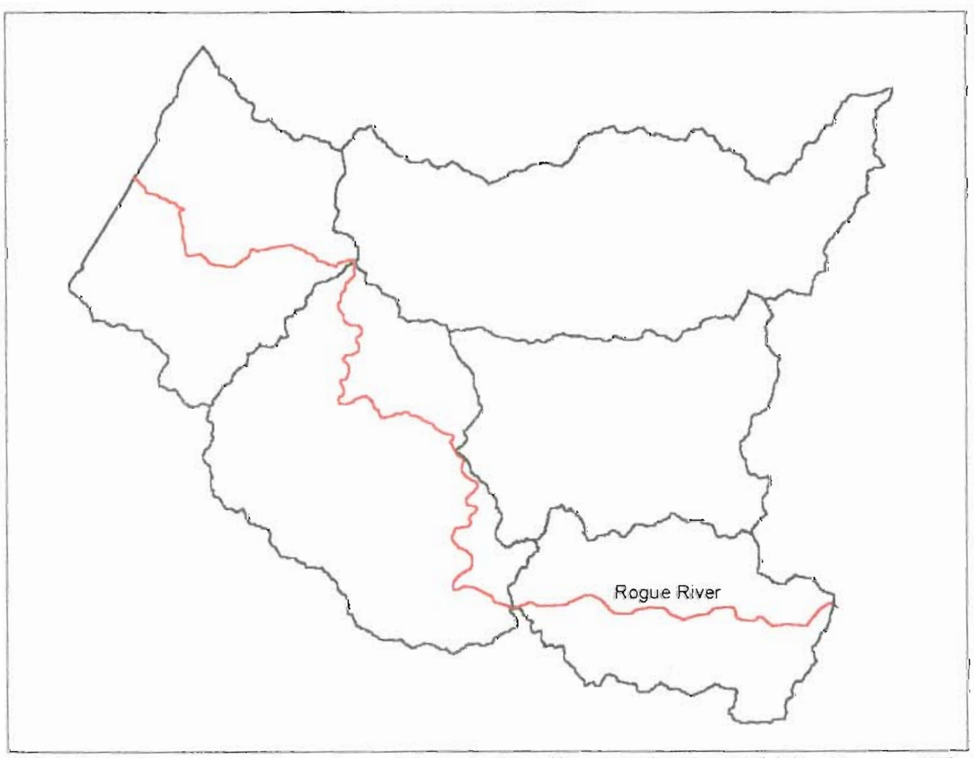
*Distance of stream measured from mouth of creek.

Coho use smaller tributaries than chinook, and they use the streams of the MRW for rearing as well as spawning and migration (see Table V-3, Map V-3). Coho use a total of 186.66 kilometers of streams within the MRW.

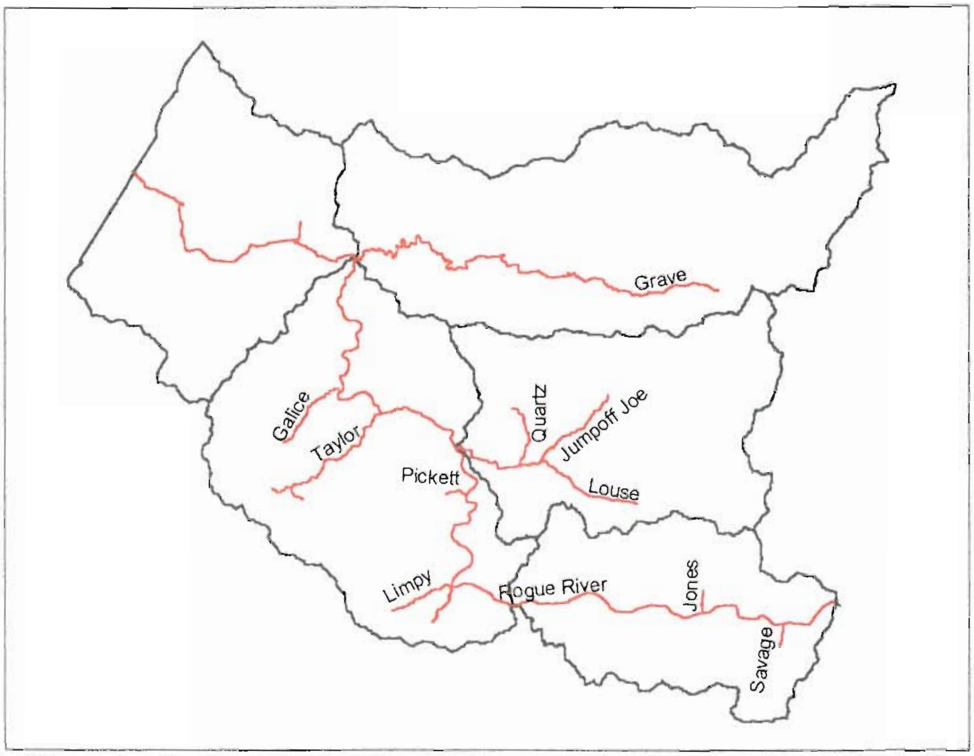
Like coho, steelhead use the smaller tributaries of the MRW for rearing as well as spawning and migration. Summer steelhead utilize the most streams of the local anadromous fish (Table V-4, Map V-4). Winter steelhead are less common in the MRW than summer steelhead (Table V-5, Map V-5). Wolf Creek, Coyote Creek and Louse Creek historically were important spawning habitats for summer steelhead (Everest, 1973). However, currently these three streams are not considered more important to summer steelhead spawning than the other streams being utilized (ODFW, 2000).



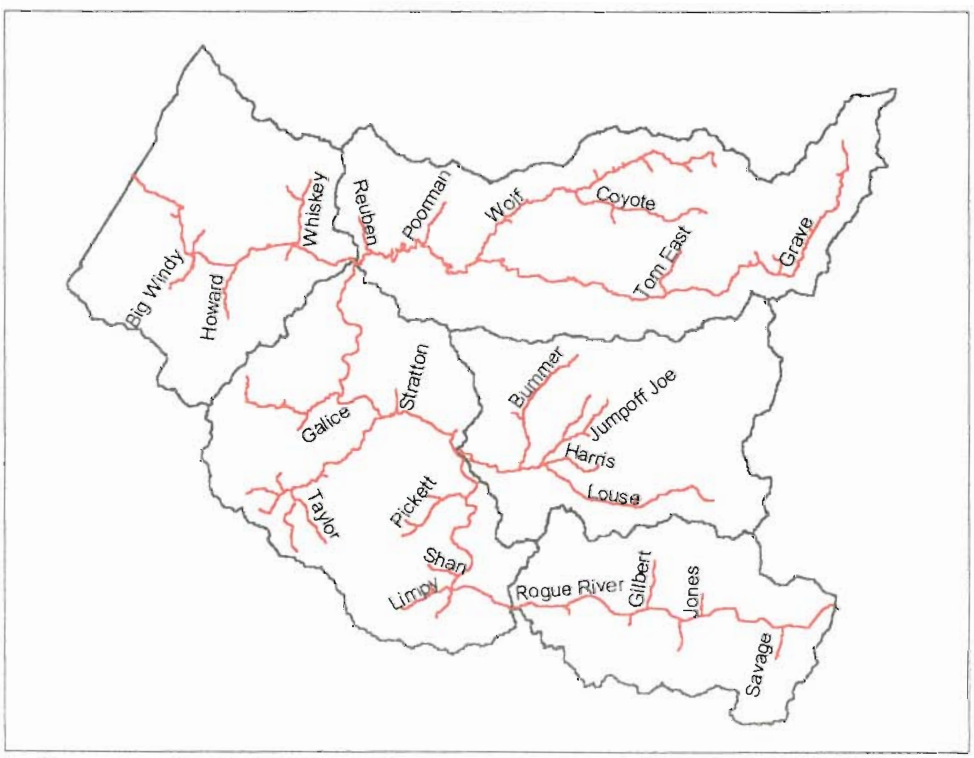
Map V-1. Current estimated fall chinook distribution in the Middle Rogue Watershed. Fall chinook use the waters of the MRW solely for spawning and migration.



Map V-2. Current estimated spring chinook distribution in the Middle Rogue Watershed. Spring chinook use the mainstem of the Rogue River in the MRW solely for migration.



Map V-3. Current estimated coho distribution in the Middle Rogue Watershed. Coho use the streams of the MRW for spawning, migration and rearing.



Map V-4. Current estimated summer steelhead distribution in the Middle Rogue Watershed. Summer steelhead use the streams of the MRW for spawning, migration and rearing.

Table V-3. Current Estimated Coho Distribution in the Middle Rogue Watershed*

STREAM	LENGTH (km)	LENGTH (mi)	STREAM	LENGTH (km)	LENGTH (mi)
Grave Creek	35.40	21.98	Louse Creek	8.05	4.50
Rogue River	90.12	55.96	Pickett Creek	0.8	0.50
Dutcher Creek	2.50	1.55	Quartz Creek	4.83	3.00
Galice Creek	6.08	3.78	Savage Creek	1.61	1.00
Jones Creek	0.80	0.50	Taylor Creek	10.50	6.52
Jumpoff Joe Creek	14.48	8.99	West Fork Taylor Creek	1.10	0.68
Limpy Creek	4.04	2.51	Whiskey Creek	0.80	0.50
			Total	**186.66**	**117.16**

*Distance measured from mouth of creek.

Table V-4. Current Estimated Summer Steelhead Distribution in the Middle Rogue Watershed*

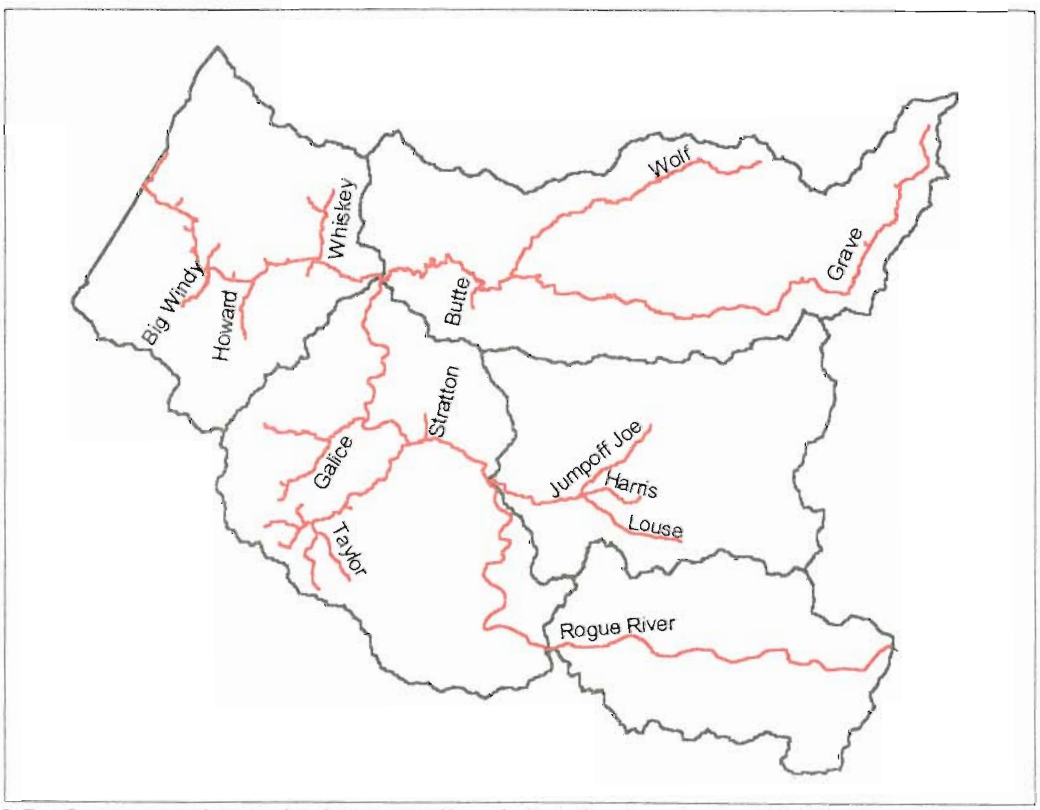
STREAM	Km	*Mi*	STREAM	Km	*Mi*	STREAM	Km	*Mi*
Grave	40.23	*24.98*	Burned Timber	0.48	*0.30*	Reuben	3.22	*2.00*
Rogue River	90.12	*55.96*	China	1.61	*1.00*	Rock (Grave)	0.48	*0.30*
Dutcher	2.57	*1.60*	Clark	0.80	*0.50*	Rum	1.21	*0.75*
Galice	4.83	*3.00*	Cold Springs	0.16	*0.10*	Sand	0.81	*0.50*
Jones	1.61	*1.00*	Coyote	10.62	*6.60*	Schoolhouse	1.9	*1.18*
Jumpoff Joe	14.48	*8.99*	E F Whiskey	1.61	*1.00*	Shan	2.41	*1.50*
Limpy	4.02	*2.50*	Fruitdale	2.41	*1.50*	Slate (Grave)	0.40	*0.25*
Louse	14.48	*8.99*	Gilbert	3.54	*2.20*	Slate (Limpy)	0.81	*0.50*
Pickett	5.63	*3.50*	Harris	4.51	*2.80*	Soldier	0.81	*0.50*
Quartz (JOJ)	10.2	*6.33*	Hog	0.48	*0.30*	Sourdough	0.16	*0.10*
Savage	2.41	*1.50*	Hole in the Ground	0.81	*0.50*	S F Taylor	1.21	*0.75*
Taylor	14.69	*9.12*	Howard	4.51	*2.80*	Stage Road Gulch	0.32	*0.20*
West F. Taylor	3.54	*2.20*	Jenny	0.64	*0.40*	Stratton	2.09	*1.30*
Whiskey	3.62	*2.25*	Kennedy Gulch	1.29	*0.80*	Tom East	3.70	*2.30*
Allen	0.80	*0.50*	Last Chance	2.09	*1.30*	Trib B Coyote	0.16	*0.10*
Bannister	4.02	*2.50*	Lone Tree	0.80	*0.50*	W F Whiskey	1.61	*1.00*
Bear Gulch (Wolf/Coyote)	0.48	*0.30*	Midnight Gulch	1.29	*0.80*	Wolf	20.92	*12.99*
Big Boulder	0.40	*0.25*	Mill (Galice)	1.61	*1.00*	Total	**237.62**	***147.56***
Big Windy	4.8	*2.98*	Minnow	4.51	*2.80*			
Board Tree	1.7	*1.06*	N F Galice	4.51	*2.80*			
Booze	0.16	*0.10*	Panther Gulch	1.29	*0.80*			
Boulder	1.61	*1.00*	Poorman	3.70	*2.30*			
Bummer	6.44	*4.00*	Quartz (Galice)	0.48	*0.30*			
Bummer Gulch (Wolf)	1.13	*0.70*	Ramsey Gulch (Wolf)	0.48	*0.30*			
Bunker	1.9	*1.18*	Rat	0.81	*0.50*			

* Distance measured from mouth of creek.

Table V-5. Current Estimated Winter Steelhead Distribution in the Middle Rogue Watershed*

STREAM	Km	*Mi*	STREAM	Km	*Mi*
Big Boulder	0.40	*0.25*	Lone Tree	0.80	*0.50*
Big Windy	4.8	*2.98*	Louse	8.00	*4.97*
Booze	0.16	*0.10*	Meadow	0.81	*0.50*
Bronco	0.48	*0.30*	Minnow	4.51	*2.80*
Bunker	1.90	*1.18*	N F Galice	4.51	2.80
Burned Timber	0.48	*0.30*	Pickett	5.60	*3.48*
Butte	1.61	*1.00*	Rogue River	90.12	*55.96*
Chieftan	0.40	*0.25*	Rum	1.21	*0.75*
China	1.61	*1.00*	Russian	0.40	*0.25*
Coyote	5.90	*3.66*	S F Taylor	2.00	*1.24*
E F Whiskey	1.61	*1.00*	Slate (Grave)	0.40	*0.25*
Galice	9.20	*5.71*	Stage Road Gulch	0.00	*0.00*
Grave	56.80	*35.27*	Stratton	2.09	*1.30*
Harris	0.00	*0.00*	Taylor	14.69	*9.12*
Howard	4.51	*2.80*	W F Whiskey	1.61	*1.00*
Jenny	0.64	*0.40*	West Fk Taylor	3.54	*2.20*
Jumpoff Joe	14.48	*8.99*	Whiskey	3.62	*2.25*
Kelsey	2.90	*1.80*	Wolf	20.92	*12.99*
Last Chance	2.09	*1.30*	Total	112.37	*69.78*
Little Windy	0.40	*0.25*			

- Distance measured from mouth of creek.



Map V-5. Current estimated winter steelhead distribution in the Middle Rogue Watershed. Winter steelhead use the streams of the MRW for spawning, migration and rearing.

Fish Population Trends

There are few data regarding the population numbers for anadromous salmonids in the MRW. Just upstream of the MRW is the ODFW fish counting station at Gold Ray Dam. Numbers from this do not give accurate numbers of fish in the MRW but the counts do reflect population trends for the various species, both for wild and hatchery fish.

Fall chinook are doing relatively well in the Rogue Watershed. Numbers of wild fish are far greater than hatchery fish, with wild fish making up over 95% of the entire population (Figure V-2). One explanation for this is that the operation of Lost Creek Dam does not negatively impact fall chinook. Rather the water releases improve habitat for fall chinook by helping to keep water temperatures in the main stem Rogue River lower during the summer months.

Spring chinook are almost the exact opposite of fall chinook, in that the numbers of wild fish make up a dwindling percentage of the total population (Figure V-3). Lost Creek dam blocks access to approximately 35 miles of habitat once used by spring chinook for spawning. This area was not used by fall chinook so they were not as negatively impacted as spring chinook. The water released from the dam early in the year is warm enough to trigger the hatching of spring chinook eggs, the river habitat is not adequate for them due the higher flows and the resultant lack of refuge.

Numbers of wild coho in the Rogue Watershed are very low, and showing minor improvement of the past decade (Figure V-4). The early years of the 1990's were extremely bad for wild coho with counts numbering less than 1000, including zero in 1992. There was a small recovery in the mid 1990's but the numbers have dropped again to between 1000-2000. This year was a record year for both wild coho and total coho. In 2000, there were 15,652 wild coho and 28,791 total coho over Gold Ray.

The winter steelhead wild population has been highly variable over the past two decades with no significant trends (Figure V-5). Hatchery fish are a small component of the entire winter steelhead population.

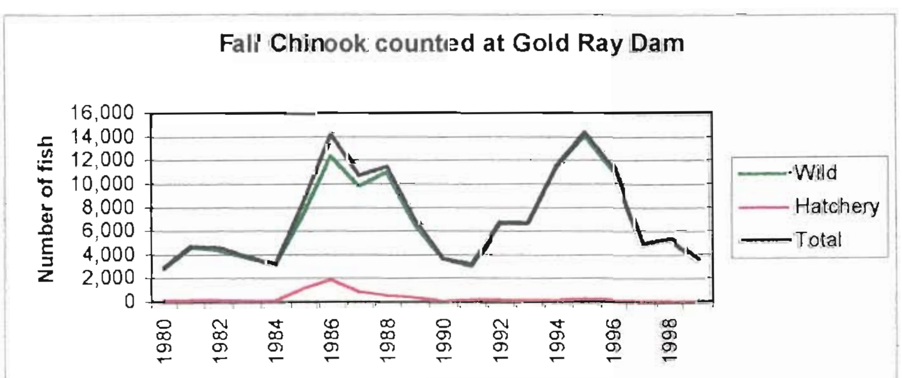


Figure V-2. Fall Chinook Counts at Gold Ray Dam[1]

[1] Figures V-2 through V-6 can only show general population trends for the species in the MRW, not actual numbers. The fish counted had migrated through the MRW.

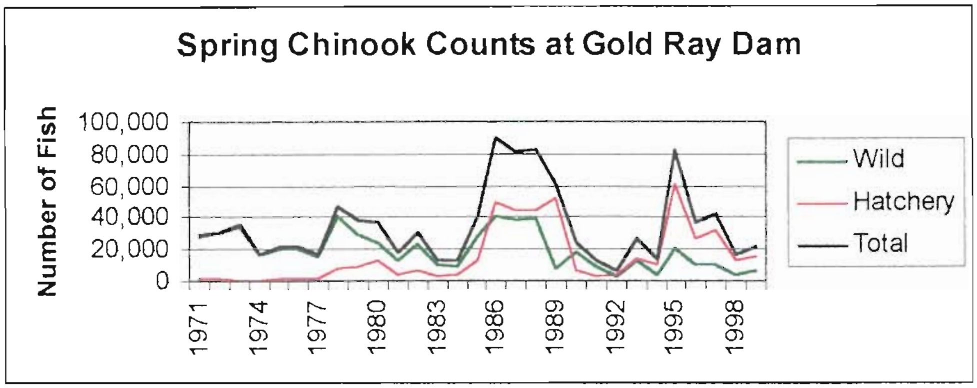


Figure V-3. Spring Chinook Counts at Gold Ray Dam

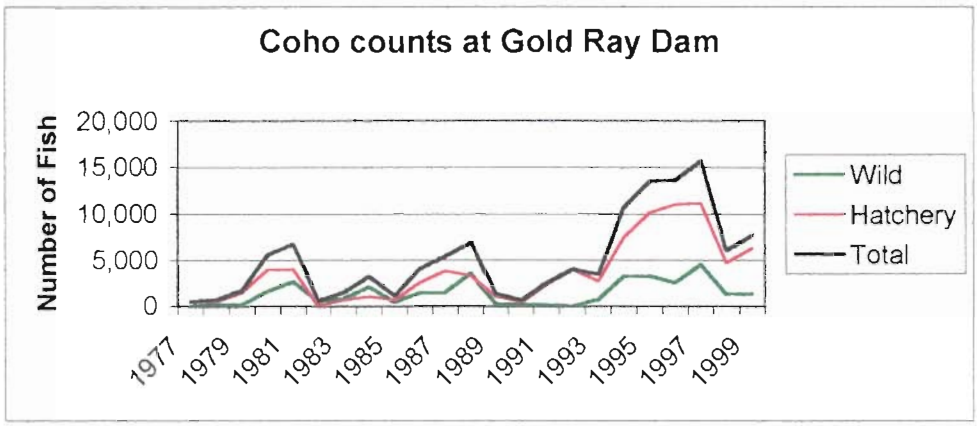


Figure V-4. Coho Counts at Gold Ray Dam

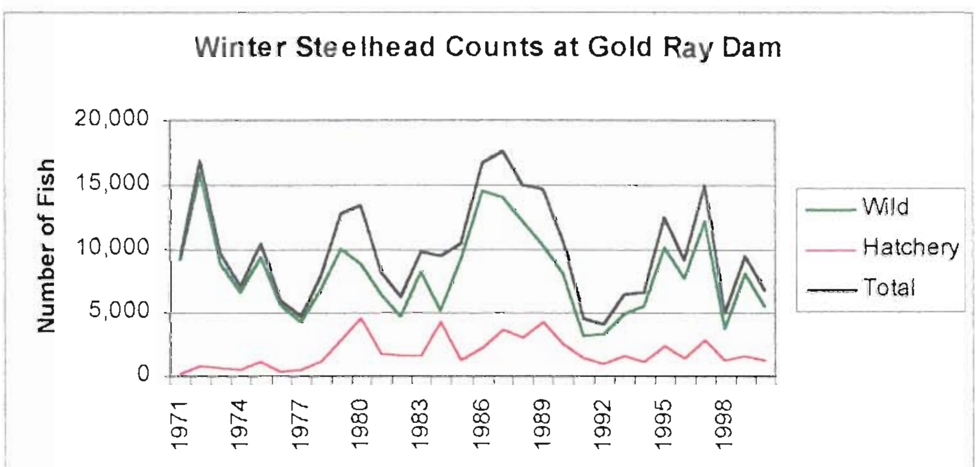


Figure V-5. Winter Steelhead Counts at Gold Ray Dam

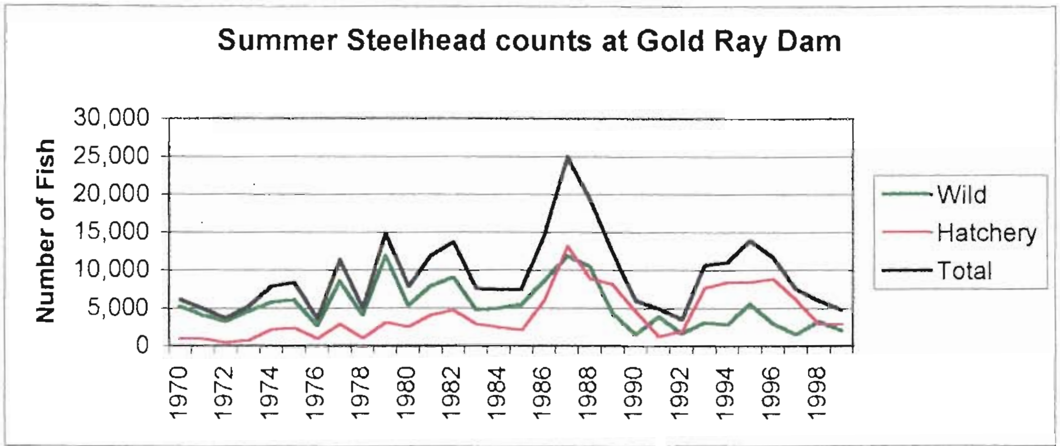


Figure V-6. Summer Steelhead Counts at Gold Ray Dam

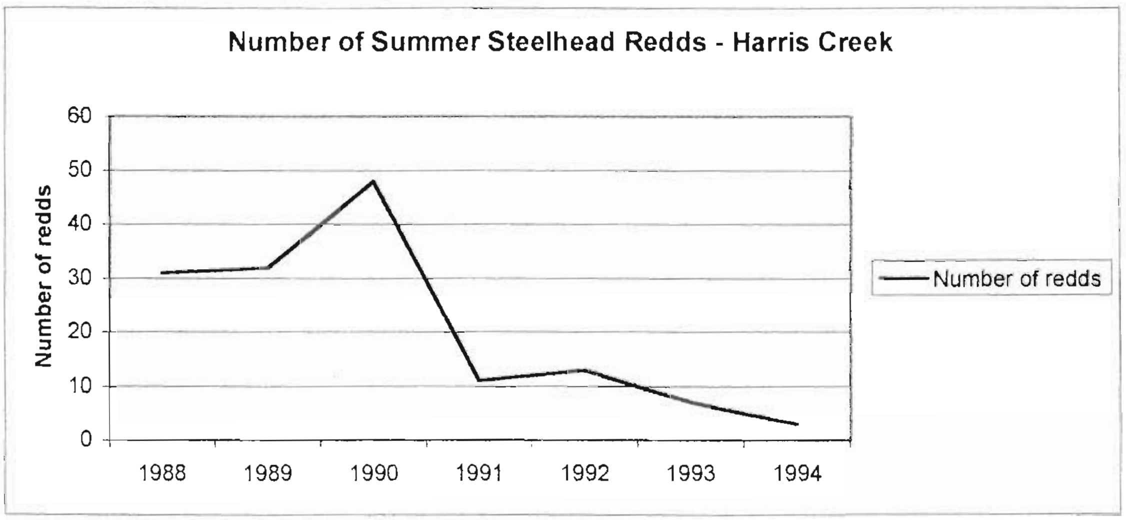


Figure V-7. Summer Steelhead Redd Counts on Harris Creek

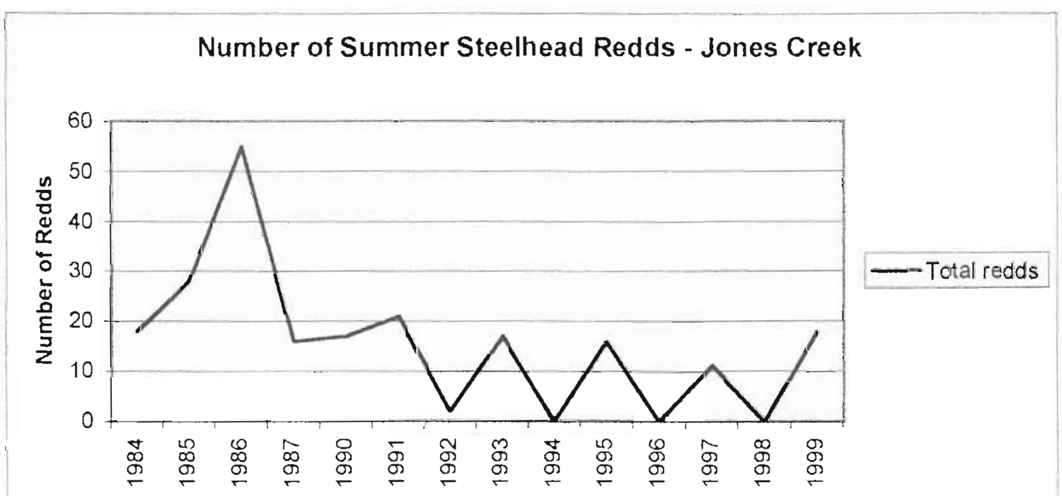


Figure V-8. Summer Steelhead Redd Counts on Jones Creek

The number of redds should not be considered an absolute count for the Jones Creek (Figure V-8). This is number of redds observed in portion of stream surveyed. This is an index that is valuable over time to chart trends but should not be considered an absolute number of redds for the stream. Stream conditions can affect visibility and surveyors ability to spot redds can change with the conditions sometimes.

Hatchery fish make up roughly two thirds of the summer steelhead population. There seems to be a general decline in the population since 1987, which was a record year, though the numbers were relatively high in 1995 (Figure V-6). The current numbers are very similar to the population numbers from 1950-1970. The ODFW has performed redd counts on two streams, Harris Creek and Jones Creek, in the MRW over the past decade (Figures V-7 and V-8). These surveys show a general decline in summer steelhead redds which suggests a continuing decline in summer steelhead numbers in these two streams if not the entire MRW (Vogt, 1999).

Federal and State Listing Status

The Southern Oregon Northern California coho was listed as threatened in May of 1997 through the Federal Endangered Species Act. Klamath Mountain Province steelhead were ruled "not warranted for listing" in the ruling anticipated in the doc (4/01). Since this time the National Marine Fisheries Service has been ordered to review steelhead again and reissue a ruling by March 31, 2001. NMFS determined that coho in Southern Oregon/Northern California did not warrant a listing in 2001. Within the MRW the ODFW has designated that coho and fall chinook populations are critical while steelhead, cutthroat trout and Pacific lamprey are vulnerable under Oregon's Sensitive Species Rule (OAR 635-100-040).

Fish Habitat Conditions

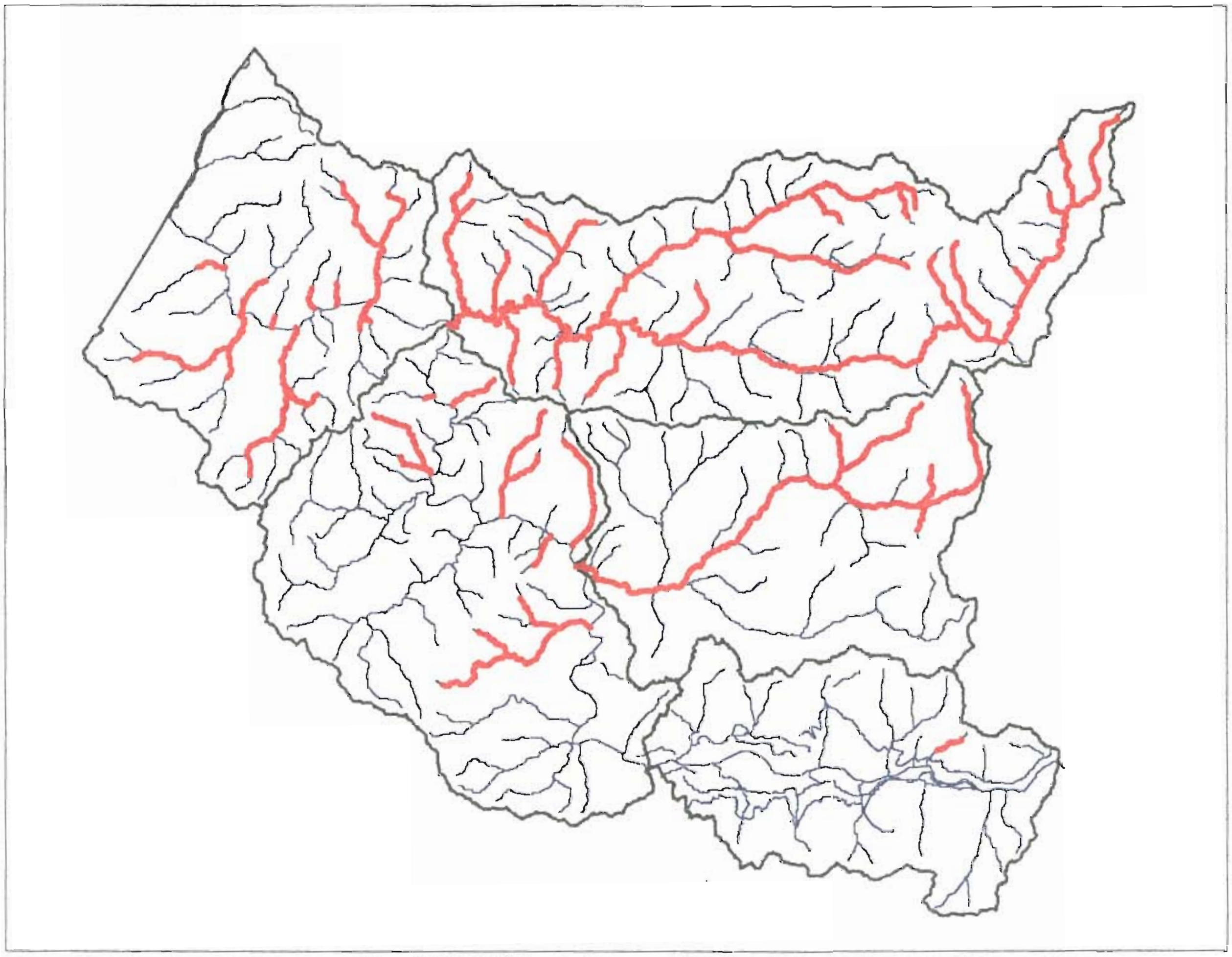
Quality stream habitat is critical for fish populations to thrive, or even maintain population levels. Four types of habitat information can give a general sense of the physical fish habitat condition within the MRW: (1) pool habitat condition, (2) riffle habitat condition (3) woody debris habitat condition, and (4) riparian habitat condition. The ODFW has developed benchmarks for each of these habitat conditions, and they have been rated accordingly. It must be noted that these benchmarks only deal with the physical habitat. Water quality and quantity are also major factors in the quality of fish habitat. Stream habitat data for these criteria have been collected on only a few select streams (Map V-6). Data for streams in the Grants Pass subwatershed is extremely limited, with data having been collected only on Bloody Run Creek. The benchmarks used to determine habitat condition are those set by ODFW (Appendix A2)

Pool Habitat

Only 13% of the reaches surveyed had desirable conditions for area of pools while 27.5% had undesirable conditions for pool area (Table V-6). Pool frequency had similar numbers with most reaches between the two criteria limits. The residual pool depth was quite good overall at 70.1% but the number of complex pools per reach was very poor. Over 85% were in the undesirable category. This is due to the general lack of large woody debris. The overall pool habitat condition was poor with only 18% in the desirable category.

Table V-6. Pool Habitat Conditions in the Middle Rogue Watershed

	Pool Area	Pool Frequency	Residual Pool Depth	Complex Pools	Overall
Undesirable	26.5%	31.3%	2%	85.7%	25.9%
Desirable	13%	23.1%	70.1%	6.8%	18.4%



Map V-6. Streams surveyed by ODFW for habitat criteria

Riffle Habitat

In general, riffle habitat conditions are better than pool habitat conditions, but they are not at desirable conditions overall (Table V-7). The indicator of riffle/depth ratio indicates that this is generally not a problem in the MRW with over 56% of reaches sampled in the desirable category. However, by far most of the reaches sampled fell in between the desirable and undesirable benchmarks, indicating that there is room for improvement but that it is not a top priority.

Table V-7. Riffle Habitat Conditions in the Middle Rogue Watershed

	Riffle Width/ Depth Ratio	Gravel (% area)	Silt-sand-organics (% area)	Overall
Undesirable	12.2%	14.3%	10.2%	5.4%
Desirable	56.5%	14.3%	33.3%	27.2%

Woody Debris Habitat

Large woody debris is very important for providing fish habitat and for generating pools. In the MRW, large woody debris is severely lacking with an overall rating of less than 7% in the desirable category for all of the reaches surveyed (Table V-8). In all three woody debris habitat conditions types, the rating is greater than 70% in the undesirable category for all of the reaches surveyed. This also helps explain the poor state of pool complexity in the MRW.

Table V-8. Large Woody Debris Habitat Conditions in the Middle Rogue Watershed

	LWD Pieces/100m	Volume LWD/100m	Key LWD/100m	Overall
Undesirable	71.4%	74.8%	76.2%	74.8%
Desirable	6.8%	16.3%	2.7%	6.8%

Riparian Habitat

The results of the riparian condition indicators seemingly give mixed results (Table V-9). The number of conifers of small and large diameter close enough to impact the stream and riparian area is extremely low. For both size categories, the habitat condition ratings are greater than 94% in the undesirable category. However, the shade habitat condition rates over 98% in the desirable category for those areas surveyed. The reason the shade factor is so high despite the lack of tall trees is mostly due to the narrow width of the streams and increased stocking of hardwoods. Therefore, restoration projects aimed at improving the amount of conifers in the riparian zone should be designed to improve stream bank stabilization an d large woody debris capture rather than as a means to improve shade conditions.

Table V-9. Riparian habitat conditions in the Middle Rogue Watershed

	Conifers #>20in dbh	Conifers #>35in dbh	Shade
Undesirable	94.6%	98.0%	1.4%
Desirable	0%	0%	98.6%

* Number and size (dbh*) of trees per 100 meters

Erosion And Secondary Channel Habitat Condition

Stream bank erosion ranks as a moderate concern overall for the streams reaches surveyed. However, some streams have serious bank erosion potential. Only 5.4%, 8 of 147, stream reaches surveyed had greater than 10% of their area in secondary stream channels (Table V-10). This indicates a lack of good complex habitat for fish.

FISH PASSAGE BARRIERS

A major characteristic of the life history pattern of anadromous fish is their migration patterns. Barriers to this migration can severely impact the stability of populations. There are numerous man-made barriers to fish passage in the MRW (Map V-7). The Rogue Basin Fish Access Team (RBFAT) is in the process of generating a barrier prioritization list (RBFAT, 2000). Currently, this prioritization list has 44 barriers for the MRW. However, that number is known to be much lower than the number of barriers actually in existence. The largest fish barrier in the MRW is Savage Rapids dam on the mainstem of the Rogue River. This barrier is for water diversion and is maintained by the Grants Pass Irrigation District. Fish passage over this barrier is ameliorated by a fish ladder. The ODFW rates fish passage over this barrier as moderate as it causes fish passage problems at most flow conditions. Savage Rapids dam affects the populations of anadromous salmonids within the MRW by delaying them and changing the out-migration of smolts that pass through

Table V-10. Oregon Department of Fish and Wildlife Habitat Benchmarks*

Habitat Condition	Undesirable	Desirable
POOLS		
---Pool Area (% total stream area)	<10	>35
---Pool Frequency (channel widths between pools)	>20	5-8
---Residual Pool Depth	<0.2	>0.5
---Complex Pools (pools w/wood complexity >3km)	<1	>2.5
RIFFLES		
---Width/Depth Ratio (active channel based)	>30	<15
---Gravel (% area)	<15	>35
---Silt-Sand-Organics (% area)	>20	<10
SHADE		
---Shade (reach average %)	<60	>70
LARGE WOODY DEBRIS		
---Pieces/100m Stream Length	<10	>20
---Volume/100m Stream Length	<20	>30
---"Key" Pieces (>60cm and 100m long)/100m	<1	>3
RIPARIAN CONIFERS		
---Number >20in DBH/1000ft Stream Length	<150	>300
---Number >35in DBH/1000ft Stream Length	<75	>200

* *See OWEB Assessment Manual for further description of benchmarks.*

Most of the barriers detailed in the RBFAT barrier prioritization are located in the Grave Creek subwatershed. Steelhead and coho are the species most impacted by the barriers that have been surveyed so far (Map V-7). Summer steelhead in particular are impacted as they have the most extensive distribution in the MRW. Coho are only affected by those barriers lower in the tributaries (Map V-8).

Of the 44 barriers in the RBFAT barrier prioritization, 34 are culverts of some type. Although there are more irrigation diversions still to be surveyed, most of the unsurveyed structures will

June, peaking during early June. Approximately 200,000 smolts are reared annually at the Cole M. Rivers hatchery and released into the Rogue River (ODFW, 1992b). Most coho spend 1.5 years at sea though some return after only one summer and are known as jacks.

Winter Steelhead

Winter steelhead enter the Rogue River from November through March, contributing to a recreational fishery in the MRW from late January through April. Wild fish comprise more than 80 percent of all winter steelhead that return to spawn in the Rogue River. This run is the largest on the Oregon coast (ODFW, 1990). During years with adequate precipitation and streamflows, most adults spawn in tributaries. However, in drought conditions when many tributaries have inadequate flow to permit access, adults are forced to spawn in the mainstem river. Spawning occurs from March to June with the peak activity in mid-April. About 30 percent of winter steelhead adults return after four months at sea and are known as half-pounders. Approximately 15 percent of wild winter steelhead are repeat spawners (ODFW, 1990). Adults average seven pounds but can reach up to 15 pounds. They spawn on low gradient riffles with small to medium size gravel and lay approximately 2,500 eggs per female. Steelhead of all sizes most often choose territories over large rubble substrate and move from shallow, slow water at the stream margin to deeper, faster water as they mature. Fingerlings in tributary streams move to pools almost exclusively as streamflow diminishes during the summer. The majority of winter steelhead migrate to the ocean during late spring after two years living in fresh water. Hatchery and wild smolts migrate through the MRW to the ocean from March through June.

Summer Steelhead

The Rogue River is one of only three rivers in North America that supports an annual run of summer steelhead half-pounders. Summer steelhead enter the Rogue River in three distinct groups each year. Early-run adults enter the river in May through July; half-pounders enter primarily in August and September; and late-run adults enter from August through September. Adults average 3-4 pounds; half-pounders are 11-17 inches in length and weight 1-2 pounds.

Rogue River summer steelhead have been shown to exhibit 15 different life history patterns. The most common pattern is 2 years in fresh water followed by two years in salt water, with the cycle repeating. The tendency for summer steelhead in the Rogue River to make an initial upstream migration as a non-spawning, a small percentage does attempt to spawn, half-pounder and to make subsequent annual spawning runs until death is primarily responsible for their small size. Smolts entering the ocean remain there for 3 to 5 months before making their first upstream migration. About 97 percent of summer steelhead make their initial upstream migration as a half-pounder (Everest, 1973). Half-pounders make it as far up stream as Medford although the majority remain below Galice Creek. They remain in the river for 6 to 9 months and then migrate back to the ocean in March and April, returning to the river in midsummer for a true spawning migration that last 6 to 9 months. Adults spend between three to four months at sea between spawning migrations. Summer steelhead support an intense sport fishery in the MRW from September through March.

Adults and sexually mature half-pounders (about five percent of the total) enter tributaries to spawn from January through March. Averaging 3 to 4 pounds, females produce about 2,300 eggs. Although the slightly favor smaller streams than winter steelhead, there is considerable spatial overlap. Many spawning streams are intermittent or dry during the summer, some as early as April or May. Alevins remain in the gravel several weeks.

Fry emigrate from their natal streams to the mainstem Rogue River from March through July where they rear, generally near the mouth of their natal stream. Juveniles frequently move between the river and tributaries, especially during winter storms. The majority of wild juveniles smolt during their second year and emigrate to the ocean between April and June.

The main difference between summer and winter steelhead is that winter steelhead enter fresh water sexually mature with fairly developed gonads. Summer steelhead on the other hand are "stream maturing". They enter fresh water sexually immature, thus spending more time in fresh water developing.

Sea-Run Cutthroat And Resident

Cutthroat trout are relatively common in the Rogue River. They generally prefer the upper reaches of tributaries that are not being utilized by juvenile steelhead and coho salmon. Their life history in the middle and upper river is poorly understood. Adults residing in the river appear to move into tributaries to spawn from February through March. They remain there for a short time and then return to the river and larger tributaries.

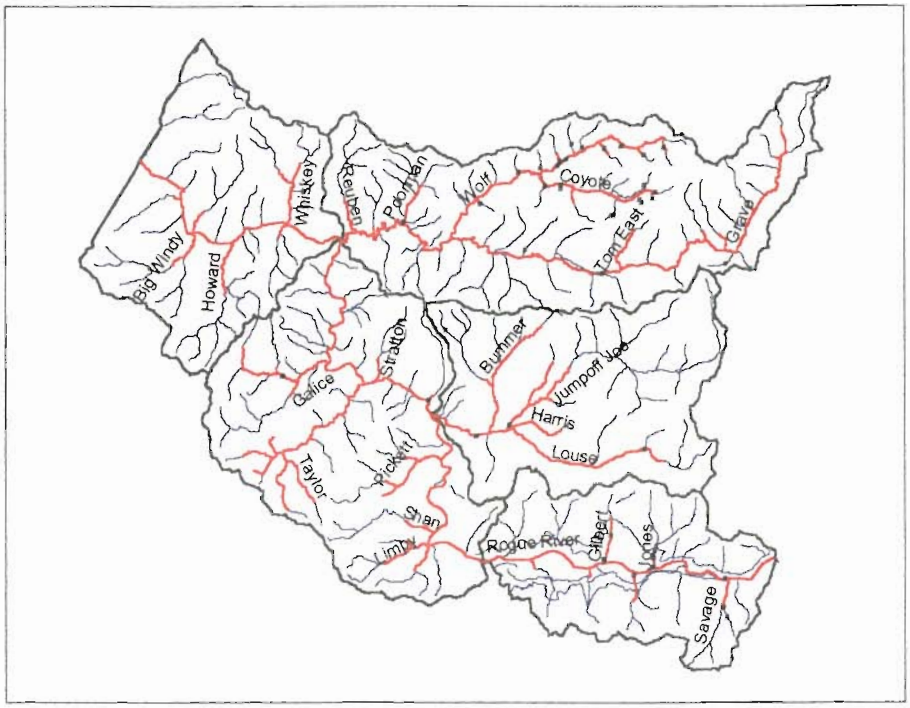
The status of sea-run cutthroat, the anadromous life history pattern of this species, in the Rogue River Watershed is uncertain. The relatively small number of sea-run cutthroat in the lower river did not appear to migrate upstream of the Illinois River (Tomasson, 1978).

Fish Life History Summary

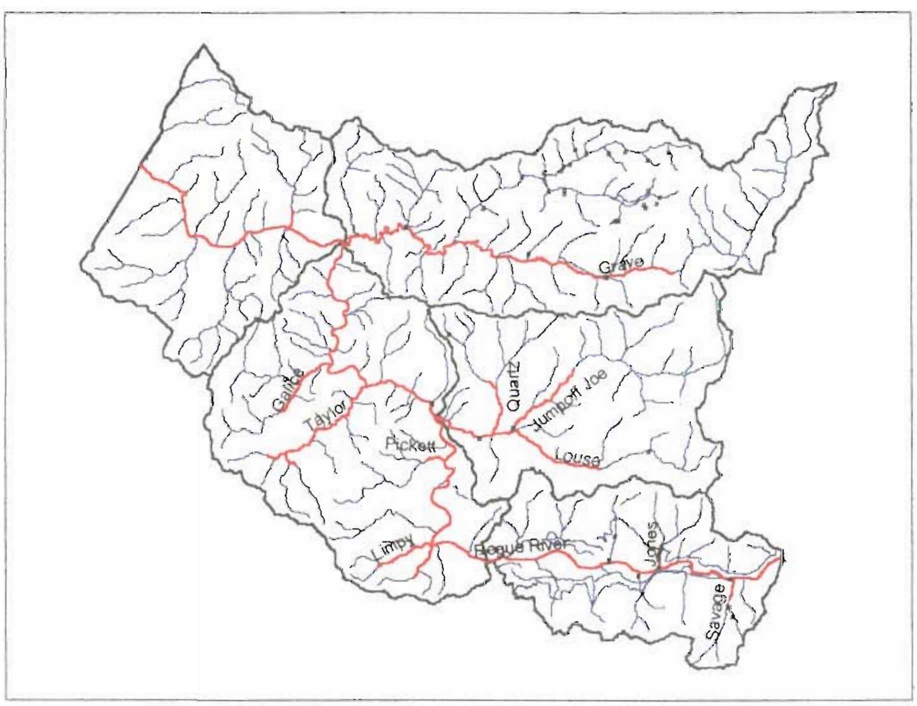
The Rogue River and its tributaries are the largest salmon and steelhead producer of Oregon's coastal streams south of the Columbia River and one of the most important on the Pacific Coast. An average of 32,100 spring chinook, 45,000 fall chinook, 130,300 summer steelhead, 44,000 winter steelhead and 6,800 coho return to the river annually.

A substantial portion of the Rogue River Basin's (RRB) juvenile and adult salmonids utilize the MRW section of the river for migration, spawning and rearing. About 50 percent of the coho salmon and all of the spring chinook salmon produced in the RRB originate upstream of the MRW. Approximately 14 percent of the RRB fall chinook spawn in the MRW. Juvenile wild salmon and steelhead rearing in or upstream of the MRW use the river as a migration corridor to and from the ocean throughout the year. The Cole M. Rivers hatchery produces 2.2 million salmon and steelhead each year that migrate through the MRW from April through October. The hatchery produces over 3.5 million fish annually, with the other 1.3 million fish being used to stock lakes and streams above Lost Creek Dam as well as other South Coast streams.

also be culverts, especially those up in the higher reaches of the watershed. In addition, pushup dams can be especially harmful barriers as they can both block fish and remove water from the habitat.



Map V-7. Barriers to anadromous fish passage. Red tracing represents the distribution of summer steelhead in the MRW.



Map V-8. Barriers to anadromous fish passage.
Red tracing represents the distribution of coho in the MRW.

Discussion

There are five main populations of anadromous salmonids in the MRW: fall chinook, spring chinook, coho, summer steelhead, and winter steelhead. Of these, coho and fall chinook are doing the worst with coho listed as threatened on the federal endangered species act. Steelhead are considered to be in relatively good shape. ODFW even allows a limited harvest on wild winter steelhead. Winter steelhead population numbers have been up and down, but generally within an acceptable range since counts have been conducted at Gold Ray Dam.

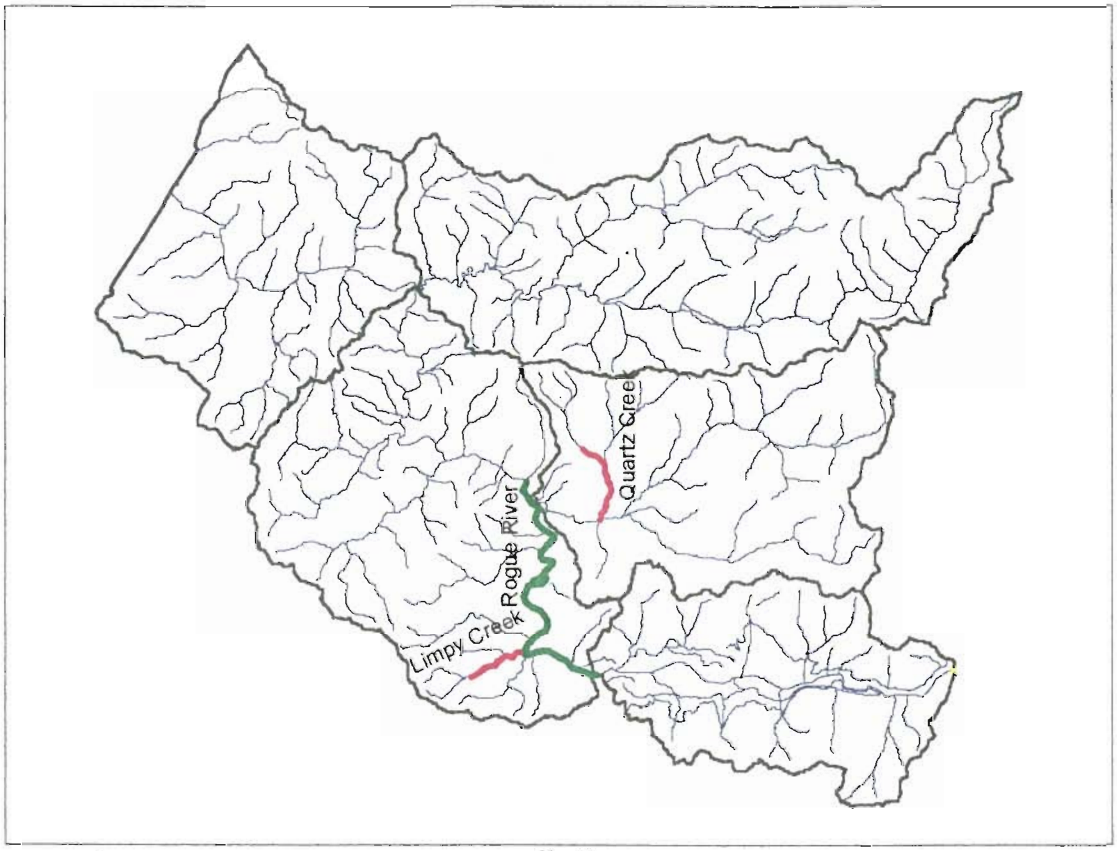
The quality of the stream habitat for these species is variable. Riffle and pool habitat conditions are generally intermediate in quality. The amount of large woody debris and standing conifers within the riparian zone is extremely low. These two factors in particular should be addressed in order to improve stream habitat conditions for the native anadromous salmonids. Projects to address these issues should be concentrated primarily within the distribution zones of coho and steelhead. ODFW has designated two stream sections as core area, meaning they are important to salmonid stocks (Map V-9). Restoration work aimed at improving coho habitat in the MRW should perhaps focus initially on Quartz and Limpy Creek.

Shade did not seem to be an issue although temperature levels in many of the streams are above those optimal for healthy salmonid populations. This suggests that lack of shading is not the cause of the elevated temperatures. However, this is based on studies in a limited number of sites that probably occurred in the more forested areas. Projects to determine the cause of the high temperatures are merited and should focus on stream flow, water diversions and land use activities as well as determining the true condition of shading on MRW streams.

Stream bank erosion is a factor of concern, especially on Jumpoff Joe Creek and Grave Creek and its tributaries including Wolf Creek and Coyote Creek. Riparian planting in these areas could be targeted to improve the erosion potential. This would provide woody debris capture benefits and organic material capture in addition to the bank stabilization.

Very few of the reaches surveyed had adequate secondary channel area. Only the upper reaches surveyed on Grave, Howard, Coyote, Reuben, Tom East and Jumpoff Joe Creeks had adequate secondary channel area. Projects that would improve this habitat condition should be implemented, particularly in the distribution range of coho and steelhead. Most likely, improving secondary channel habitat will be a secondary benefit of a project.

Improving passage at the numerous fish passage barriers within the MRW should be a primary concern for improving and extending fish habitat. Fish screening, or lack thereof, is believed to be a major problem in the MRW. It is believed that there are numerous legal and illegal diversions that are unscreened or improperly screened, thus representing a serious danger to salmonids. Legal diversions are any that have a water right. Many of these may be poorly or completely unscreened and need to be properly screened with assistance from ODF&W. Illegal diversions are those that take water without having a water right. These are most likely not be screened either, and owners could not get assistance from ODFW with their screen as they should not even be taking water. Owners of illegal diversions need to be made to stop taking water and leave the additional water in the stream. The accumulated affect of poorly screened and unscreened, legal or illegal diversions can be especially damaging on smaller tributaries.



Map V-9. Core salmonid areas in the Middle Rogue Watershed as designated by ODFW. Purple = coho. Green = fall chinook.

Data Gaps

The major data gap that exists is the lack of habitat information for most of the anadromous salmonid bearing streams in the MRW (Map V-6). This is particularly true in the Grants Pass, Jumpoff Joe and Galice subwatersheds. Future surveys should first be concentrated in those streams that support anadromous salmonids.

Information about the distribution of the local anadromous salmonids is currently acceptable. The ODFW does annual spawning surveys on many of the streams in the MRW. However, surveys of those streams not covered by ODFW should be considered. These should include carcass and spawning surveys in order to get information about both distribution and abundance.

There is a severe lack of information of barriers to anadromous fish passage in the MRW. Barrier surveys need to be conducted throughout the MRW; in particular, the Jumpoff Joe, Galice and Grants Pass subwatersheds. Any projects aimed at gathering this type of data should coordinate with the Rogue Basin Fish Access Team.

Chapter VI - WATER QUALITY

Water quality is an issue that affects all living organisms, humans included. The federal Clean Water Act has a mandate "to protect and maintain the chemical, physical, and biological integrity of the nation's waters." (WPN, 1999). The Oregon Department of Environmental Quality (DEQ) has set standards for the parameters of water quality that are most important for maintaining the quality of Oregon's waterbodies for all beneficial uses. The list of beneficial uses varies from basin to basin depending human requirements, land use patterns and aquatic life that exists there (Table VI-1).

Table VI-1. Beneficial Uses of Water within the Middle Rogue Watershed

Beneficial Uses	Mainstem Rogue River	Tributaries
Public Domestic Water Supply[1]	X	X
Industrial Water Supply	X	X
Irrigation	X	X
Livestock Watering	X	X
Anadromous Fish Passage	X	X
Salmonid Fish Rearing	X	X
Salmonid Fish Spawning	X	X
Resident Fish & Aquatic Life	X	X
Wildlife & Hunting	X	X
Fishing	X	X
Boating	X	X
Water Contact Recreation	X	X
Aesthetic Quality	X	X
Hydro Power		X
Commercial Navigation & Transportation	X	

[1] With adequate pretreatment (filtration and disinfection) and natural quality to meet drinking water standards.

Water quality is influenced by natural and human activities. Point and non-point source pollution, land use activities in riparian zones, instream disturbances that affect flows, substrate particle size, and water withdrawals or diversions can all affect water quality. Natural conditions of streams, such as low summer flows and low stream gradient can make streams more susceptible to water quality changes.

WATER QUALITY PARAMETERS

The parameters that are of most importance for water quality are: temperature, dissolved oxygen, pH, nutrients, bacteria, chemical contaminants and turbidity/sediment. Evaluation of water quality is done by comparing key indicators against the criteria set by the DEQ for that parameter. These parameters are based on the beneficial uses that have been determined for the water.

Temperature

Water temperature is a parameter of water quality that has a dramatic effect on many aquatic species. Cold clear water is characteristic of the streams of the Northwest and is essential for the survival of anadromous fish as well as native resident trout, amphibians and macroinvertebrates. During warm summer months, the temperature standard has been set at 64°F (17.8°C). At this time of year, the life stages that are present in the streams are rearing juvenile, adult holding (chinook) and adult migration for summer chinook. Above this temperature, salmonids begin to suffer physiologically. A second criteria (55°F/13°C) has been set for the spawning months of mid-fall through spring and applies in those areas where spawning occurs. When the water temperature is above 55°F, salmonid spawning is negatively affected.

Solar radiation is one of the primary sources of increases in water temperature, the more sunlight that hits the stream the greater the temperature. Deeper streams take more energy to warm than shallow streams due to the difference in surface area to volume ratio. Thus low flows and reduced return flows can negatively impact the temperature of a stream. Streamside shading will prevent sunlight from hitting the stream, thus keeping it cooler. Shade dramatically slows the rate of heating but does not cool the stream. At night there is usually a lowering of stream temperature because the ambient air temperature is lower than the stream temperature. Thus there is a diurnal variation in stream temperature. To limit the stress to salmonids and other aquatic organisms, it is important to keep this daily variation to a minimum. Since temperature varies diurnally, it is important to measure instream temperatures over 24 hour periods. The temperature standard set by the Oregon Department of Environmental Quality (DEQ) is based on a seven day moving average.

Dissolved Oxygen

For fish and macroinvertebrates, the level of dissolved oxygen (DO) is very important. Nearly saturated levels (10mg/L) are required for salmonids to maintain normal metabolic function. Lower levels of DO make it difficult for salmonids to seek food and shelter. The early life stages of salmonids, eggs and fry, are particularly sensitive to low levels of dissolved oxygen. For the purpose of this screening level assessment, the criterion has been set at 8mg/L DO.

There are several factors that affect the level of DO. Both higher water temperature and higher elevations reduce the solubility of oxygen in water. Increased rates of photosynthesis within the stream raise the level of DO. Levels of dissolved oxygen are generally highest in the afternoon due to photosynthesis and respiration of aquatic organisms and lowest late at night due to oxygen uptake by organisms, both plant and animal. Like temperature, it is important to measure dissolved oxygen over a 24-hour cycle due to the diurnal variation.

pH

The pH is a measurement of how acidic or basic water is. The scale is logarithmic with 7 being neutral. Values below 7 indicate acidic conditions and values greater than 7 indicate alkaline or basic conditions. The measurement of pH is especially important in areas of mining due to the potential for generation of heavy metals and decreases in pH. With acidic conditions, metal ions transform to more toxic forms.

The pH levels of Oregon's waters naturally vary across the state due to rainfall and the chemical composition of the rocks and soils the water flows through. East of the Cascades the values range from 7.0 to 9.0 while west of the Cascades the values range from 6.5 to 8.5. Salmonids are adversely affected by pH values outside of the latter range.

Nutrients

Phosphorus and nitrogen are the major growth limiting nutrients in water and are therefore the two nutrients that are most typically measured to monitor water quality. In streams, increased levels of these two nutrients promote increases in the growth of algae and other water plants. Excessive growth can cause low or no dissolved oxygen. In moderation, these nutrients promote a healthy stream system, plant growth that provides for macroinvertebrates and increased levels of oxygen, but at high levels the streams can become unhealthy for fish and other aquatic organisms and can inhibit the recreation value of the water as well.

To measure phosphorus, Total Phosphorus is generally used. This is a primarily a measurement of the phosphates in the water column and phosphorus in suspended organic material. In non-agricultural areas, minerals leached from rock are the main source of phosphate (AWRC, 1998). Total Nitrate, nitrites plus nitrate, provides a measurement of the majority of the nitrogen in the water.

Bacteria

Coliform bacteria are used as indicators to test for the sanitary quality of water for drinking and recreational use such as swimming. In fresh water, the standard has been set at 406 *E. Coli*/100ml.

Chemical Contaminants: Organic Compounds, Pesticides and Metals

The term contaminant refers to any compound that may cause toxicity in aquatic organisms such as industrial compounds and pesticides. Because of the large number of organic compounds that are used in forestry, agriculture and home gardening, it is not feasible to establish standards for each one is a screening level assessment such as this. Values above detection levels are considered a red flag and should be investigated. The standards for metals are expressed as either acute or chronic values. For most metals, toxicity is based on the hardness of the water, and therefore the standard is based on a formula. For this process, two hardness levels are used for fresh water, 25 and 100mg/l.

Turbidity

Turbidity is a measure of the clarity of water. Since in most cases, increases in turbidity are due to sediment runoff, turbidity is a surrogate for a measure of suspended sediment. High levels of suspended sediment can cause damage to the gills of fish and inhibit the feeding of fish, such as salmonids, that rely on sight to find their food. Suspended sediments are also potential carriers of other pollutants such as pesticides, nutrients and bacteria and therefore are a concern of water quality in general. High levels of suspended sediments can also degrade recreational and aesthetic values of water.

The standard for turbidity has been set at 50 NTU. At levels above this, the sight feeding ability of salmonids is impaired. This level of turbidity is not lethal to fish but represents a useful screening level for this parameter.

Alkalinity and Conductivity

Alkalinity is a reflection of dissolved minerals and represents ability of the water to resist changes in pH, the higher the alkalinity the more difficult it is to alter pH levels. Alkalinity in itself is not harmful to fish or other beneficial uses, but since changes in pH greater than 2 can cause stress in aquatic organisms, it is a measure of the health of a stream. Alkalinity levels higher than 50 mg/l ($CaCO_3$) are considered to be healthy.

Conductivity is a measure of the ability of water to conduct electrical current and is dependent upon the amount of dissolved salts and minerals. It is an important tool in monitoring the exchange of groundwater, which is usually higher in dissolved salts than surface water, and septic tank influences. The range for potable water in the U.S. is 30-1500 μmhos/cm^3. In the Pacific Northwest, the conductivity of streams emanating from forested areas is almost always at the low end of the range (ARWC, 1998).

DEQ 303D LIST OF WATER QUALITY LIMITED STREAMS

Many of the streams in the MRW are listed on the 1998 DEQ 303d list (Table VI-2, Map VI-1). All but the Rogue River, from Grave Creek to the upstream boundary of the MRW, are listed for temperature. However, numerous streams are being considered for listing of numerous other criteria at this time, such as sediment, habitat modification, flow modification, nutrients, algae and toxics, but more data is needed (Table VI-3, Map VI-2).

Over 95% of the stream miles that are listed on the 303d list in the MRW are located in the Grave, Jumpoff Joe and Galice subwatersheds (Table VI-4). The Grave Creek subwatershed has 126.71 kilometers of listed streams that make up 41.2% of the streams in the subwatershed. Although there are fewer kilometers of listed streams in the Jumpoff Joe subwatershed (65.69km), a greater percentage (43.17%) of the streams in the subwatershed are listed[1]. Galice is the only other subwatershed with a significant percentage (20.79%) of the total stream distance listed on the DEQ 303d list.

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[1] Jumpoff Joe Creek has summer temperatures exceeding the temperature standard high up in the system. BLM data of continuous summer temperature measurements from 1996-2000 show 7-day moving maximums of between 76.3 and 79.2 degrees Fahrenheit for those years at T34S R5W Sec 31. BLM data from 1996-2000 show 7-day moving maximums of between 65.5 and 67.7 degrees Fahrenheit for those years at T34S R4W Sec 30. This is also consistent with shade data in Jumpoff Joe and the increase in rural residential communities. (BLM Review of this Assessment, Comment No. 37, 5/17/01)

Table VI-2. Streams in the Middle Rogue Watershed Listed on 1998 DEQ 303d List

Subwatershed	Stream	Stream Segment	Parameter
GALPIC	Dutcher Creek	Mouth to RM 2.5	Temp*
GALPIC	Galice Creek	Mouth to North/South Fork Confluence	Temp
GALPIC	Galice Creek, South Fork	Mouth to Chieftain Creek (RM 3)	Temp
GALPIC	Hog Creek	Mouth to Headwaters	Temp
GALPIC	Pickett Creek	Mouth to RM 4	Temp
GALPIC	Rogue River	Grave Creek to Applegate River	Bacteria
GALPIC	Rogue River	Grave Creek to Applegate River	pH
GALPIC	Rogue River	Grave Creek to Applegate River	Temp
GALPIC	Shan Creek	Mouth to Headwaters	Temp
GALPIC	Taylor Creek	Mouth to China Creek	Temp
Grants Pass	Bee Creek (Savage Creek)	Mouth to Headwaters	Temp
Grants Pass	Rogue River	Applegate River to Evans Creek	Bacteria
Grants Pass	Rogue River	Applegate River to Evans Creek	Temp
Grants Pass	Savage Creek	Mouth to headwaters	Temp
GRAVE	Big Boulder Creek	Mouth to Headwaters	Temp
GRAVE	Boulder Creek (Grave Creek)	Mouth to headwaters	Temp
GRAVE	Clark Creek (@ Grave Creek)	Mouth to Headwaters	Temp
GRAVE	Coyote Creek	Mouth to Headwaters	Temp
GRAVE	Grave Creek	Mouth to Last Chance Creek	Temp
GRAVE	Poorman Creek	Mouth to Headwaters	Temp
GRAVE	Reuben Creek	Mouth to Headwaters	Temp
GRAVE	Slate Creek (Grave Creek)	Mouth to Headwaters	Temp
GRAVE	Wolf Creek	Mouth to Headwaters	Temp
JOJ	Jump Off Joe Creek	Mouth to Headwaters	Temp
JOJ	Louse Creek	Mouth to Headwaters	Temp
JOJ	Quartz Creek	Mouth to Headwaters	Temp
W & S	Rogue River	Illinois River to Grave Creek	Temp
W & S	Whiskey Creek	Mouth to Headwaters	Temp

- All temperature listings are for summer temperatures.

For the entire MRW, over 25% of the stream miles (251.37km) are on the 1998 DEQ 3030d list. In addition to this, the entire section of the Rogue River (91km) within the boundaries of the MRW is listed for temperature. All temperature listing in the MRW are for summer temperature. The section of the Rogue River from Grave Creek to Applegate River is also listed for bacteria and pH while the section upstream of the Applegate River is also listed for bacteria.

Many streams that do not appear on the 1998 303d list are under consideration for at least one of the water quality criteria. In the Grants Pass subwatershed, these streams include Vannoy Creek, Fruitdale Creek, and Jones Creek. Other streams that are under consideration for listing include Last Chance Creek (temperature) in the Grave Creek subwatershed and the North Fork Galice Creek (sedimentation) in the Galice subwatershed.

Taylor Creek from China Creek to the headwaters and Limpy Creek from the mouth to the headwaters were surveyed for summer temperature and did not meet the listing criteria of 64°F.

The BLM has surveyed North Fork Galice Creek, Mill Creek, Jenny Creek, and Rum Creek and found that all of these streams were below 64 degrees Fahrenheit.

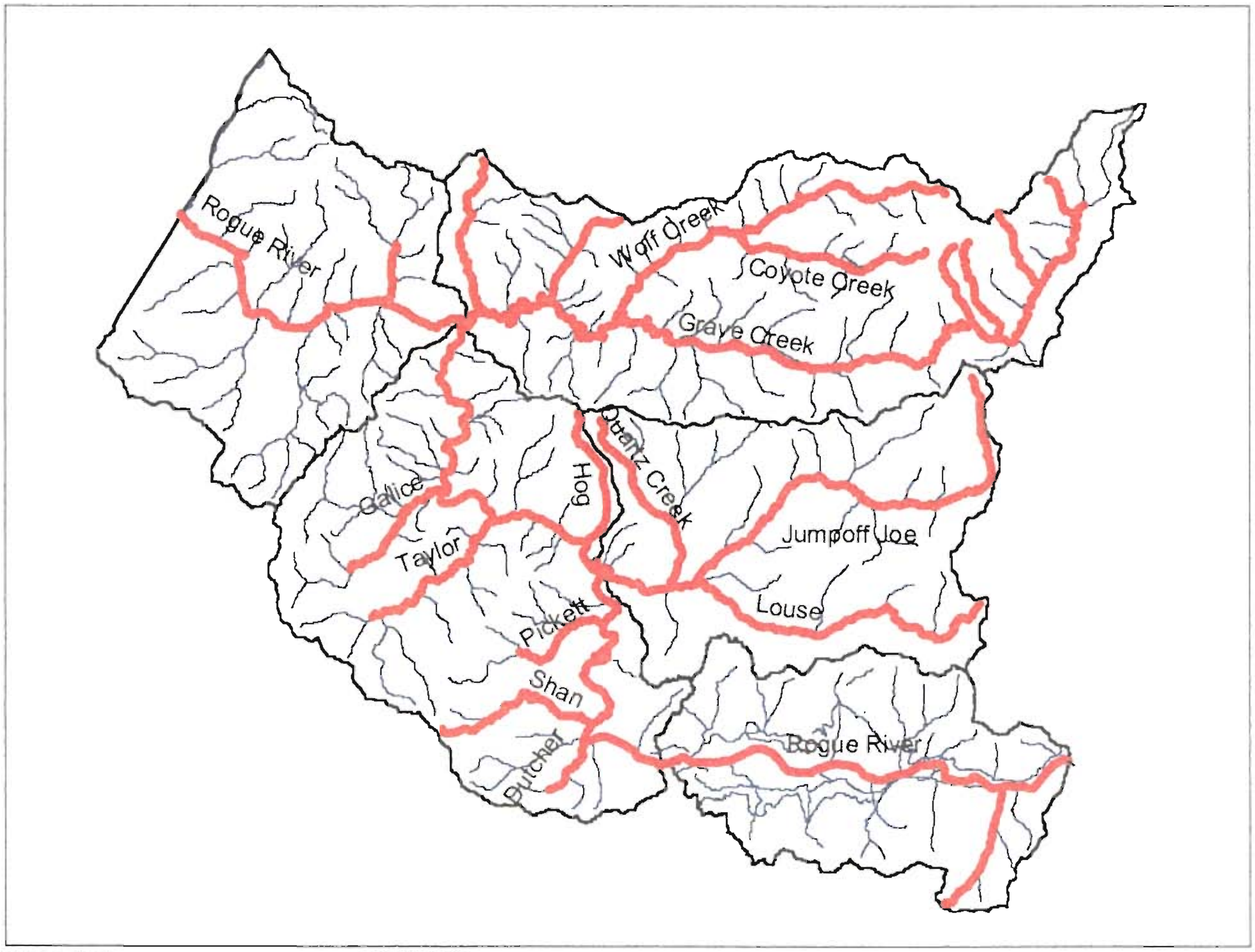
Table VI-3. Streams in the Middle Rogue Watershed Under Consideration for DEQ 303d Listing

Subwatershed	Stream	Segment Description	Parameter
GALPIC	Galice Creek	Mouth to North/South Fork Confluence	Sedimentation
GALPIC	North Fork Galice Creek	Mouth to Headwaters	Sedimentation
GALPIC	Pickett Creek	Mouth to RM 4	Habitat Modification
GALPIC	Rogue River	Grave Creek to Applegate River	Flow Modification Nutrients Sedimentation
Grants Pass	Fruitdale Creek	Mouth to Headwaters	Flow Modification Sedimentation Summer Temperature
Grants Pass	Rogue River	Applegate River to Evans Creek	Aquatic Weeds or Algae Flow Modification Nutrients Sedimentation
Grants Pass	Vannoy Creek	Mouth to Headwaters	Flow Modification Nutrients Sedimentation Summer Temperature Toxics
Grants Pass	Jones Creek	Mouth to Headwaters	Flow Modification Sedimentation
GRAVE	Coyote Creek	Mouth to Headwaters	Flow Modification Sedimentation
GRAVE	Grave Creek	Mouth to Last Chance Creek	Aquatic Weeds or Algae Flow Modification Habitat Modification Sedimentation
GRAVE	Last Chance Creek	Mouth to Headwaters	Summer Temperature
GRAVE	Rock Creek	Mouth to Headwaters	Summer Temperature
GRAVE	Wolf Creek	Mouth to Headwaters	Flow Modification Habitat Modification Sedimentation
JOJ	Jump Off Joe Creek	Mouth to Headwaters	Flow Modification Habitat Modification Sedimentation
JOJ	Louse Creek	Mouth to Headwaters	Flow Modification Habitat Modification Sedimentation

Table VI-4. 303d-Listed Streams and Percent of 303d-Listed Streams by Subwatershed*

Subwatershed	303d		Stream Distance		% of Subwatershed Streams Listed	% of Total Listed Streams in MRW	% of MRW Streams
	km	*mi*	km	*mi*			
Wild & Scenic	3.79	*2.36*	159.56	*99.17*	2.38	1.51	16.16
Grave	126.71	*78.75*	307.56	*191.15*	41.20	50.41	31.15
Galice	47.42	*29.47*	228.12	*141.78*	20.79	18.87	23.11
Jumpoff Joe	65.69	*40.83*	152.16	*94.57*	43.17	26.13	15.41
Grants Pass	7.75	*4.82*	139.83	*86.90*	5.54	3.08	14.16
Total	251.37	*156.23*	987.23	*613.57*	25.46		

* Stream miles based on 1:100000-scale map. Not all minor tributaries are included in this number.



Map VI-1. Streams on the 1998 DEQ 303d list

Map VI-2. Streams under consideration for listing on the DEQ 303d list

DISCUSSION

Over 25% of the stream miles in the MRW are currently listed for temperature. This number is likely to increase as more data are collected for those streams currently under consideration for listing. As previously unsampled streams are tested for water quality parameters, more streams are likely to be added as well

The exceedance of the temperature criteria is for the summer months only and is due to a combination of factors including: lack of riparian shading, water withdrawals, return flows, and poor groundwater recharge. The exact cause will vary from site to site and projects aimed at improving water temperature should determine the site specific causes of the elevated temperatures. The Grave Creek and Jumpoff Joe subwatersheds have the largest number of temperature listed streams.

In addition to temperature, sedimentation, habitat modification and flow modification are parameters of concern for the streams in all of the subwatersheds except perhaps for the Wild & Scenic subwatershed.

DATA GAPS

For those streams that are being considered for listing on the DEQ 303d list, more data about the parameters of concern is needed. Many streams that are listed from mouth to headwaters are listed based on only one survey point along the stream. Further analysis can indicate the source of the problem and whether upper reaches should be recommended for de-listing. In particular, data should be collected for those streams that bear anadromous salmonids. Additionally, information as to why criteria are exceeding the listing parameters should be collected. This should include land use activities, instream modifications and flow diversions as well as riparian condition. Similarly, data should be collected for those streams that have yet to be surveyed. As above, surveys should begin with those streams that support anadromous salmonids.

Chapter VII - SEDIMENT SOURCES

Erosional processes occur naturally and lead to sedimentation of streams. The amount of erosion varies throughout the year, with most occurring during the winter months with the highest stream flows and precipitation. However, human activity can increase the sediment load reaching the streams, potentially causing harm to the habitat for fish and other aquatic wildlife. Like natural processes, human induced sedimentation varies over time and occurs predominantly during the times of high flows and precipitation.

The major concern with sedimentation is the harm it can cause to fish and other aquatic species. Other beneficial uses can be impaired as well, including drinking water and recreation. Although it is difficult to determine exactly how much sedimentation is too much for local fish populations and other aquatic animals, deviations beyond those occurring naturally have a greater chance of causing harm.

In the Middle Rogue Watershed (MRW), there are three main causes of sedimentation: road runoff, road instability, and slope instability. Roads can transport large amounts of sediments through the associated drainage ditch system. Sediment that is captured in the ditch system, from ravel, sliding, and erosion of the road itself, is transported to the stream channel. The surface of the road itself can also provide sediment, depending on the surface material and condition of the road, weather conditions and the amount of traffic. Natural surface roads have the greatest potential for generating sediment, especially if they are heavily used. Wet weather and heavy track traffic lead to the most rapid breakup of the road surface. Low quality rock rapidly breaks down, forming potholes, which can lead to ruts if the road is not maintained. The location of the road in the watershed is also a factor in how much sediment is delivered to the stream system. Roads on ridge crests generally produce less sediment than a road that runs adjacent to a stream or mid-slope roads.

The stability of a road depends upon how well the road was constructed and the inherent stability of the materials used during construction. Generally, roads built on ridgelines or low gradient slopes are most stable. The most unstable roads are those constructed near streams and on steep terrain in the middle of the slope. Most road failures occur during times of high subsurface water flows. Thus most road failures occur during times of high intensity rainstorms or rain on snow events. There are two general types of road construction on slopes, sidecast and full-bench, with the later being more stable. Sidecast construction describes a process in which soil dug from the inside of the road is used to build up the outside of the road. On steep terrain, this fill can be unstable and be transformed into a landslide. A full-bench road does not use soil dug from the hillside for fill. Rather, the excavated soil is transported to a different location and the road is built on the excavated area. The inside slope can also become unstable and lead to small failures which divert water onto the road surface. This type of failure is generally dependant on the stability of the soil. Road crossings can also lead to large pulses of sedimentation reaching streams. Sedimentation occurs when a culvert is inadequately sized to accommodate a flood flow or it becomes clogged with debris. There are two types of erosion processes related to culvert failure. The first and greater source of sedimentation is a diversion. This occurs when the culvert is clogged and the water is diverted down the road. The other type of failure is when the water crosses over the road and flows immediately back into the waterway. This type of failure generally can only erode the fill used in placing the culvert. A diversion failure can capture many times more sediment and cause much more damage to the road surface.

Three general types of erosion dominate in the MRW: concentrated flow erosion (sheet/rill erosion and gully erosion), stream channel erosion and mass wasting (BLM, 1998). These processes are driven by gravity, water flow and soil strength. Other contributing factors are climate vegetation and fire. Soil erosion occurs when soil particles are detached by raindrop splash or overland flow of water and moved to another location. The distance soil is moved is variable depending on the terrain and vegetative condition of the land. This type of erosion is important because it reduces the amount of soil on a landscape, reducing the productivity of the land and increasing sedimentation to the local streams. Slope failure is the third important potential sedimentation source in the MRW. Concentrated flow erosion is of concern on slopes that have had most of the vegetation removed and where roads have concentrated runoff in areas where surface protection is inadequate. Gully erosion occurs predominantly on granitic soils, the dominant soil type which is highly erosive, where a disturbance has occurred. On this type of soil with little or no vegetation, a small rill can become a large gully during a single large precipitation event. These gullies can deliver very large amounts of sediment to the local streams.

Stream channel erosion occurs when large amounts of water carrying debris, rush through a channel, dislodging soil from the bank. This type of erosion can widen stream channels, causing the stream to widen and become shallower as well as directly increasing the sediment load in the stream. Deep, fine textured soils that occur at the base of upland areas on fans, footslopes and terraces are the most susceptible (BLM, 1998).

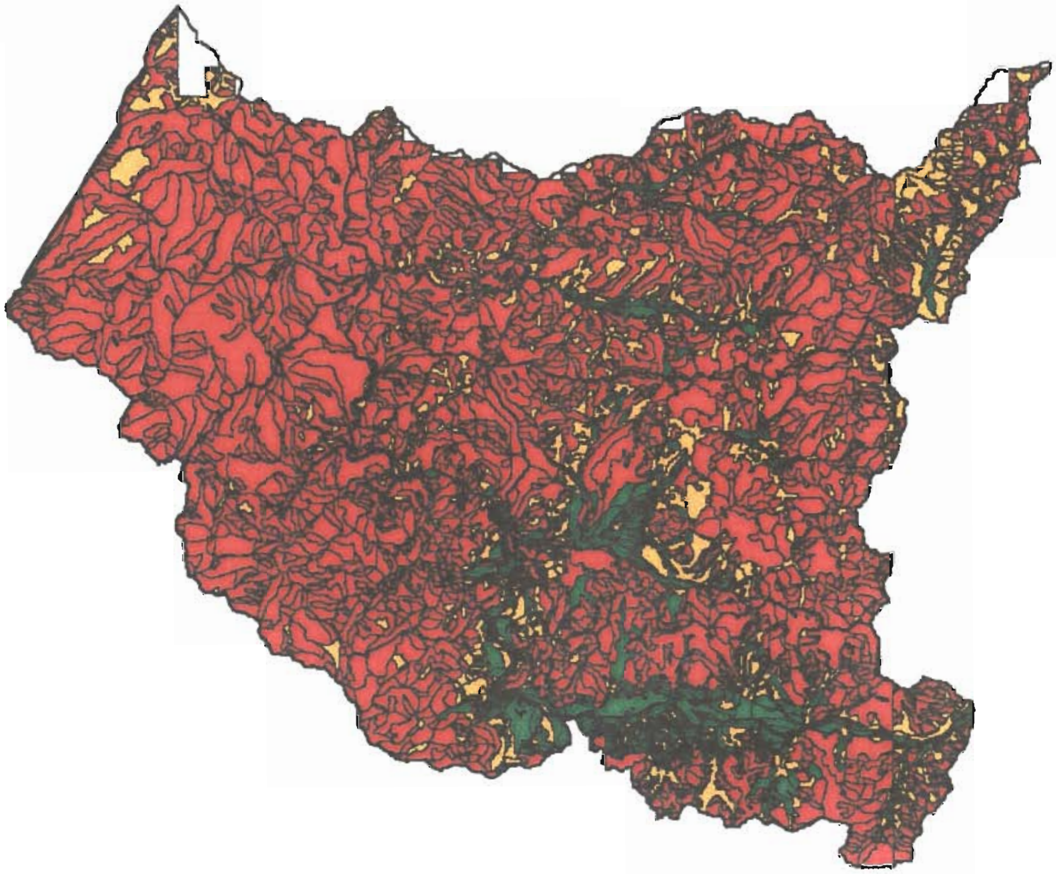
Mass wasting occurs when the soils on a slope become saturated. In the MRW, soils on slopes are often deep with fine texture, the type that is indicative of mass movement potential.

SOILS

Granitic soils are very prevalent in the MRW. These soils are associated with a high potential for erosion, especially when on steep slopes and in areas of disturbance. Over 78% of the soils in the MRW have a severe potential for erosion (see Table VII-1, Map VII-1). The rating of slight, moderate, or severe is based on the type of soil, the lack of vegetative cover to provide stability, the slope and the length of the slope. The potential for soil erosion varies across the subwatersheds based on the soils and the general terrain. All five of the subwatershed have greater than 50% of the soils rated as severe erosion potential, with Grants Pass subwatershed as the only one with less than 70% rated severe.

Table VII-1. Potential for Soil Erosion in the Middle Rogue Watershed.

Watershed	Slight	Moderate	Severe
Wild & Scenic	0.34	5.34	94.32
Grave	4.11	17.67	78.22
Galice	6.83	9.98	83.19
Jumpoff Joe	10.57	18.17	71.25
Grants Pass	24.31	15.79	59.90
Middle Rogue	**8.12**	**13.54**	**78.35**



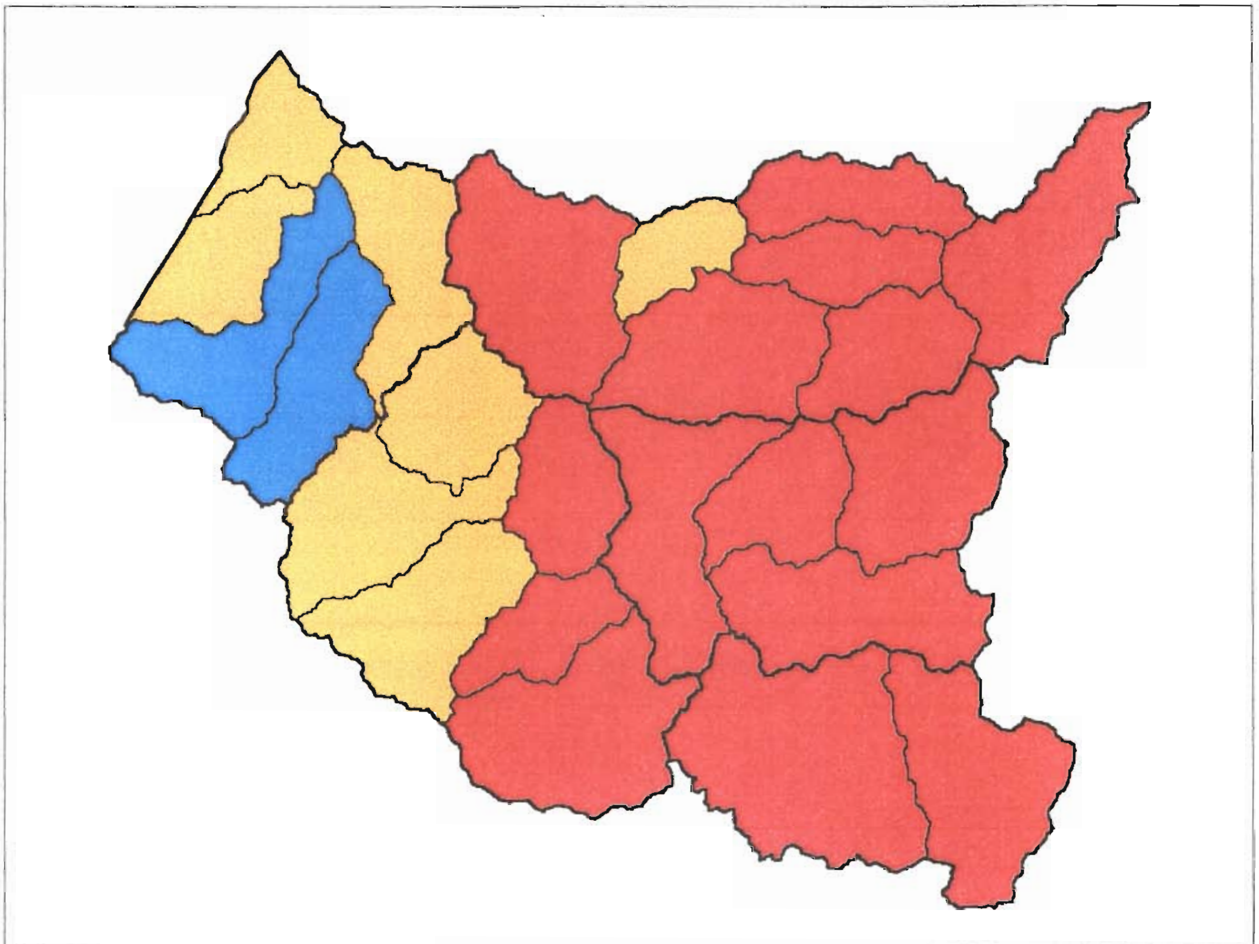
Map VII-1. Soil Erosion Potential in the Middle Rogue Watershed based on bare soil with no vegetative cover. Red = Severe. Orange = Moderate. Green = Slight.

ROAD DENSITY

Road density is a measure of the total road length (miles) for a given area (square miles). It is a means to determine the potential for sediment delivery to streams caused by roads. In general, road densities greater than 3.5 mi/mi^2 are considered to have a high potential for delivering excessive amounts of sediment to the stream system. Road densities less than 2 mi/mi^2 are considered to be low and do not represent an important source of sedimentation. However, location of the road is important, with those adjacent to streams having a high potential for increasing sediment loads.

Table VII-2. Road Densities in the Middle Rogue Watershed.

Subwatershed	Subwatershed Area (mi^2)	Total Linear Distance of all Roads (mi)	Road Density (mi/mi^2)
Wild & Scenic	104.90	230.40	2.20
Galice	145.81	488.73	3.35
Grave	163.15	819.26	5.02
Jumpoff Joe	108.90	594.88	5.46
Grants Pass	83.81	548.92	6.55
Middle Rogue	**606.57**	**2682.20**	**4.42**



Map VII-2. Road Densities in the Middle Rogue Watershed shown of the 6th field HUC level. Red <3.5. Orange 2 – 3.5. Cyan < 2.

In general, the road densities for the MRW are very high (Table VII-2, Map VII-2). Only the Galice and Wild & Scenic subwatersheds have a total road density lower than 3.5 mi/mi^2. When the road densities are examined at the 6th field HUC level, the pattern remains generally the same although the Lower Wolf subwatershed does have a road density lower than 3.5 mi/mi^2 (Table VII-3).

More than 60 percent of the total road distance in the MRW is located within 60 meters of a stream (see Table SS4). All the subwatershed, except for Grants Pass subwatershed which is less than 50%, have more than 60 percent of the road distance located near a stream.

Table VII-3. Road Densities in the Middle Rogue Watershed at the 6th field HUC Level.

Subwatershed (6th HUC)	Subwatershed Area (mi²)	Total Linear Distance of all Roads (mi)	Road Density (mi/mi²)
W & S - Kelsey Ck	18.06	42.69	2.36
W & S -Whiskey	23.59	62.90	2.67
W & S -Howard	23.95	30.21	1.26
W & S -Big Windy	25.57	51.07	2.00
W & S -Horseshoe Bend	17.74	43.54	2.45
Grave - Lower	37.22	180.87	4.86
Grave - Wolf, Lower	11.46	39.50	3.45
Grave - Wolf, Upper	17.46	69.02	3.95
Grave - Upper	31.11	187.43	6.03
Grave - Placer	20.00	115.67	5.78
Grave - Sunny Valley	30.59	156.20	5.11
Grave - Coyote	15.39	70.57	4.58
Galice - Lower	20.08	61.05	3.04
Galice -Stratton	18.49	82.21	4.45
Galice - Pickett	14.72	57.44	3.90
Galice - Upper	36.77	140.43	3.82
Galice - Taylor Ck	27.59	65.84	2.39
Galice - Galice	28.23	81.78	2.90
Jumpoff Joe - Bummer	30.72	167.00	5.44
Jumpoff Joe - Middle	18.68	94.26	5.05
Jumpoff Joe - Upper	28.63	148.88	5.20
Jumpoff Joe - Louse Ck	30.92	184.79	5.98
Grants Pass, Lower	50.24	355.92	7.08
Grants Pass, Upper	33.60	193.00	5.74

Table VII-4. Percent of Road Miles within 60 Meters (65.4 Yards) of a Stream.

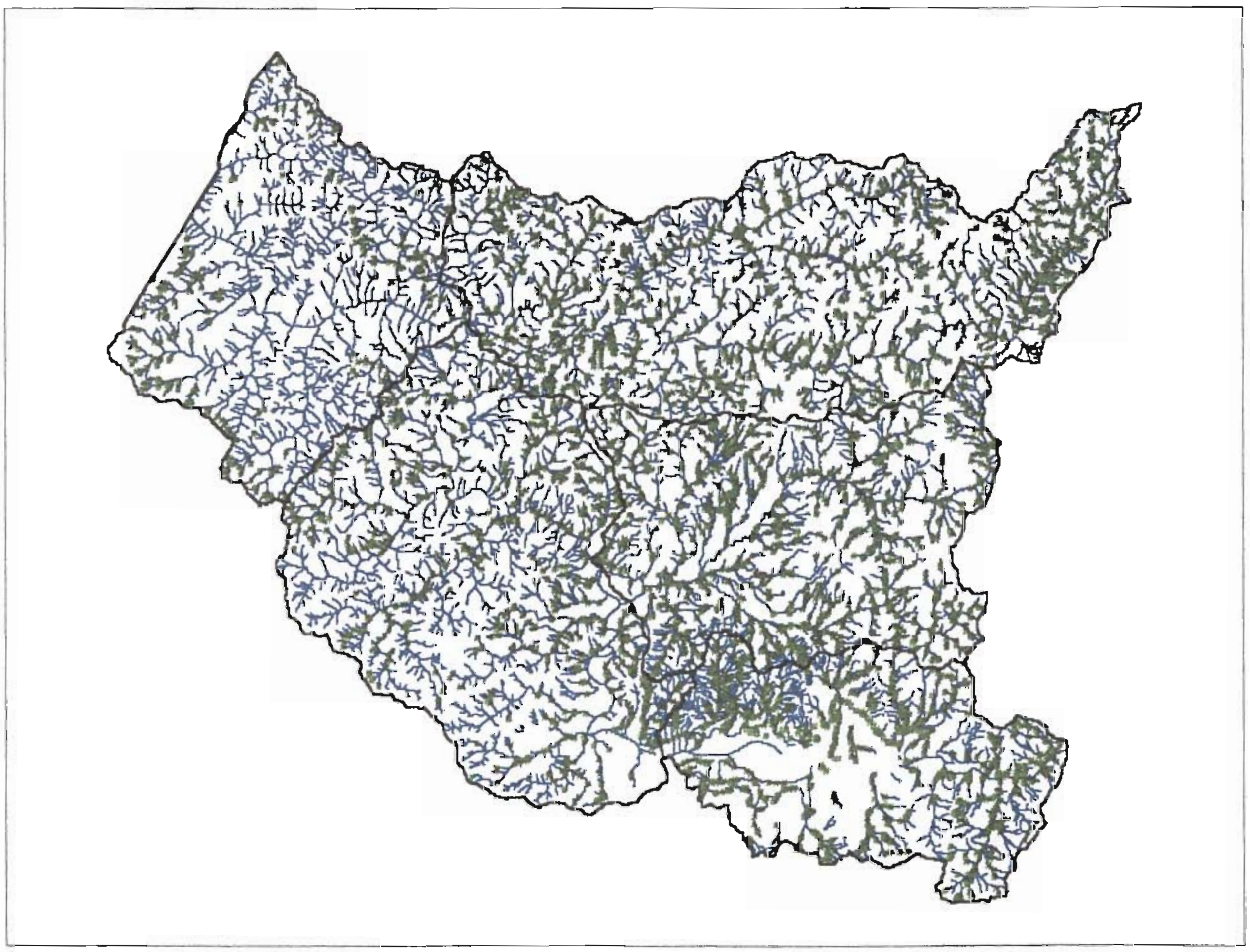
Subwatershed	Stream Miles	Road Miles	Miles within 60m/65.4y of a Stream	Percent of Total Road Miles
Wild & Scenic	391.39	230.40	144.67	62.79
Galice	526.65	488.73	295.30	60.42
Grave	594.26	819.26	543.73	66.37
Jumpoff Joe	406.73	594.88	383.19	64.41
Grants Pass	311.70	548.92	270.97	49.36
Total	2230.73	2682.20	1637.86	61.06

Stream Crossings

Stream crossing have the potential for causing sediment to reach the local streams. There are over 3750 stream crossings in the MRW (Table VII-5, Map VII-3). More than 90% of these crossings are culverts. Without surveying each crossing, which is impractical due to the large number, the density of crossings (crossings/mi^2) can be used as an indicator of potential sedimentation caused by stream crossings. The Grave, Jumpoff Joe and Grants Pass subwatershed have the highest density of stream crossings. However, the issue in the Grants Pass subwatershed is different due to the urban nature of the subwatershed and the fact that most of the area is low gradient terrain.

Table VII-5. Stream Crossings in the Middle Rogue Watershed.

Subwatershed	Subwatershed Area (mi^2)	Stream Crossings	Crossings/mi^2
Wild & Scenic	104.90	241	2.30
Galice	145.81	624	4.28
Grave	163.15	1185	7.26
Jumpoff Joe	108.90	897	8.24
Grants Pass	83.81	804	9.59
Middle Rogue	606.57	3751.00	6.18



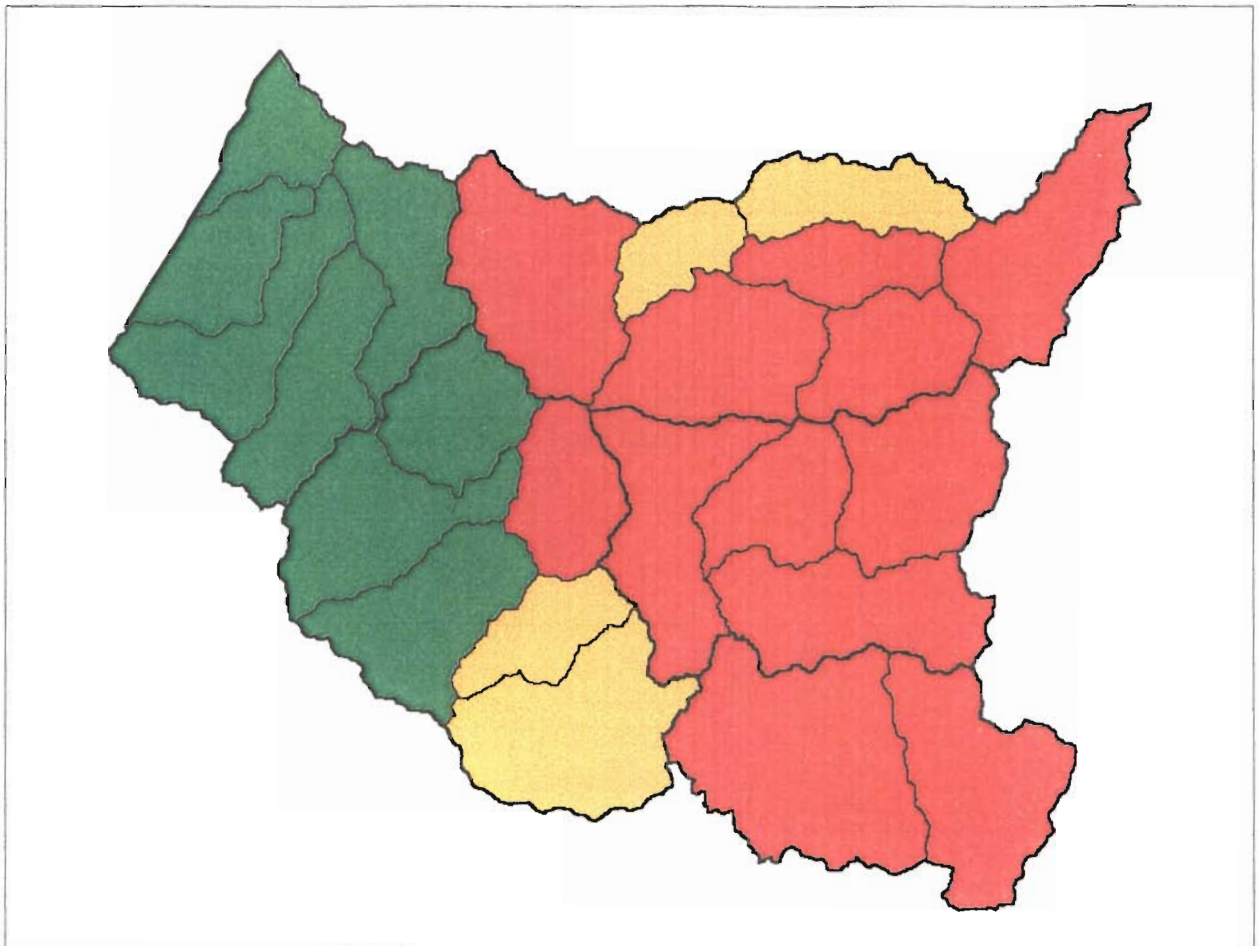
Map VII-3. Stream Crossings in the Middle Rogue Watershed.

The Grave and Jumpoff Joe subwatersheds have both steep terrain and a high density of stream crossings. To increase the value of the stream crossing parameter, it has been evaluated to the 6th field Hydrologic Unit Code (HUC) level (Table VII-6, Map VII-4). An HUC is a US Geological

Survey designation that correspond to specific watersheds and are expressed in a hierarchical scale. The higher the level, the smaller the stream; for example, the Rogue River is a 4th HUC level, Grave Creek, which flows directly into the Rogue River, is a 5th HUC level, and Wolf Creek, which flows into Grave Creek, is a 6th HUC level. The evaluations, then, include all streams in the subwatersheds up to and including the 6th HUC level.

Table VII-6. Stream Crossings in the Middle Rogue Watershed at the 6th Field HUC Level.

Subwatershed	Subwatershed Area (mi^2)	Stream Crossings	Crossings/mi^2
W & S - Kelsey Ck	18.06	30	1.66
W & S -Whiskey	23.59	80	3.39
W & S -Howard	23.95	28	1.17
W & S -Big Windy	25.57	55	2.15
W & S -Horseshoe Bend	17.74	48	2.71
Grave - Lower	37.22	263	7.07
Grave - Wolf, Lower	11.46	67	5.85
Grave - Wolf, Upper	17.46	100	5.73
Grave - Upper	31.11	306	9.84
Grave - Placer	20.00	146	7.30
Grave - Sunny Valley	30.59	198	6.47
Grave - Coyote	15.39	105	6.82
Galice - Lower	20.08	67	3.34
Galice -Stratton	18.49	129	6.98
Galice - Pickett	14.72	73	4.96
Galice - Upper	36.77	173	4.71
Galice - Taylor Ck	27.59	79	2.86
Galice - Galice	28.23	103	3.65
Jumpoff Joe - Bummer	30.72	232	7.55
Jumpoff Joe - Middle	18.68	144	7.71
Jumpoff Joe - Upper	28.63	224	7.83
Jumpoff Joe - Louse Ck	30.92	297	9.60
Grants Pass, Lower	50.24	476	9.47
Grants Pass, Upper	33.60	328	9.76

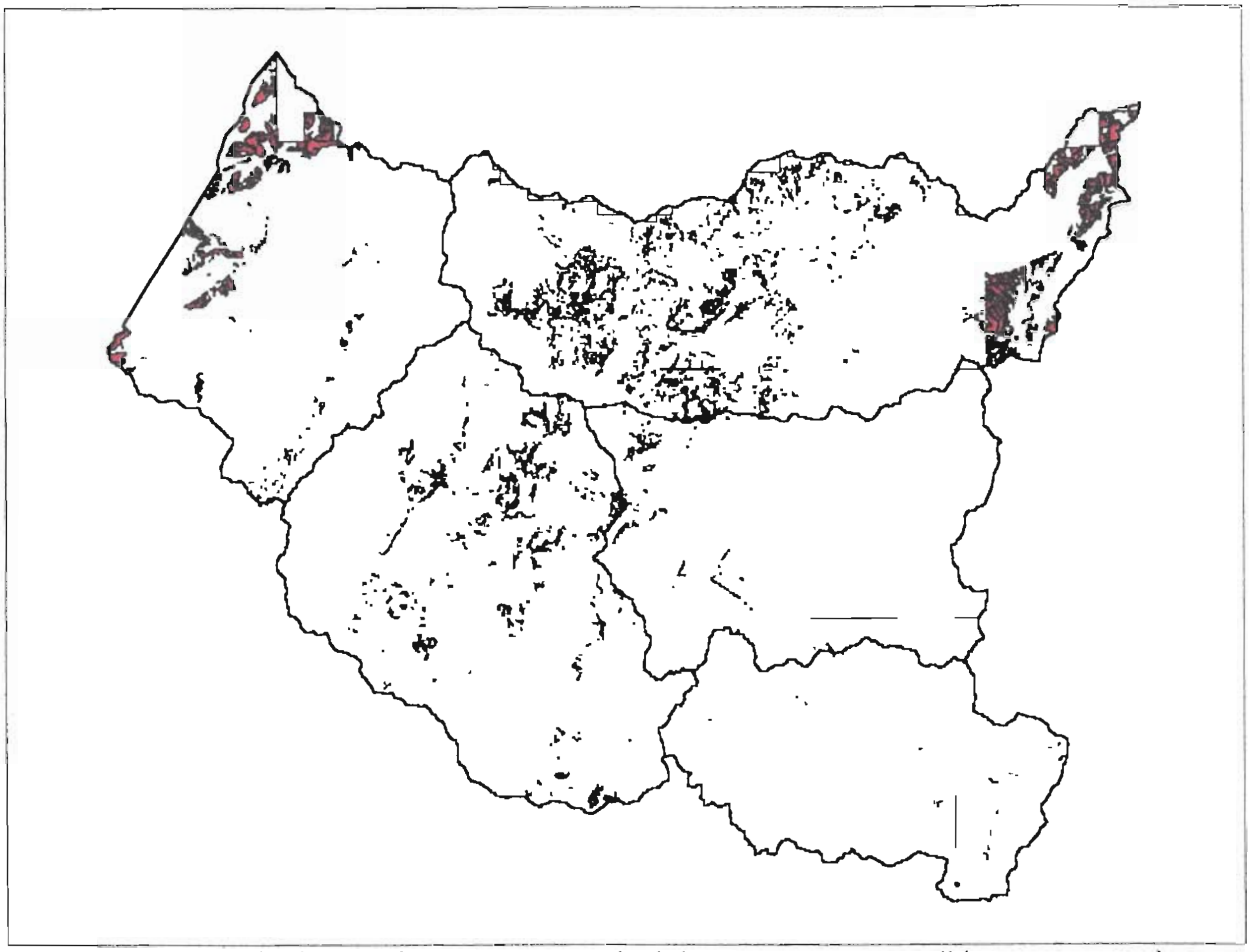


Map VII-4. Stream crossing density in the Middle Rogue Watershed at the 6th field HUC level. Red > 6 crossings/mi^2. Orange 4 – 6 crossings/mi^2. Green < 2 crossings/mi^2.

Mass Wasting

As mentioned above, the majority of soils in the MRW are granitic in nature and prone to severe erosion. Mass wasting, the slumping of soil not related to roads or streams, has occurred in various parts of the MRW. Mass Wasting is concentrated in the areas with steep terrain, low vegetative cover, and unstable soils (Map VII-5). The Grave and Galice subwatersheds have the most area that is susceptible to mass wasting.

Most of the roads on slopes in the MRW are on public lands. This means that the MRWA will have to work with the local offices of the Bureau of Land Management and Forest Service for many of the projects. There are numerous activities that should be pursued in order to lower the potential for sedimentation in the MRW. Road density should be lowered through road decommissioning, barricading and decommissioning. Educating off road vehicle users and mountain bikers about sedimentation and its effects on the watershed should be a priority. Removing valley bottom roads should be a major focus in order to help return proper functioning of the riparian habitat.



Map VII-5. Areas in the Middle Rogue Watershed that are most susceptible to mass wasting. Colored areas are unstable and have the potential for mass wasting when saturated with water.

Discussion

The three main sources of sedimentation in the MRW are road runoff, road instability and mass wasting. The potential for human induced sedimentation to the streams is exacerbated by the high percentage of granitic soils in the area. Human activity on steep slopes also increases the potential for human induced sedimentation. Both on private and public lands, intensive forest management practices such as fire suppression, extensive road construction and extensive logging on steep slopes have increased the potential for high levels of sedimentation in the MRW.

Much of the MRW is at high risk for high levels of human induced sedimentation, with the Grave, Galice and Jumpoff Joe subwatersheds at the greatest risks. As listed in the Water Quality chapter, there are nine streams, as well as the Rogue River upstream of Grave Creek, that have been shown to have high levels of sedimentation: Grave, Coyote, Wolf, Galice, Jumpoff Joe, Louse, Fruitdale, Jones, Vannoy (Table VI-3).

Data Gaps

Most of the data in this section are at a general level. Before individual projects can be listed, site-specific surveys should be conducted. Much of this is being done by the ODFW, BLM and USFS. However, the watershed council could do surveys on private lands. Types of surveys could include:

- In conjunction with water quality surveys, sediment loads and their sources should be a priority. This should be focused initially on the streams listed above.
- A survey of the roads on private lands could be done, detailing the surface, condition and traffic load as well as slope. This effort should be focused where high sediment levels have been documented.
- Upslope surveys on private land for mass wasting sites could be done. However, more important would be determining those sites that have the greatest potential for erosion in the future. Locating areas on steep slopes that have been denuded of vegetation would be the best way to approach getting this information.
- Storm drain surveys and data collection in the Grants Pass subwatershed were recommended in the hydrology chapter. These surveys should include gathering data about the amount of sediment being delivered to the waterways through the city's storm drain system.

Chapter VIII – RIPARIAN and WETLAND HABITAT

The vegetation area found along streams and rivers is known as the riparian zone. The character of a local riparian zone is determined by many factors including hydrologic, geomorphic and biotic processes. Soils moisture and vegetative cover is generally higher in riparian zones than in adjacent areas.

Riparian zone health is important to fish, aquatic organisms, and terrestrial animals as well as water quality. Healthy riparian zones help filter out sediment and pollutants. The root systems of riparian vegetation provide stream bank stabilization, helping to reduce bank erosion and downcutting. Riparian vegetation also provides habitat for insects and aquatic macroinvertebrates, both food sources for fish. Additionally, riparian material that makes it into the streams provides nutrients to the system. Riparian zones also provide hydrological benefits such as reducing stream velocities during high flow events and dissipating the energy of the floodwaters.

The above list of benefits provided by a healthy riparian zone is difficult to quantify. Therefore, this chapter will assess the potential for the riparian zones in the Middle Rogue Watershed (MRW) to provide shade for temperature control. Riparian zones also provide woody debris to the system, helping to maintain fish habitat and stream complexity. This aspect of riparian health is assessed in the fish habitat component.

Other factors influence stream temperature, but riparian shading can provide the greatest impact in preventing water temperature increases. This is because it directly prevents the greatest source of heating during the summer, solar radiation. It is important to remember that riparian shading does not reduce the temperature of the water. Rather it reduces the amount of solar radiation reaching the stream and therefore reduces the increase in heating. The riparian canopy itself does radiate heat to the stream, but this is very small compared to the amount of energy from direct solar radiation. The slope and aspect of the stream topography can also play an important role in the amount of solar radiation that reaches the stream surface.

The vegetation density in the riparian zone is the most important factor in water temperature. It is also the process most influenced by human activities. There is very little site-specific data for riparian zones in the MRW. Some data does exist about the general vegetation patterns. This data has been used, along with information about stream temperature and local topography, to develop a general assessment of the riparian zones in the MRW.

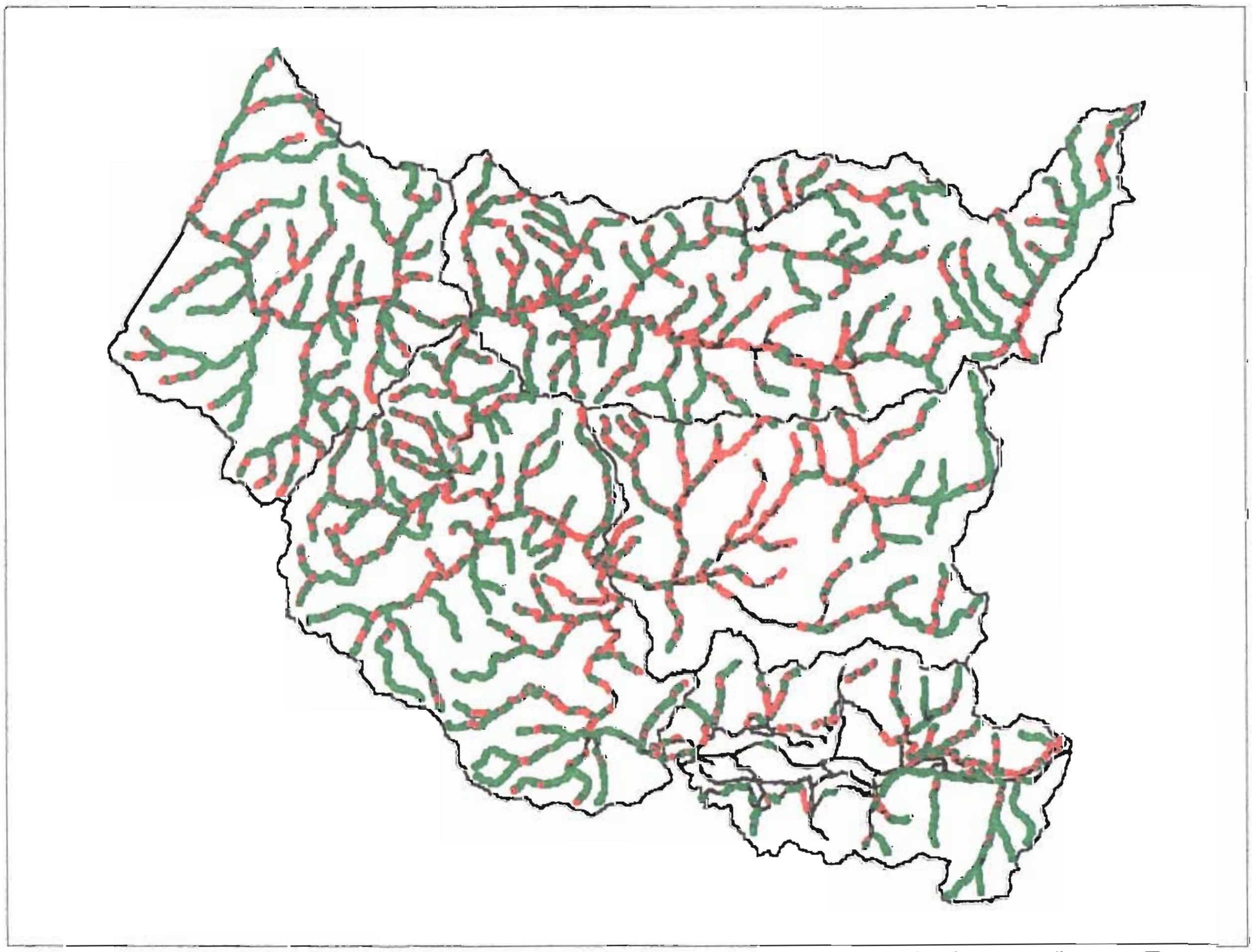
VEGETATION

More than fifty percent of the riparian zone on the larger streams in the MRW is described as either dense forest or young dense forest (Table VIII-1). Most of this classification is found on smaller streams and in higher reaches. Larger stream segments, such as the lower reaches of Jumpoff Joe Creek, Grave Creek and Taylor Creek, are dominated by young nonforest (Map VIII-1). This indicates that the riparian zones in these sections are not able to provide adequate shading to protect against high stream temperatures. Riparian shading is most important in areas of gentle slope where streams tend to be wider and shallower, thus more susceptible to increased temperature from solar radiation.

Table VIII-1. Vegetation Classification for Larger Streams in the Middle Rogue Watershed. *

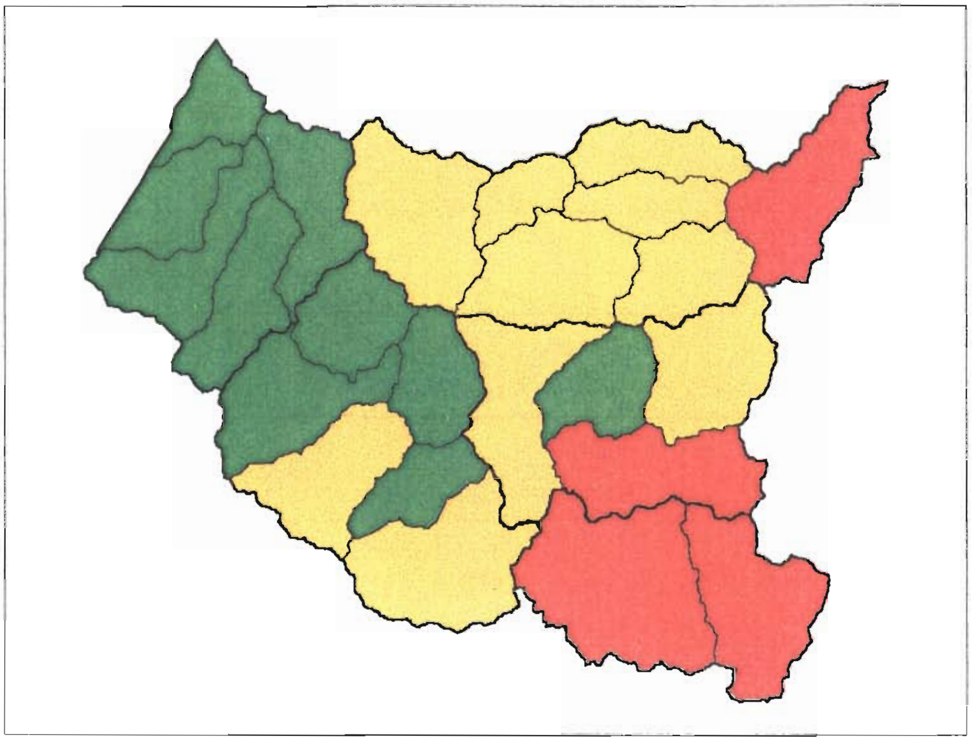
	Area (mi^2)	Percentage of Total Riparian Area
Dense Forest	22.78	50.31
Sparse Forest	0.02	0.04
Urban Ag	7.05	15.58
Young Dense Forest	1.53	3.38
Young Nonforest	13.90	30.69
Total	45.28	

*First and second order streams not included.

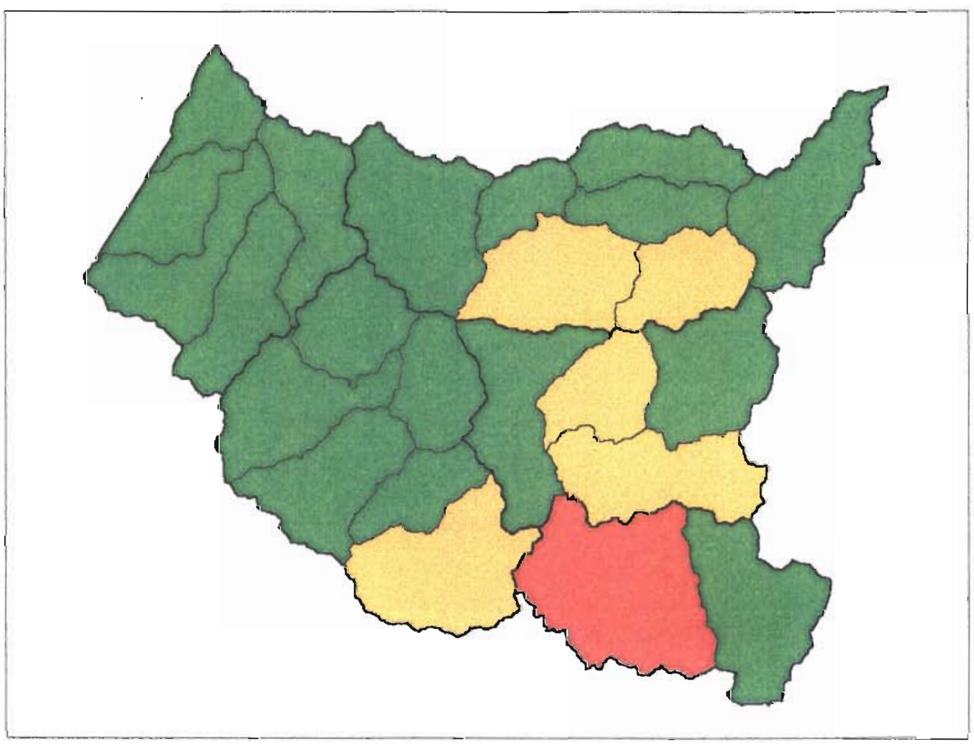


Map VIII-1. Vegetation classification in the Middle Rogue Watershed. Green = Dense Forest. Red = Sparse or Nonforest. Riparian sections not colored are dominated by Urban Vegetation.

Much of the riparian habitat in the Jumpoff Joe, Grave and Grants Pass subwatersheds is in poor condition (Map VIII-2). The riparian areas in the Louse Creek subwatershed and the Grants Pass subwatershed have been greatly affected by urbanization. The entire Grave Creek subwatershed



Map VIII-2. Percent of riparian area that is poor condition.
Red > 36%. Orange 15% - 36%. Green < 15%.



Map VIII-3. Percent of riparian network associated with low gradient streams (slope <4%).
Red > 30%. Orange 10% - 30%. Green < 10%.

and parts of the Galice and Jumpoff Joe subwatersheds have moderate riparian conditions. The conditions in the lower reaches are mostly a result of rural development. This includes forestry practices on private lands. In areas of steeper slopes, and or lower population densities, riparian conditions are slightly better (Map VIII-3).

Potential natural vegetation was mapped on three levels. The series is determined by the most abundant reproducing tree in the understory of late-successional stands. Often, this is the most shade-tolerant species present. Plant associations are fine scale divisions based on the indicator species present in late-successional stands. These associations are further aggregated into plant association groups, to ease interpretation. The plant associations used are described in Atzet et al. (1996). This book gives more detailed information on species composition.

WETLANDS

Wetlands are marshes, swamps, or bogs defined by state and federal law as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal conditions do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Wetlands may support both aquatic and terrestrial species and favor the growth of hydrophytes (plants specially adapted to live in wet areas) and promote the development of hydric soils (soils formed under saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part). Wetlands may be found in flat vegetated areas, in landscape depressions, and between dry land and water along the edges of streams, rivers, lakes and coastline.

Wetlands play an important role in the ecology of the watershed for the development of organisms that feed fish, amphibians, insects, birds, and terrestrial animals; more species of wildlife use wetland and riparian areas than any other type of habitat. They are effective at filtering out pollutants and sediments in the water, and they absorb and store storm water flows, which reduces flood velocities and stream bank erosion. Their capacity to store and slowly release water aids in recharging groundwater tables.

Agriculture, ditching and storm drain installation, obstructions, and flood reduction activity have destroyed much wetland area, while residential development, industrial development, commercial development, recreational usage, transportation facilities and utilities, and vegetation removal have negatively impacted wetland area. On the other hand, wetlands have been created, both intentionally and unintentionally, from irrigation, the creation of agricultural and aggregate mining ponds, the creation of detention basins, and the creation of wetland mitigation sites.

That wetlands may have surface water present for only part of the year can make them difficult to identify. The City of Grants Pass has identified 34 wetlands within the Urban Growth Boundary (UGB), although these do not comprise all of the wetlands in the Grants Pass subwatershed, and the Golden-Coyote Wetland in the Grave subwatershed has been restored. While perhaps hundreds of wetlands have been identified and mapped by the US Geological Survey (USGS), they have not been compiled into one listing or map, making it extremely difficult for planners to consider wetland protection into land use activity in the county

Discussion

Human activities such as mining, logging and rural development have seriously impacted the health of the riparian zones in much of the MRW. This is especially true on private lands. Federal lands are under tighter restrictions, and the riparian conditions on public lands are improving.

The existing vegetation conditions in the watershed today are a result of fire exclusion and replacing the natural disturbance pattern with human disturbances such as logging (particularly of the high-value pine species), farming and rural development.

This is not true on private lands. Riparian restoration needs to occur in much of the low gradient streams of the MRW. This is especially true for those streams that have high summer temperatures, see the Water Quality chapter for this information. Much of the riparian zone on private lands has been altered in condition as well as composition. Many of the large conifers necessary for woody debris recruitment are being slowly replaces with hardwoods such as alders and maples. And although these latter species are native riparian trees, the percentage of the riparian habitat that they compose is generally higher than reference conditions.

Site-specific information on riparian habitat condition is extremely limited. This means that any current information of riparian conditions in the watershed is general in nature. More information is need on the condition of riparian zones on private lands.

Blackberries represent a severe hazard to riparian zone health. The non-native species of the plant is highly invasive, especially in areas where there is little over structure. And although blackberries with cover much of the stream bank, they provide very little shade or stream bank stabilization. Actions should be taken to reduce the level of blackberries in the watershed, replanting the areas with native riparian plants.

Data Gaps

There is a great need for riparian information on private lands. This is particularly true on streams that have high stream temperatures. Any surveys conducted should be coordinated with ODFW. The type of information that is needed includes: shade potential, species composition, size of trees. While many wetlands are mapped, their locations are not easily accessible to those in the best position to protect them.

Chapter IX - CONCLUSIONS

The goal of this assessment was to define the current conditions within the watershed and how severely they have been impacted by human activities over the past century. Due to the large size of the area studied as well as a lack of available data, most of the analysis is generalized for each of the subwatersheds. More detailed analysis was done where data was available. In addition to determining the watershed condition, data gaps were noted and suggestions for future studies were suggested.

The Middle Rogue Watershed is a very large area (606 square miles) made up of five distinct subwatersheds: Wild & Scenic, Grave, Galice, Jumpoff Joe and Grants Pass. Though the terrain is mostly mountainous, the elevations in the watershed are relatively low ranging between 500 and 5200 feet with a mean elevation of 2509 feet. These low elevations mean that although there is snowfall throughout much of the watershed, streamflows are not impacted by spring snowmelt so much as rain-on-snow events. This results in high peak flows when rain falls on snow pack and very low summer flows.

Overall, the condition of the Middle Rogue Watershed is somewhat degraded. The true extent of the degradation as well as the specific locations needing restoration is unknown due to a lack of quality data. However, it is obvious that the one and a half centuries of human development in the area have significantly reduced the quality of the watershed habitat. This is particularly true in those areas where development has been concentrated.

HYDROLOGY

Human development has been affecting the condition of the watershed since settlers began developing in the area over 150 years ago. Historically, mining and farming were the activities that had the most serious impacts on the habitat. However, with the continuing rapid population growth in the area, land development, home building and road construction are the activities most affecting the watershed health at this time. Since there is only one urban area in the entire MRW, the impact of urbanization on the entire watershed is minimal. However, urbanization in the Grants Pass subwatershed and the similar urbanization characteristics of rural communities such as increased impervious surfaces and altered drainage networks, hydrologic cycle can be severely impacted as well as fish habitat and stream conditions

Table IX-1. Impacts of Roads and Land Uses on Hydrology by Subwatershed

	Roads			Land Use	
Subwatershed	**Forest**	**Rural Agriculture**	**Rural Residential**	**Agriculture**	**Timber Harvest**
Wild & Scenic	Low	Low	Low	Low	Low
Galice	Low	Low	High	Low	Low
Grave	Low	Low	High	Low	Low
Jumpoff Joe	Low	Moderate	High	Low	Low
Grants Pass	Low	Moderate	High	Low	Low
Total	Low	Low	High	Low	Low

The two main mechanisms through which forestry practices impact hydrologic processes are (1) the removal and disturbance of vegetation and (2) the road system and related harvesting systems. The greatest likelihood of hydrologic problems arising from forestry practices is through increases in peak flows associated with rain-on-snow events, but the potential for peak flow enhancement due to forestry practices is considered low for the Middle Rogue Watershed as well as each of the five subwatersheds (Table IV-4).

Streamflows, naturally low during summer months, have been severely impacted by human water use activities. Except for the smallest tributaries, each stream in the MRW has been over-allocated for water rights. This means that more water has been promised to water users than naturally exists in the streams. The OWRD does not allow all the water in the streams to be diverted, keeping a small amount flowing for fish habitat and passage. Almost one third of the water use areas as defined by the OWRD have a potential for restoration of stream flows. This is due to the fact that more than 10% of the water used in the areas is dedicated to consumptive water rights.

Fish And Fish Habitat

There are five major salmonid stocks present in the MRW: fall chinook, spring chinook, summer steelhead, winter steelhead and coho. Coho are currently listed as threatened under the Endangered Species Act. Spring chinook and coho numbers have declined greatly over the past century for a variety of reasons. Hatcheries have supplemented numbers in the watershed, but habitat degradation has limited the potential for natural stocks to recover to pre settlement numbers.

Very few of the streams within the MRW have been surveyed, and those were in the less developed areas of the watershed. Those that have been surveyed have generally moderate fish habitat conditions (pools, riffles, large woody debris, riparian) except for large woody debris that is severely lacking in the streams surveyed. It seems likely that fish habitat conditions in the more developed areas will be much poorer that those areas already surveyed, and the priority for restoration much higher than the data indicate in this assessment.

There are a large number of barriers to anadromous fish passage within the MRW. Most of these barriers are culverts for stream crossings. There are also an extremely large number of stream crossings in the higher reaches. Although these culverts do not affect anadromous fish, they do represent barriers to movement of resident trout throughout their habitat.

Water Quality

To date, the most important water quality issue in the MRW is stream temperature. It must be noted, however, that there has been very little water quality monitoring in the watershed and thus other issues may actually be more significant. Regardless, temperature is a glaring problem in the watershed and will need to be addressed.

More than 25% of the stream miles in the MRW have summer water temperatures that exceed the state standard of 64°F. At this temperature, salmonids begin to show signs of stress. One aspect of the temperature problem that has not been satisfactorily answered is what the natural stream temperatures in the watershed are. It is possible that some of the streams naturally run warm. It should be noted that ODFW surveys are done on fish-bearing streams, so perennial nonfish-bearing streams are not typically surveyed. Therefore, perennial streams that contribute to elevated temperatures would not have been picked up in stream surveys.

The Grave and Jumpoff Joe subwatersheds currently have the most streams with temperature problems. However, other water quality issues are of concern in all of the subwatersheds except for the Wild & Scenic. Parameters such as sedimentation, habitat modification, and flow modification represent issues of concern in many of the streams in the watershed.

Urban development has led to water quality issues in those streams near the city of Grants Pass. However, rural development, which is growing continually in the MRW, poses the greatest threat to water quality in the watershed. Poor land management practices on developed sites and sites under development have degraded the quality of the streams in the MRW over the last few decades.

Sediment Sources

In the MRW, the three main sources of sedimentation are road runoff, road instability and mass wasting. The high percentage of granitic soils in the watershed further exacerbates these problems. Human activity on slopes and near streams has greatly increased the potential for sedimentation.

Forest practices such as fire suppression, road building and extensive logging on slopes have increased the potential for sedimentation. This is true for both public and private lands. The Grave, Jumpoff Joe and Galice subwatersheds are the areas in the MRW at the greatest risk of human induced sedimentation. This is due to the high level of rural development and prevalence of steep terrain in these locations. The streams in the Grants Pass Urban Growth Boundary have all been seriously impacted by development with most of the streams suffering from high amounts of sedimentation.

Currently, most unpaved roads in the MRW are on public lands. However, as rural development continues to grow in the watershed, unpaved surfaces on private lands will become more and more of a sedimentation source. Public offices are working towards reducing the number of roads through decommissioning and barricading. Also, road-building techniques have improved greatly over the past few decades. However, private lands owners do not have the same strict guidelines to follow when installing driveways and roads, thus the importance of working with private landowners to reduce the potential of sedimentation.

Riparian and Wetland Habitat

Human activities such as logging, mining and rural development have seriously impacted riparian zones in much of the MRW. Since public lands are under much more stringent restrictions, the riparian areas on private lands are those most degraded, both in the condition and composition of the riparian areas. The large conifers, important for recruitment of large woody debris as well as shade are being replaced ubiquitously with hardwoods that do not provide the same benefits as conifers. Most of the riparian zones on the lowlands and lesser slopes have been impacted through rural development. These are the areas where stream flows are slowed and often stream channels widen. Thus the shading of riparian vegetation is vital in these locations. As rural development continues in the watershed, more land on steep slopes will fall under development, thus upstream riparian zones will become more and more impacted.

In the MRW, blackberries, a non-native species, represent a serious threat to the integrity of riparian zones in the low elevation areas. This is particularly true where there is little or no over structure. Blackberries provide very little shade and inhibit the growth of young trees.

OVERALL WATERSHED HEALTH RATING

This assessment analyzed five watershed health factors to determine the overall health of the MRW. These overall combination of these factors, hydrology, fish and fish habitat, water quality, sedimentation and riparian zones, gives a general indication of watershed health condition. For the purposes of this assessment, this was done at the subwatershed level as well as the entire MRW (Table IX-2). A rating from 1-5 (1 = Slightly Degraded, 3 = Somewhat Degraded, 5 = Severely Degraded) was given to each of the subwatersheds for each of the watershed health factors. These factors were then averaged to determine the overall watershed health score for the entire MRW. The Middle Rogue was given two scores: the first included the Wild & Scenic subwatershed scores and the second excluded it. The reason for this was that the Wild and Scenic subwatershed is somewhat of an anomaly as there are practically no private lands in the area.

Table IX-2. Overall Watershed Rating.

Subwatershed	Hydrology	Fish & Fish Habitat	Water Quality	Sediment Sources	Riparian Health
Wild & Scenic	1	2	1	3	1
Grave	3	3	3	4	3
Galice	3	3	2	3	2
Jumpoff Joe	4	3	3	4	3
Grants Pass	4	4	4	4	4
Middle Rogue	3 3.5	3 3.25	2.6 3	3.6 3.75	2.6 3

Overall, the health of the MRW is somewhat degraded. Water quality is rated as the least degraded of the health factors, but this could be due to a severe lack of water quality data. Sedimentation appears to represent the greatest threat to watershed health in the MRW. The potential impact of sedimentation will only continue to grow as population and development expand throughout the watershed. Like water quality, the rating for riparian health is somewhat misleading due to a lack of data.

The Grants Pass subwatershed is the most degraded of the five subwatersheds in the MRW. This is due to the long history of development and the fact that it contains the only truly urban area in the entire MRW. The Grave, Galice and Jumpoff Joe subwatershed all have somewhat degraded overall watershed health. Galice is the best off of the three. To exacerbate problems in the

Jumpoff Joe subwatershed, this is the area, outside of the Grants Pass subwatershed, that is experiencing the most population growth and subsequent impacts due to development.

Natural salmonid populations have declined throughout the Rogue Watershed over the past few decades. In the Middle Rogue Watershed, the potential for these populations to rebound is limited by the health of the watershed. This is particularly true for coho and steelhead populations. These salmonids use much of the stream habitat within the MRW while the chinook populations rely on the Rogue River and the lowest reaches of the larger streams in the case of fall chinook. To begin improving the salmonid populations, the watershed health of the MRW and its subwatersheds needs to be improved and preserved.

This assessment has highlighted the general areas and factors that need to be addressed. For site-specific information, more data is needed. Additional data will also refine the knowledge about the different watershed health factors. Due to the severe lack of data for many of the watershed health indicators that were analyzed in this document, methods other than those detailed in the OWEB Watershed Assessment Manual (WPN 1999) had to be used. In some cases, such as with the Riparian and Water Quality components, the analysis was severely curtailed by a lack of data (Table IX-3 and IX-4). In other instances, such as fish habitat, there exists quality data but only for selected areas (Grave subwatershed). This analysis has shown a need for different restoration projects throughout much of the MRW. However, it has also shown that there is a glaring need for more data on the pertinent watershed health parameters spelled out in this document.

Table IX-3. Data Availability Rating. 1 = Most data; 3 = Little data; 5 = No data.

Subwatershed	Historical	Hydrology & Water Use	Fish & Fish Habitat	Water Quality	Sediment Sources	Riparian Health
Wild & Scenic	1	2	4	3	3	4
Grave	1	3	3	3	4	4
Galice	1	3	4	4	4	4
Jumpoff Joe	1	3	4	3	4	4
Grants Pass	1	3	4	4	4	4
Middle Rogue	1	2.8	3.8	3.4	3.8	4

There are specific gaps in each of the watershed health categories. These gaps have been tabulated from the assessments performed in each of the subwatershed by BLM and USFS as well as the data gaps recognized through the development of this analysis (Table IX-4).

Table IX-4. Data Gaps Information Needs

Component	Need
Historical	▪ Information of reference conditions for understanding fish population trends, riparian conditions and what the natural stream temperatures are. ▪ To a lesser extent, mapping of historical clearcutting operations would aid in the understanding of sedimentation and hydrological impacts.
Hydrology and Water Use	▪ Source and flow characteristics for each stream. ▪ Extent and location of logging and development on private lands. ▪ Private road inventory. ▪ Number and locations of wells and total domestic water use.
Fish & Fish Habitat	▪ Spawning numbers for the anadromous salmonid populations. ▪ Numbers of smolts emigrating from each stream and subwatershed. ▪ Habitat information (pools, riffles, gravel, LWD) for the salmon bearing streams in the MRW. ▪ Fish passage barrier information, including location and type.
Water Quality	▪ Range of daily water temperatures. ▪ Information explaining why streams exceed DEQ listing criteria, including land use activities, shade, background conditions and water use patterns. ▪ Water quality data such as macroinvertebrate information, flow modifications, instream habitat modifications, nutrient levels, turbidity and dissolved oxygen. This is most important for fish bearing streams.
Sediment Sources	▪ Better information on sedimentation rates, causes and trends. ▪ Site-specific data on sedimentation sources so projects can be targeted. ▪ Locations of potential mass wasting sites. ▪ Upslope sites of potential erosion, including areas of denuded vegetation. ▪ Road surveys on private lands, including driveways, for data on road density, surface type, slope, proximity to stream channel, and use pattern.
Riparian Habitat	▪ Riparian data including vegetation species profile, width of riparian zone for both banks, maturity, stream size, discontinuities, aspect, slope, channel confinement and shading potential. This is most important for fish bearing streams on private lands.
Wetlands	▪ Listing and mapping for easy accessibility and use. ▪ Survey existing wetlands to document health and mitigate impacts.
Channel Modification	▪ Location of reservoirs and artificial impoundments. ▪ Location of dikes and levees, including both historical and current. ▪ Information on those stream sections that have been channelized, straightened or hardened. ▪ Location of stream bank protection sites: riprap, pilings and bulkheads. ▪ Location of built up areas in floodplains and wetlands. ▪ Information on road crossing sites that used extensive fill (>250 feet). ▪ Location and type of push-up dams. This information is also useful for the fish habitat component. ▪ Location of sand and gravel mining operations in or near the stream channels, as well as location of current and historical tailings deposits.

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APPENDIX
Water Availability and Natural Stream Flows.

The Oregon Water Resources Department has modeled streamflow for each of the streams in the Middle Rogue Watershed. This model shows the season nature of the flow patterns in the MRW. Due to very little snowmelt late in Spring and early Summer, streamflows are extremely low during summer months. Peak flows are generally found between December through April (see Figures A-1 – A-27).

WILD & SCENIC WATER AVAILABILITY BASINS (WABS)

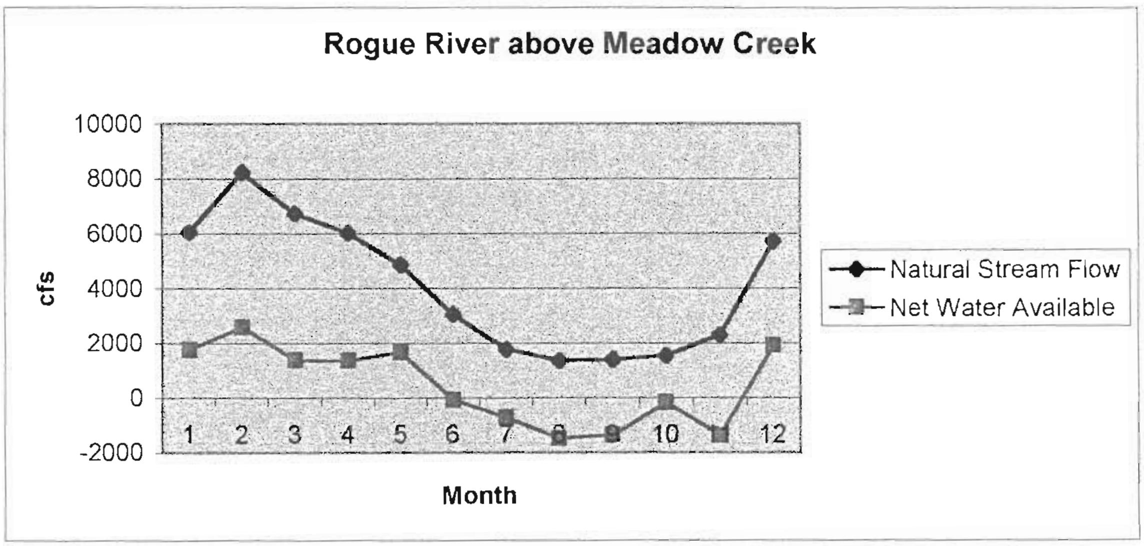

Figure A-1. Streamflow and Water Availability for the Rogue River above Meadow Creek

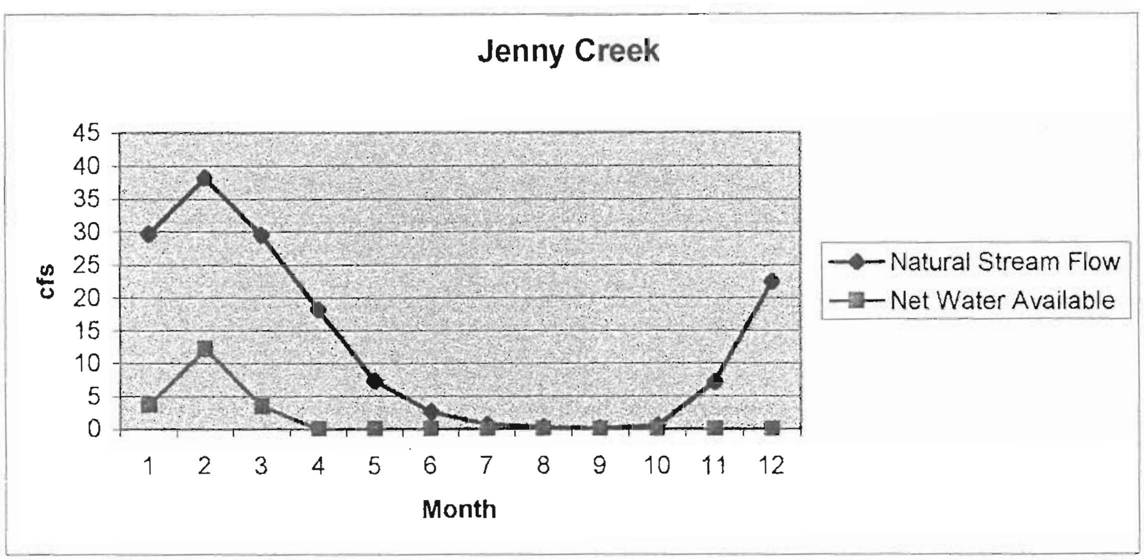

Figure A-2. Streamflow and Water Availability for Jenny Creek

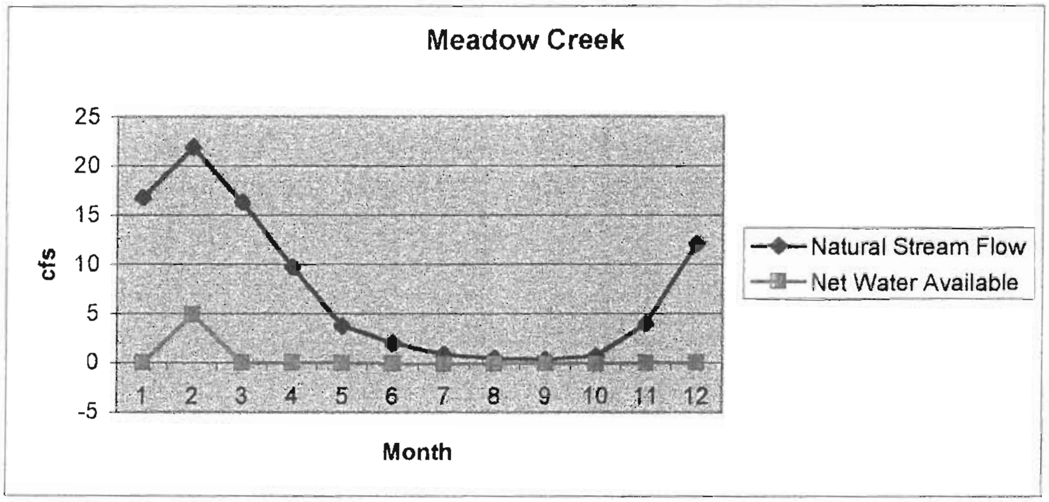

Figure A-3. Streamflow and Water Availability for Meadow Creek

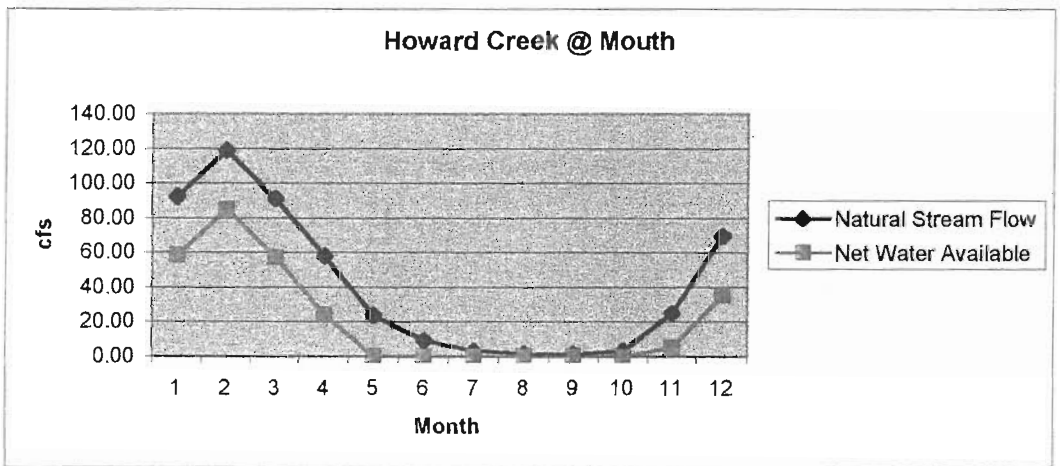

Figure A-4. Streamflow and Water Availability for Howard Creek

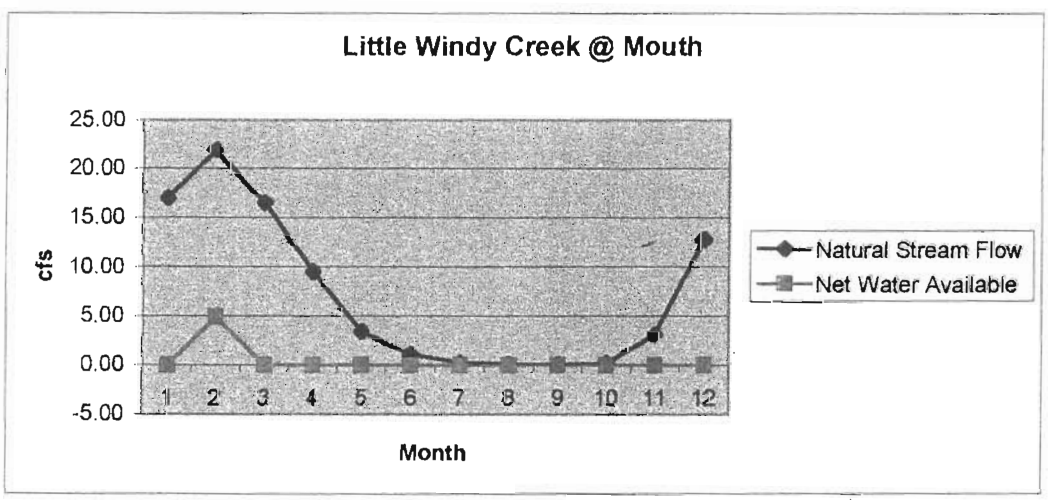

Figure A-5. Streamflow and Water Availability for Little Windy Creek

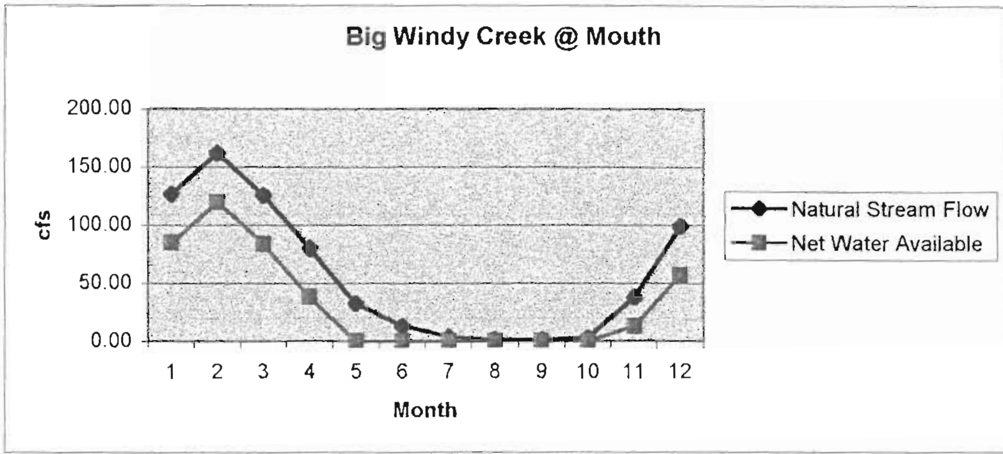

Figure A-6. Streamflow and Water Availability for Big Windy Creek

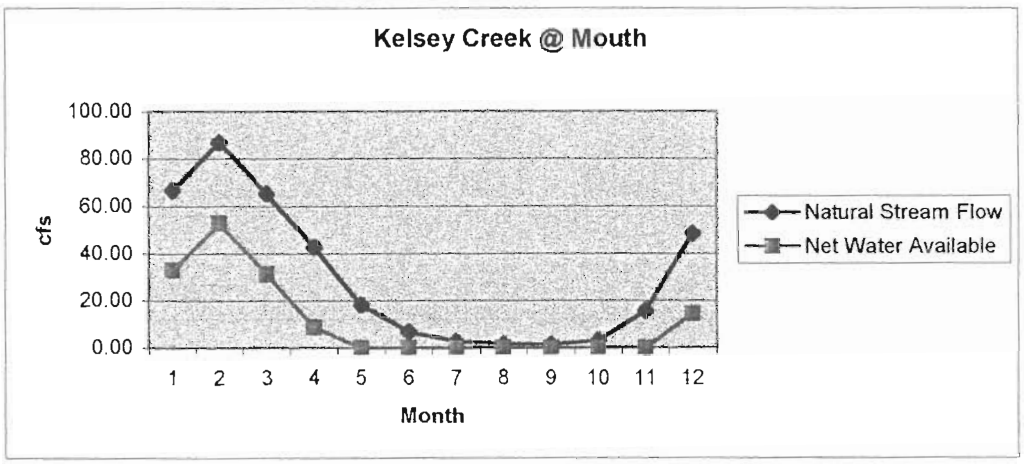

Figure A-7. Streamflow and Water Availability for Kelsey Creek

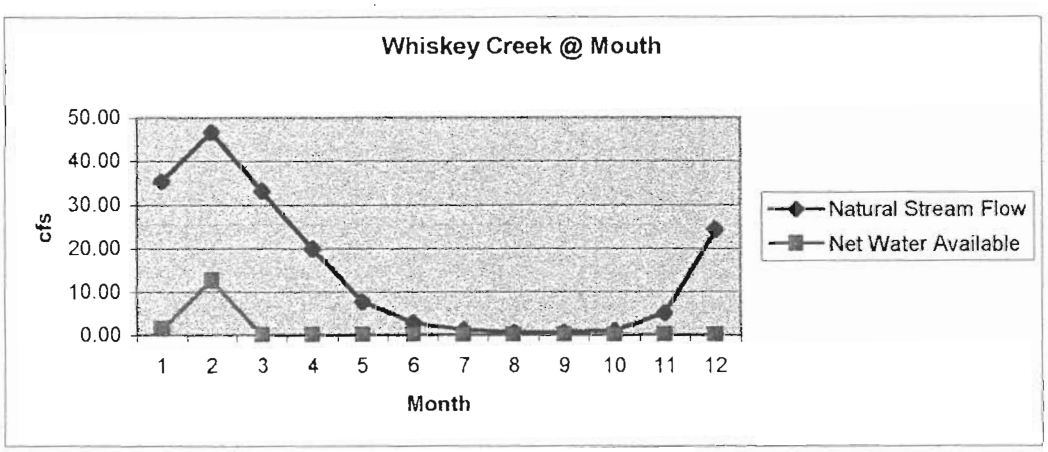

Figure A-8. Streamflow and Water Availability for Whiskey Creek

GRAVE CREEK WATER AVAILABILITY BASINS

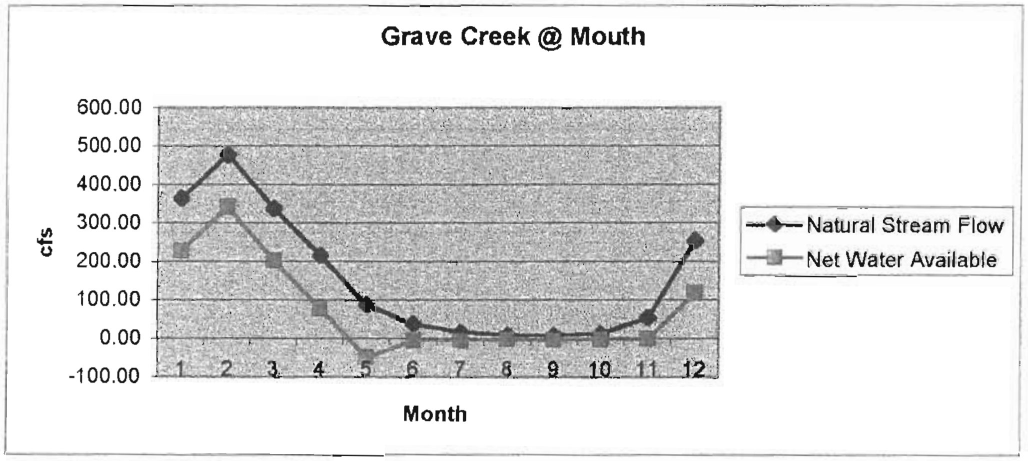

Figure A-9. Streamflow and Water Availability for Grave Creek @ Mouth

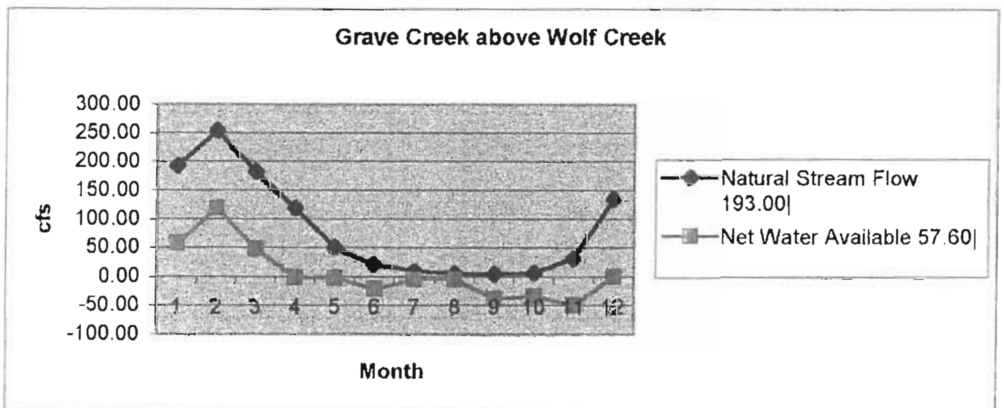

Figure A-10. Streamflow and Water Availability for Grave Creek above Wolf Creek

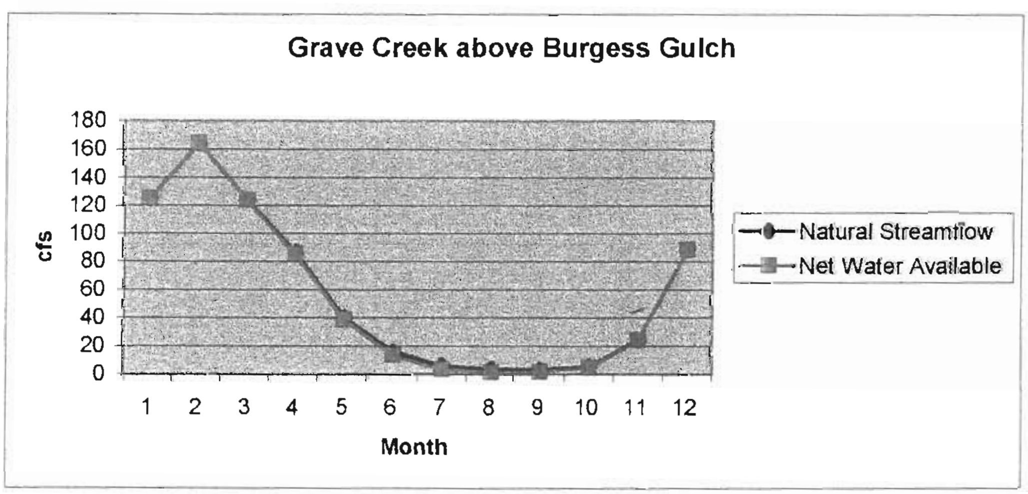

Figure A-11. Streamflow and Water Availability for Grave Creek above Burgess Gulch

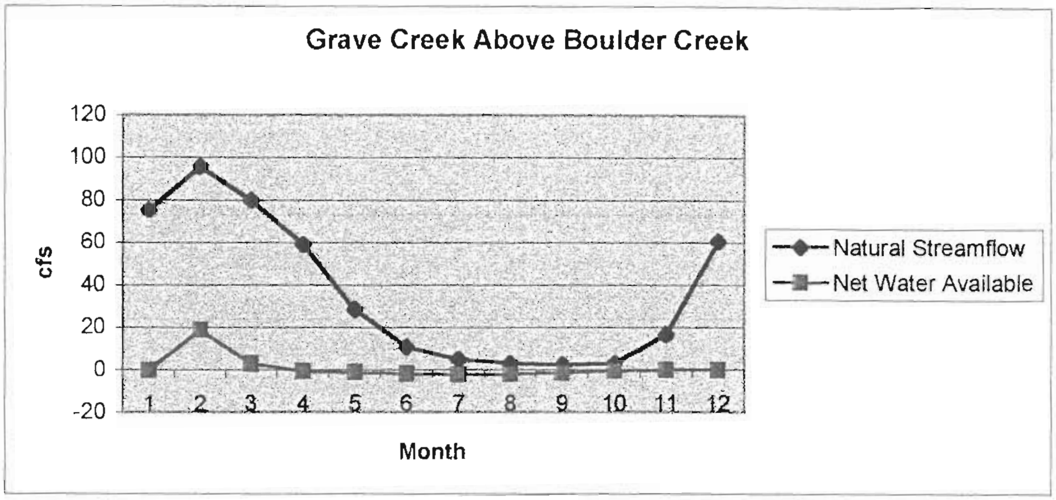

Figure A-12. Streamflow and Water Availability for Grave Creek above Boulder Creek

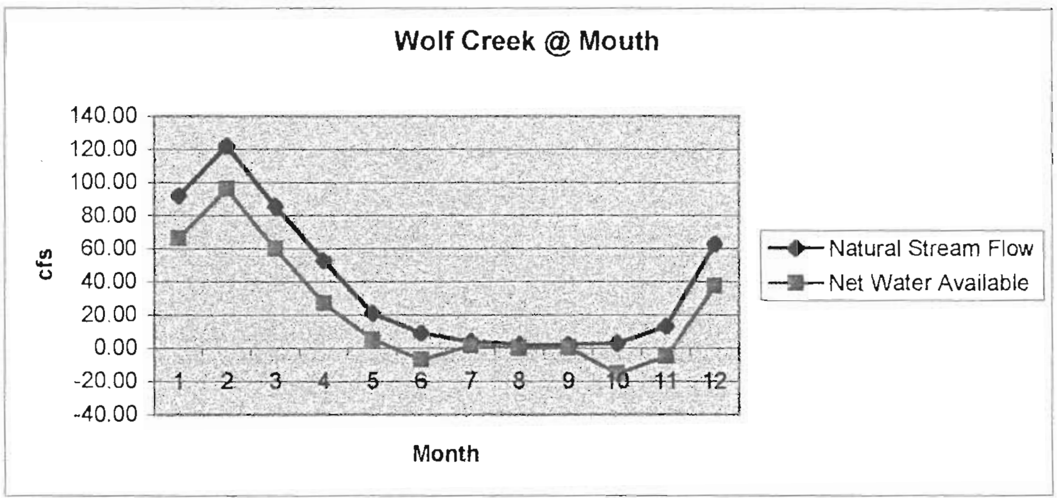

Figure A-13. Streamflow and Water Availability for Wolf Creek

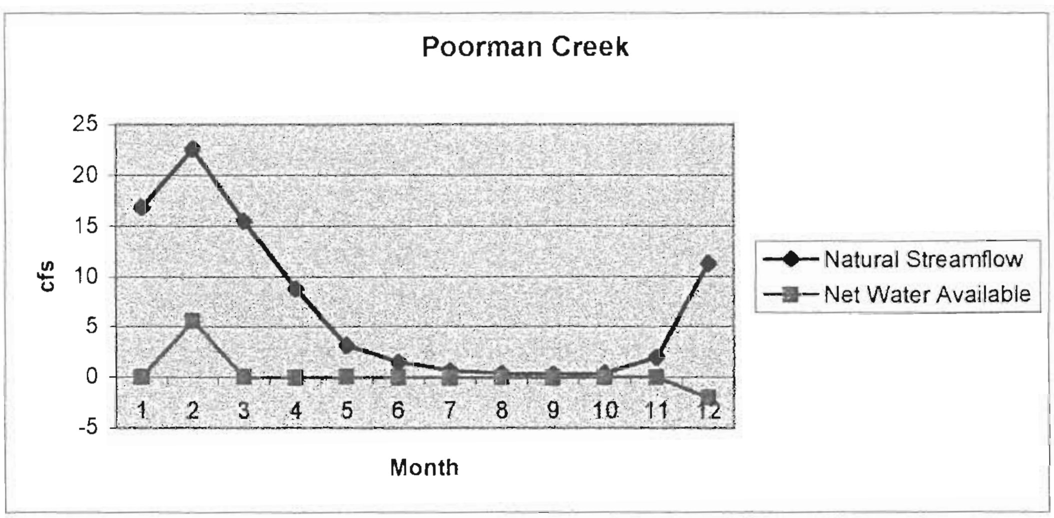

Figure A-14. Streamflow and Water Availability for Poorman Creek

Galice Water Availability Basins

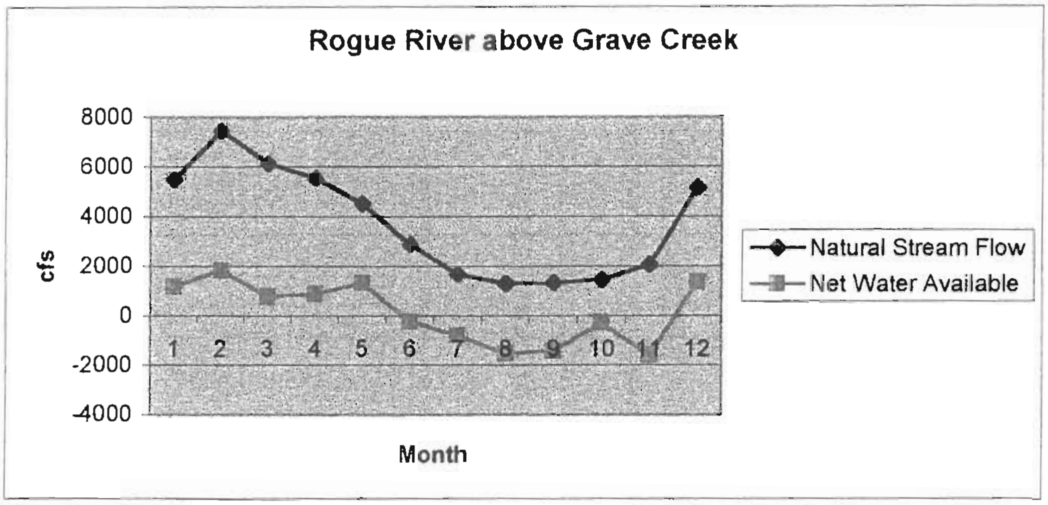

Figure A-15. Streamflow and Water Availability for Rogue River above Grave Creek

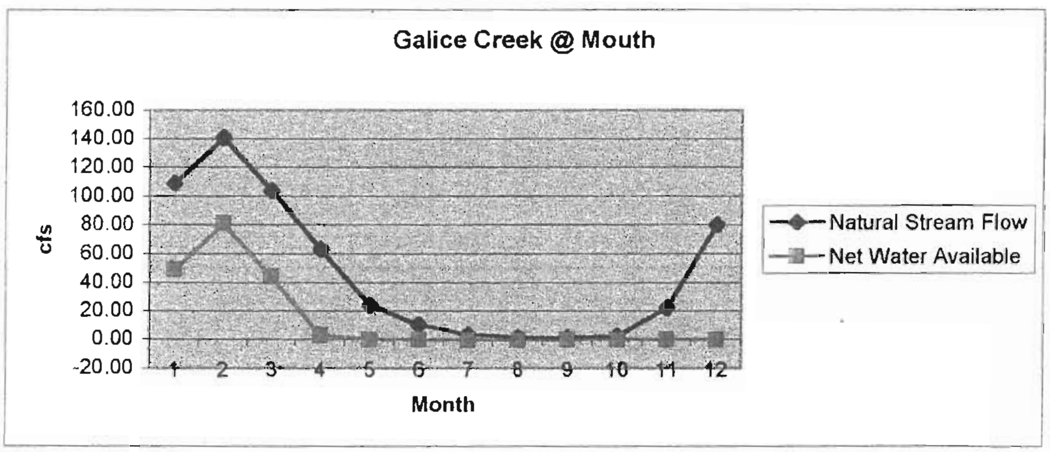

Figure A-16. Streamflow and Water Availability for Galice Creek

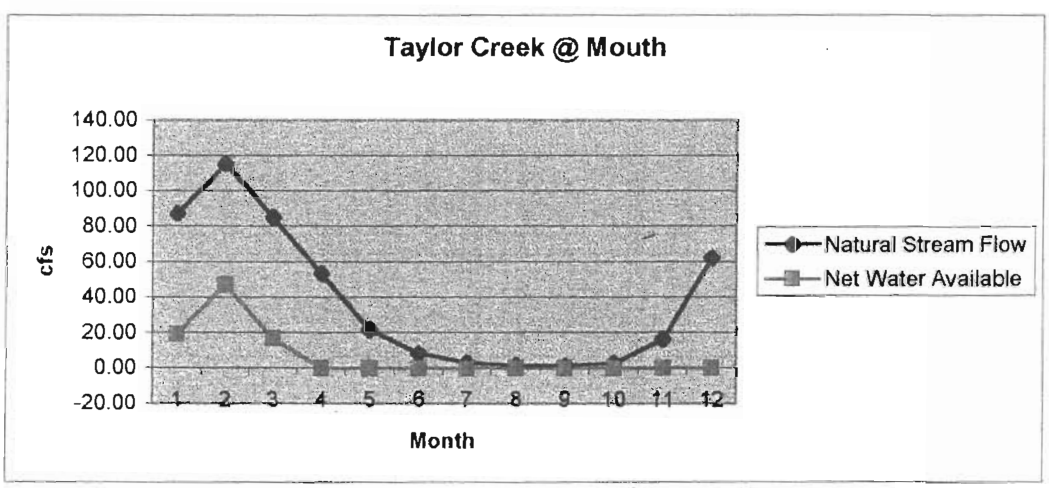

Figure A-17. Streamflow and Water Availability for Taylor Creek

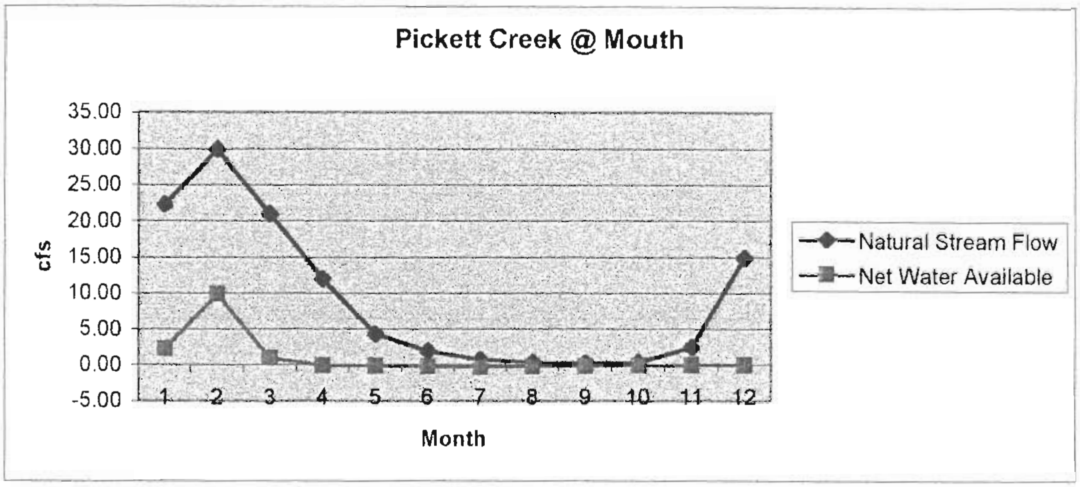

Figure A-18. Streamflow and Water Availability for Pickett Creek

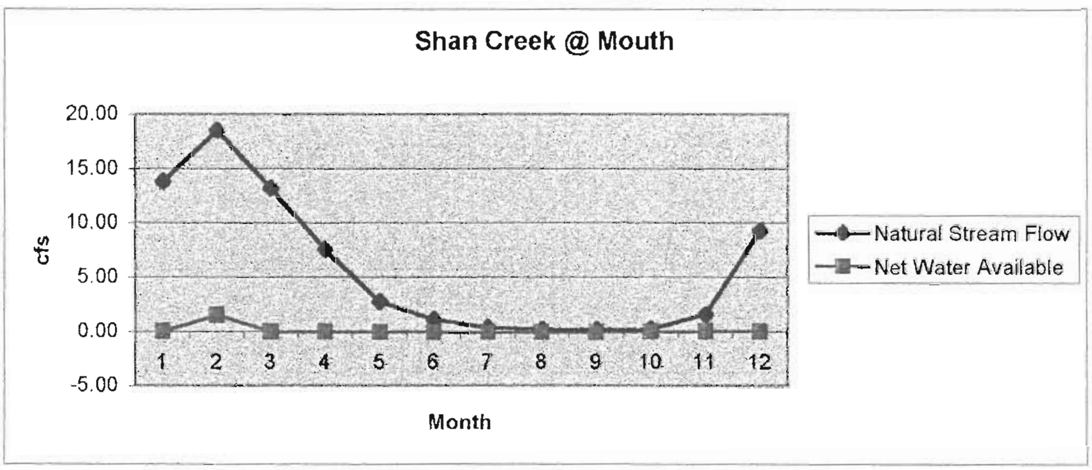

Figure A-19. Streamflow and Water Availability for Shan Creek

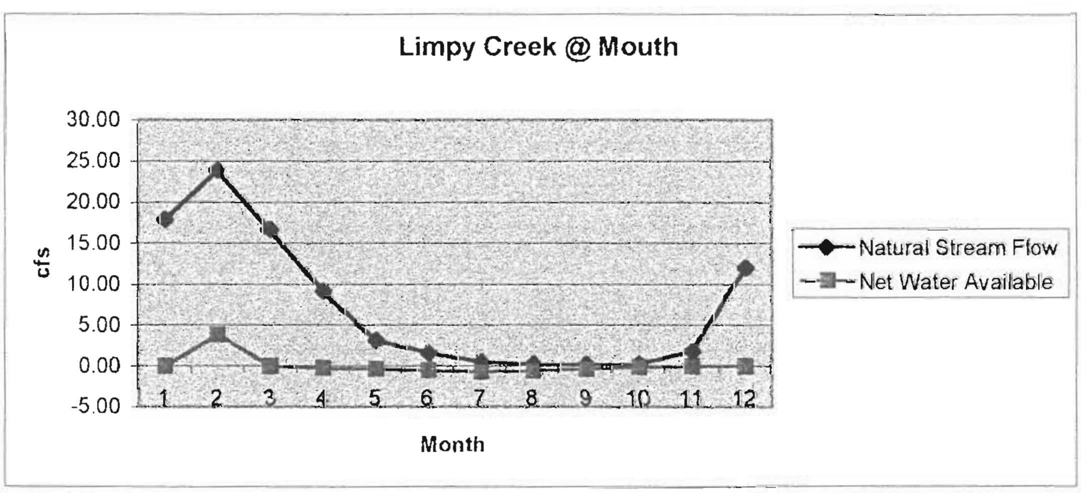

Figure A-20. Streamflow and Water Availability for Limpy Creek

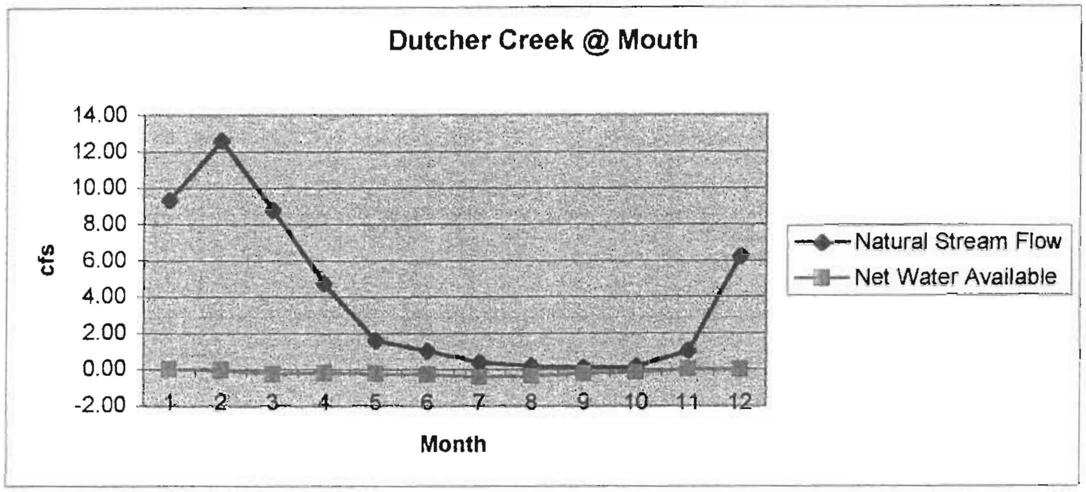

Figure A-21. Streamflow and Water Availability for Dutcher Creek

Jumpoff Joe Creek Water Availability Basins

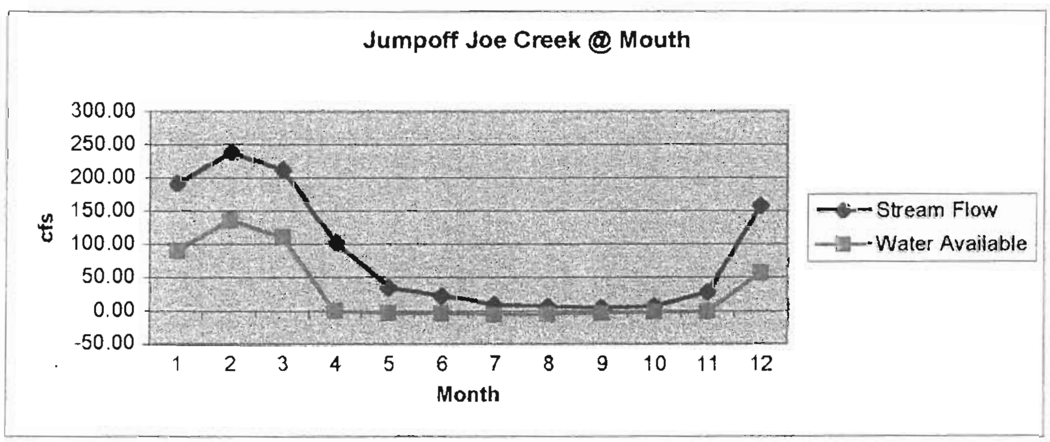

Figure A-22. Streamflow and Water Availability for Jumpoff Joe Creek @ Mouth

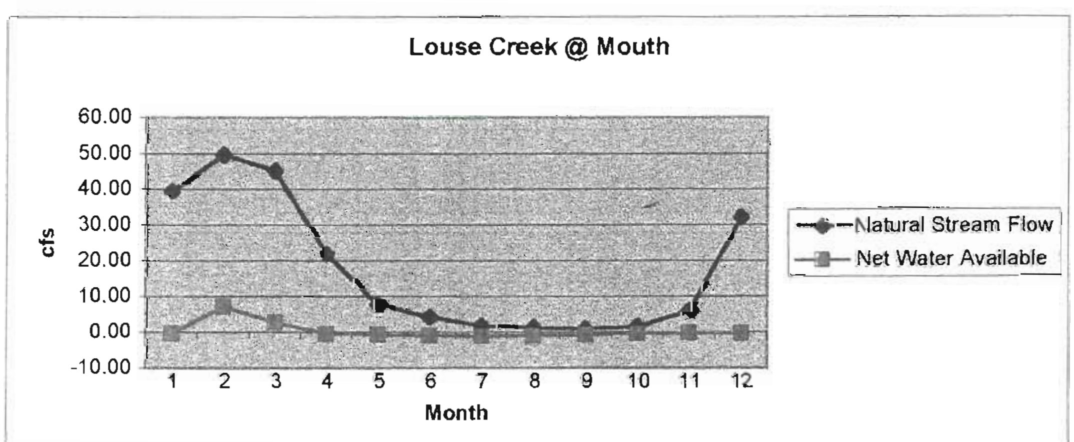

Figure A-23. Streamflow and Water Availability for Jumpoff Joe Creek above Louse Creek

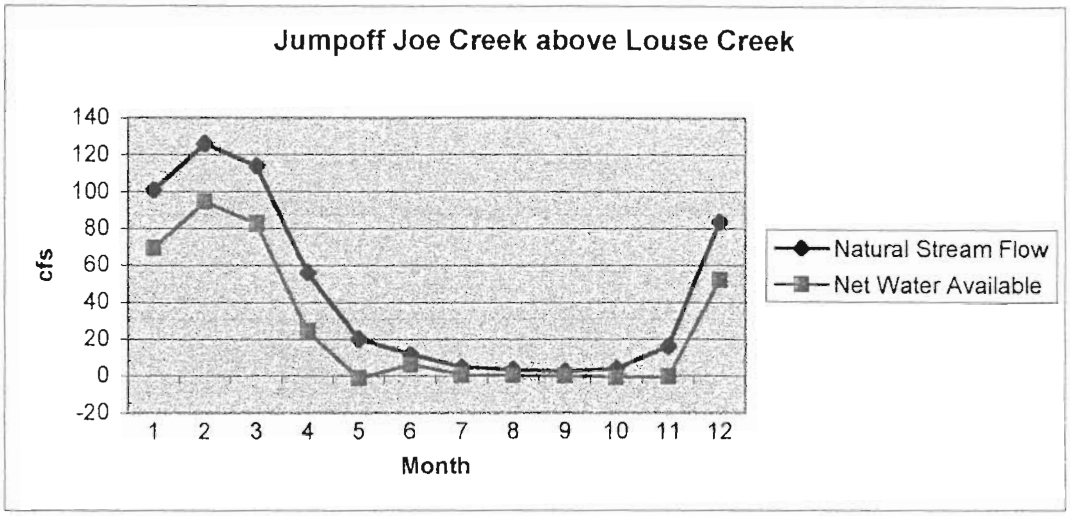

Figure A-24. Streamflow and Water Availability for Louse Creek @ Mouth

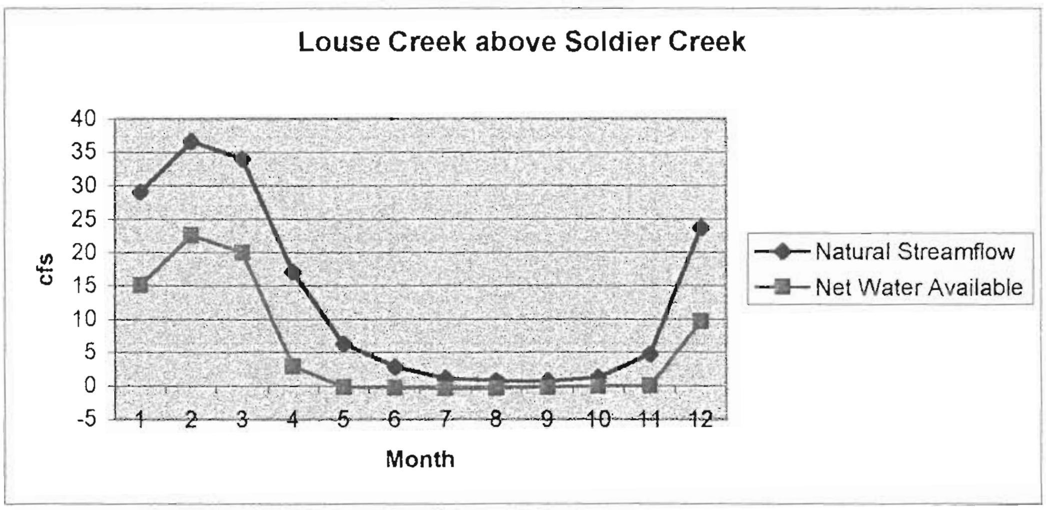

Figure A-25. Streamflow and Water Availability for Louse Creek above Soldier Creek

GRANTS PASS WATER AVAILABILITY BASINS

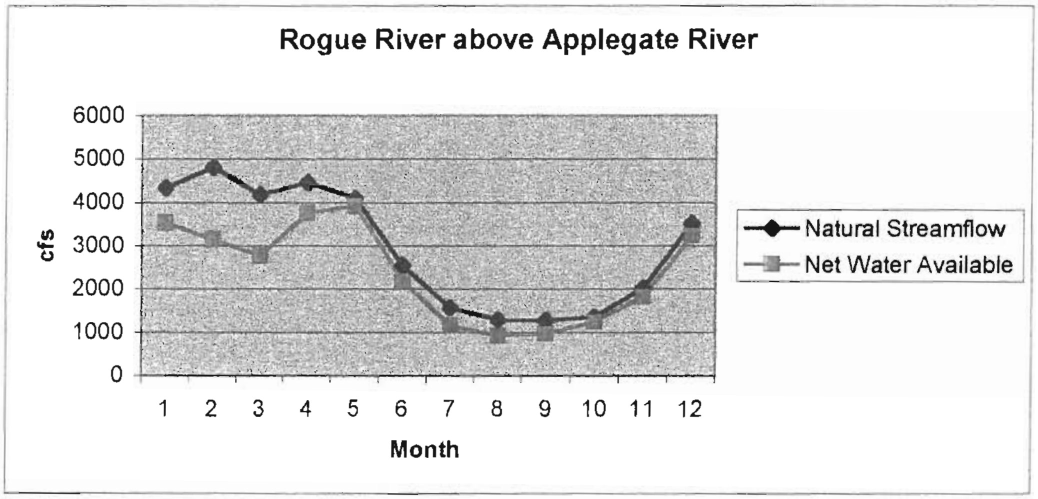

Figure A-26. Streamflow and Water Availability for Rogue River above Applegate River

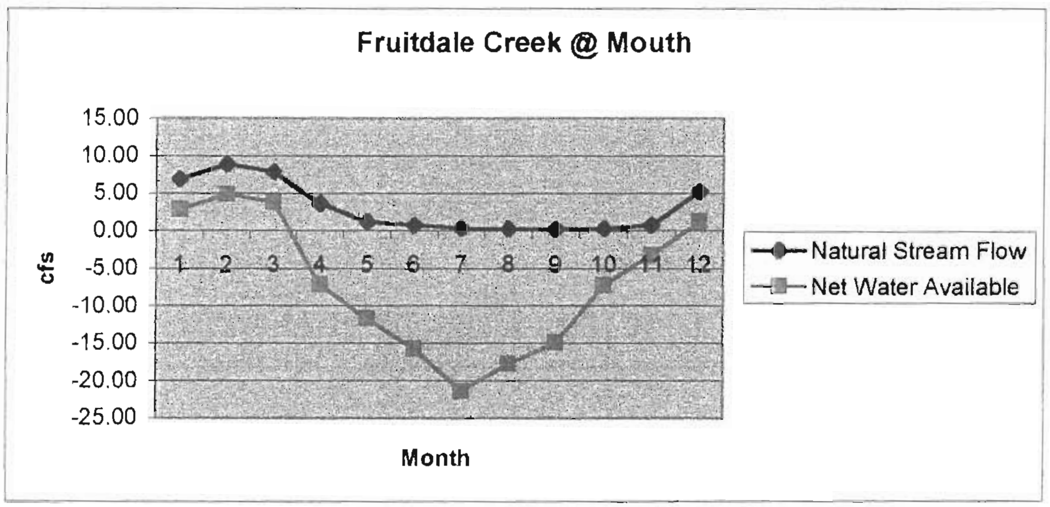

Figure A-27. Streamflow and Water Availability for Fruitdale Creek

GLOSSARY[1]

Term	Definition
Alevin	Newly hatched salmonids with the yolk sac still attached.
Anadromous	Fish that move from the sea to fresh water for reproduction.
Beneficial Uses	Uses of water specified in Oregon Water Quality Standards
Braiding	Branching of a stream into many channels.
Canopy Cover	The overhanging vegetation in a given area.
Channel Complexity	A term used in describing fish habitat. A complex channel contains a mixture of habitat types that provide areas with different velocity and depth for use by different fish life stages. A simple channel contains fairly uniform flow and few habitat types.
Channel Confinement	Ratio of bankfull channel width to width of modern floodplain. Modern floodplain is the flood-prone area and may correspond to the 100-year floodplain. Typically, channel confinement is a description of how much a channel can move within its valley before it is stopped by a hill slope or terrace.
Channel Gradient	The slope of the stream channel floor (or the water surface) with respect to the horizontal, measured in the direction of flow.
Channel Habitat Types (CHT)	Groups of stream channels with similar gradient, channel pattern, and confinement. Channels within a particular group are expected to respond similarly to changes in environmental factors that influence channel conditions. In this process, CHTs are used to organize information at a scale relevant to aquatic resources, and lead to identification of restoration opportunities.
Channel Pattern	Description of how a stream channel looks as it flows down its valley (for example, braided channel or meandering channel).
Connectivity	The physical connection between tributaries and the river, between surface water and groundwater, and between wetlands and these water sources.
Dissolved Oxygen	Oxygen present in water. Dissolved oxygen is absorbed by fish and other aquatic organisms through gills and membranes.
Downcutting	When a stream channel deepens over time.
Drainage Basin	A geographic and hydrologic subunit of a watershed.
E. Coli	The *Escherichia coli* bacterium is an indicator of human or animal feces.
Ecoregion	Land area with fairly similar geology, flora and fauna, and landscape characteristics that reflect a certain ecosystem type.
Elevation	The vertical reference of a site location above a mean sea level, measured in feet or meters.
Evaporation	As water is heated by the sun, its surface molecules become sufficiently energized to break free of the attractive force binding them together; they evaporate and rise as invisible vapor in the atmosphere.

[1] Most definitions from Watershed Professionals Network, Oregon Watershed Assessment Manual, 1999.

Evapotranspiration	The amount of water leaving to the atmosphere through both evaporation and transpiration.
Exceedance	When a measure of water quality exceeds the criteria. The exceedance needs to be evaluated with respect to natural or human causes.
Fecal Coliform	Bacteria group used as an indicator of human or animal feces.
Fingerling	
Floodplain	The flat area adjoining a river channel constructed by the river in the present climate, and overflowed at times of high river flow.
Floodplain: 100-Year	That area adjacent to the channel that has a 1 in 100 chance of being flooded in any given year.
Fry	The early life stage of salmon and trout after the yolk sac is absorbed
Gradient	Channel gradient is the slope of the channel bed along a line connecting the deepest points (thalweg) of the channel.
Hydrologic Unit Codes (HUCs)	US Geological Survey designations that correspond to specific watersheds, and are expressed in a hierarchical scale.
Hydrology	The science of the behavior of water from the atmosphere into the soil.
Impervious Surface	Surface (such as pavement) that does not allow, or greatly decreases, the amount of infiltration of precipitation into the ground.
Infiltration	The rate of movement of water from the atmosphere into the soil.
Juvenile	The early life stage of salmon and trout, usually the first and second years.
Life Stage (Fish Life Stage)	A part of a fish's life cycle, with identifiable habitat requirements associated with it; for example, summer rearing, spawning, and juvenile outmigration to ocean waters.
Mass Wasting	Downslope transport of soil and rocks due to gravitational stress.
Meandering	When a stream channel moves laterally across its valley.
Nonpoint Source Pollution	Sources of pollution from diffuse sources such as storm runoff from farming, logging, and roads.
Parr	
Peak Flow	The maximum instantaneous rate of flow during a storm or other period of time.
pH	A measure of the relative acidity or alkalinity of water.
Precipitation	The liquid equivalent (inches) of rainfall, snow, sleet, or hail collected by storage gages.
Rain-On-Snow (Event)	When snowpacks are melted by warm rains, causing peak flow events.
Redd	The salmonid gravel nest.
Riparian Area(S)	Areas bordering streams and rivers.
Riparian Zone(S)	An administratively defined distance from the water's edge that can include riparian plant communities and upland plant communities. Alternatively, an area surrounding a stream, in which ecosystem processes are within the influence of stream processes.
Salmonid	Fish of the family *Salmonidae*, including salmon, trout, char, whitefish, ciscoes, and grayling. Generally, the term refers mostly to salmon, trout, and char.

Smolt	
Stream Density	Total length of natural stream channels in a given area, expressed as miles of stream channel per square mile of area.
Stream Segment	Contiguous stream reaches that possess similar stream gradient and confinement, and which can be used for analysis.
Surface Runoff	Water that runs across the top of the land without infiltrating the soil.
Transpiration	Loss of water to the atmosphere from living plants.
Turbidity	An optical measure of the murkiness of water. An indirect measure of suspended sediment in water.