AQUATIC ECOSYSTEM NARRATIVE

Geology

Lower Rogue River

The Rogue River, from headwaters to mouth, crosses three geologic provinces and millions of years in geologic time. Its origin is in the volcanic highlands of the Cascades Province, relatively young volcanic rocks of 38 to 9 million years for the Western Cascades, with historically recent episodes of volcanism recorded in the High Cascades. The Rogue River and its major tributary the Illinois River traverse the Klamath Geologic Province, an accretion of ancient (approximately 200 million to 65 million years old) metamorphosed volcanic and sedimentary rocks that extend from northern California through southwestern Oregon. The river skirts rocks of the Coast Range (approximately 60 million years old) near Agness, but turns again to run through rocks of the Klamath Province until it reaches Gold Beach.

The Rogue River basin between Agness and the mouth of the river lies entirely within rocks of the Klamath Geologic Province, all of which have undergone some degree of tectonic deformation, alteration, and episodes of granitic intrusions. The Klamath Province extends from northern California through southwestern Oregon and consists of late Jurassic to early Cretaceous-aged arcuate belts of rocks that bend convexly to the west and trend roughly north. The oldest rocks are in the eastern portion of the river basin, with progressively younger rocks to the west. The rock formations were formed in a marine environment as part of a continental margin or volcanic island archipelago, which collided with and was accreted to the continent by the process of subduction (Orr, 1992). Portions of oceanic floor, including what are interpreted as upper mantle material (ophiolite suite) were also accreted to the continent (Mason, 1977). Heat generated during these tectonic processes melted portions of both oceanic and continental material, which were subsequently intruded into faulted and fractured zones as igneous sills and dikes.

The Rogue River is an antecedent stream. It possessed enough erosive power to cut a relatively direct western course through bedrock as tectonic processes were uplifting the Klamath Geologic Province and hindering passage between the Cascades and the ocean. During this time, the rock formations experienced intensive folding and faulting that are part of the accretionary process in an active subduction zone. East-dipping faults thrust older rocks over the younger rocks. These rocks were subsequently offset by north-south trending normal faults and shear zones, followed by northwest trending high angle faults. In the analysis area, this structural displacement is especially evident between the confluence of the Illinois River and the mouth of Bradford Creek. The Mountain Wells and Coquille River Faults are both extensive major faults in the area. North-south trending faults are reflected in the geology and topography of the analysis area (see Map 6, Slope Classes and Map 7, Geology).

Although even major faults appear as narrow lines on regional geologic maps, in actuality a fault trace is most often a zone of sheared and altered rock up to one mile wide. Serpentine and landslides are commonly associated with the fault zones, making geologic mapping even more complex and difficult. Proximity to fault zones increases the amount of groundwater (perched water tables, springs), and reduces the strength of already weakened, sheared bedrock by increasing the degree of alteration and weathering in the underlying rocks. Mass wasting, soil creep and stream bank instability are common within shear zones in the watershed area. The faults also strongly influence stream course and gradient, especially where rock types of different hardness are juxtaposed. Sharp and unlikely stream bends and meanders can often be traced to fault offset.

The terrain through which the river travels between Agness and the Pacific Ocean reflects the underlying rock types and tectonic history. More easily eroded rocks in the area such as mudstone and serpentine erode into rounded hills, while harder, more resistant rocks such as metamorphosed volcanic rocks form sharp ridges, knobs, and peaks that overlook the river valley.

Lithology, Soils and Slope Stability

Formations of the Western Jurassic Belt are exposed in the watershed analysis area and provide a representative slice of the complex terrane that is the Klamath Geologic Province. The following section outlines a brief description of the rock types, typical soils that are derived from the different rock types, and a general slope stability description. Geologic maps for the analysis area were compiled by using DOGAMI geologic maps, mapping done during previous studies done in the area, and aerial photo interpretation. Some, but not all of maps are entered into the Geographic Information System (GIS) database. They are not included in the Watershed Analysis document but can be viewed in District geology files. Slope stability mapping was done using a combination of contracted map analysis and aerial photos from flights in 1997 and 1986 with spot-checking of photos from 1969. The map included in the document was compiled by US Geologic Survey in 1991 and is part of the Forest GIS database.

Quaternary unconsolidated alluvium, colluvium and fluvial deposits (Qus): Geologically recent alluvial, terrace and landslide deposits consist of unconsolidated sand, silt and gravels deposited by water or erosional processes. Mineralogy is dependent on the source material. There are substantial terrace and streambed deposits along the flood plain of the Rogue River and some tributary streams where lower gradients have allowed deposition of material. These reaches of lower gradient can often be traced to lithologic (rock type) or structural influence (faults or folds), or to accumulations of landslide debris.

Humans have long used the terraces in the watershed area for settlements, pasture, and agriculture. Soil development tends to be minimal and droughty on these deposits. Deeper, productive soils have developed on several of the higher and more ancient terraces, possibly accelerated by organic material from crops and livestock. However, because of position on the lower slope and poor consolidation, alluvial deposits are prone to stability problems caused by undercutting from streams, roads or building sites. Surface erosion and landslides can also be triggered by groundwater saturation or by concentrating surface water runoff.

The larger landslide deposits in the area are generally within less resistant rock type with finer-grained soils. The deposits are often hummocky or benchy landforms with deep, clay-rich soils. Large slump/earthflow forms and deposits were mapped in the drainages of Bill Moore, Sundown, Stonehouse and Painted Rock Creeks.

Cretaceous marine sedimentary rocks (KJm): There are two formations in the Cretaceous Myrtle Group exposed in the analysis area; the Humbug and Rocky Point Formations. The Humbug group consists of coarse conglomerates and sandstones with some mud and siltstone, while the Rocky Point Formation contains more fine-grained sand, silt and mudstone. The majority of the Humbug and Rocky Point exposures occur north of the analysis area. Within the watershed, they are associated with major faulted areas, so they are highly sheared and difficult to differentiate.

Soils developed on the Humbug Formation are coarse-grained, have shallow to moderate depth, and are free draining to the point of being somewhat droughty. Surface ravel and shallow debris slides are the most common forms of erosion. Rocky Point soils are generally deeper and more fine-grained. They tend to be more poorly drained, are also subject to ravel and prone to debris slides especially in areas of increased groundwater. Inner gorges within the Rocky Point are often very unstable.

Jurassic Dothan and Otter Point Formations (Jop, KJds, KJdv): Metamorphosed sedimentary and volcanic rocks of late Jurassic age cover large areas of Curry County and the analysis area west from near Kimball Hill. In the eastern part of the County, the rocks are mapped as the Dothan Formation, thin to thickly bedded marine sedimentary rocks (KJds) with minor amounts of deep water chert and volcanic pillow basalts and breccias (KJdv). The Otter Point Formation (Jop) mapped in the western part of the analysis area is similar in composition and age to the Dothan, but contains more finer-grained, thinly bedded meta-sedimentary units, more volcanic inclusions and is more pervasively sheared. It is mapped as a 'mélange', the French word for mixture. A mélange is defined as a complex association of varied rock types of diverse origin, highly sheared, with intermixed serpentine and blue schist, and commonly associated with subduction or overthrust zones (Raymond, 1984). It can be difficult to differentiate between the Dothan and Otter Point formations in the field unless shearing or lithologies are exposed over large sections. Rocks of the Otter Point Formation, including sheared serpentinite zones, are well exposed at the mouth of the Rogue River in Wedderburn.

Terrain within the Dothan Formation varies according to underlying rock type: fine-grained siltstones and mudstones form rolling hills with low relief; coarser-grained sandstone and greywacke form steeper, rocky ridges; volcanic units or inclusions form knobs and cliffs or rock outcrops. Sheared mudstones, siltstones and serpentine also form rolling hills and prairies in terrain underlain by Otter Point Formation. In both formations, soils derived from coarser-grained rock types, such as sandstone or conglomerate, are of a more medium depth, sandy and well drained. Soils derived from fine-grained rocks tend to be deep, silty or clayey in texture, and are poorly drained. Volcanic units form shallow, rocky soils.

Slope instability is most pronounced in the highly sheared, fine-grained metasedimentary units of the Otter Point Formation, especially where slopes are saturated and/or undercut by streams, as in inner stream gorges, or in areas affected by roads, construction, or ocean waves. In coarser-grained units, road building activity and logging appear to increase the number of small landslides, ravel and surface erosion on steep slopes, and debris flows associated with road failures. Faulted and sheared zones, which are areas of groundwater concentration, deeper soils, and fractured, weakened bedrock, are often areas of decreased slope stability.

Jurassic Colebrooke Schist (Jc): The Late Jurassic Colebrooke Formation includes metamorphic rocks derived primarily from fine-grained marine sedimentary rocks and submarine basalts, with some metasandstones and chert. Probable sources were the older Galice or Rogue Formations, located east of the analysis area. The predominant rock type in the Colebrooke is a tightly folded, silver-gray, fine-grained schist or phyllite. White chert seams and fracture filling are common. Weathered clasts of phyllite appear as flat, shiny coins in the creek beds and gravel bars.

Colebrooke terrain is typically rolling and benchy, interspersed with knobs and rocky outcrops where volcanic units are exposed. Large chert 'knockers' often form resistant knobs within bowls of more easily eroded schist or phyllite. Streams are typically deeply incised within inner gorges. Soils developed on steep ridges and oversteepened stream banks are shallow and fine-grained with abundant quartz clasts. More typically, the Colebrooke forms deep, dark gray residual and colluvial soils, also with abundant quartz clasts. On stable benches, weathering has developed red, iron-rich lateritic soils. Drainage characteristics of the soils range from well- to poorly-drained, often depending on slope configuration.

Within the analysis area, the most extensive form of erosional processes occurs in terrain underlain by Colebrooke Schist. The relatively rapid tectonic uplift rate of four to five millimeters per year measured on the coast of southwestern Oregon contributes to continuous down cutting by streams. This tectonic uplift and stream down cutting, plus pervasively sheared, faulted, and deeply weathered bedrock have combined to produce large areas of instability. The activity on many of these may date back to glacial periods. The fine-grained, cohesive soils derived from schist and phyllites commonly fail as deep-seated slump-earthflows. The earthflow features often encompass entire watersheds, although activity levels on individual lobes and benches can vary from ancient inactive, to recent and very active. Most commonly, however, the failure exhibits a steady creeping and slumping of material down slope. Incised margins and the toes of the landslide deposits often fail as shallow debris slides. Two very large, recent debris failures associated with basin-wide slump/earthflows occurred in Bridge and Bill Moore Creeks (the Moorsky slide) as recently as the winter of 1996-97.

Ultramafic rocks (Ju): In the analysis area, serpentinites occur along faults and zones of shearing that occur in conjunction with major faulting or within ophiolitic mélanges such as the Otter Point Formation and the near-by Josephine ophiolite sheet. Landforms underlain by serpentine are often gentle and rolling. Where oversteepened by road cuts or stream cutting they can fail as debris slides, and oversteepened stream banks are often unstable. Streambeds can become wide and aggraded, both from the ease with which streams erode the side slopes, and from the large amounts of landslide debris generated by the bank instability. Because the soils developed on ultramafic rocks are relatively unproductive and poorly vegetated, landslides often continue to fail and ravel, becoming chronic sources of sediment. In areas of deeper soil development, often created along fault traces, deeper-seated slump/earthflows can occur.

Soils developed on ultramafic rock are generally less productive than other soils in the area. They have reduced levels of calcium and elevated levels of magnesium, nickel and chromium that are toxic to most vegetation. Vegetation is often sparse and stunted. Many of the prairies in the analysis area are underlain by serpentinite bedrock. Where parent material is mixed, or fault or shear zones have accelerated weathering and concentrated groundwater, deeper, more productive soils can develop. Soils are prone to surface erosion as sheet wash and gully formation, or ravel on rocky, steep slopes. Long-term compaction can occur with use of heavy equipment.

Geologic Structure

There are three major mapped faults in the analysis area. Although the faults appear on geologic maps as well defined lineations, in actuality they represent wide shear zones that may contain slices of different rock types, other associated faults, and areas of fractured and contorted bedrock. Some of the earliest tectonic activity is represented by a thrust fault that emplaced older Colebrooke schist over rocks of the younger Otter Point formation west of the mouth of Lobster Creek. The Mountain Wells and Coquille River Faults are younger, high-angle, north-trending faults. Bradford Creek follows a trace of the Mountain Wells Fault, and the Coquille River Fault has been mapped near Copper Canyon. Sheared serpentine has been emplaced in most of the major fault zones. Although most have not been mapped, numerous other faults can be traced in the area, either by changes in rock type or distinct lineations that can be seen on aerial photos.

The significance of faulting can be seen in the geomorphologic expression of the area. Streams such as Bradford, Morris Rogers and Slide Creeks follow traces of high-angle faults; the course of Tom East Creek is influenced by a thrust fault between Dothan and Colebrooke rock types. Fault activity, and the weakening of the bedrock plus concentration of groundwater that occurs in fault zones, have contributed to increased landslide activity in these drainages. The mainstem Rogue River changes direction and has sharp meanders where faults and shear zones juxtapose rock types of different hardness, for example at Copper Canyon and near the mouth of Wakeup Rilea Creek. The hard, prominent ridge that has created the rocky gorge of Copper Canyon is a fault-bounded block of metamorphosed volcanic rock within the Colebrooke Formation that has weathered to the reddish-brown, coppery color that gives the canyon its name.

Within faulted zones, rocks are more sheared and fractured and more deeply weathered. Ground water tends to be more concentrated in these areas, and soils are deeper. Streams are often more deeply incised into the weaker, sheared rock. Slope instability is a natural outcome of the above conditions, and it is not surprising that landslides are a common and natural occurrence within the analysis area.

Management Opportunities: Complete transfer of DOGAMI Geology maps into GIS geology layer.

Subwatershed Descriptions

See also channel morphology descriptions on pages 25-29.

Tom Fry Creek: The headwaters of Tom Fry Creek are in Cretaceous sedimentary rocks. A fault zone cuts the drainage; the lower two-thirds of the drainage is underlain by serpentine. Jones and Ferrero mapped numerous active debris slides and ravel slopes in the headwaters of the west fork that were apparently related to timber harvest and road building activity. The stream adjacent slopes exhibit both stream bank instability and rock outcrops. In the lower watershed, above the 3300250 crossing, the stream has incised steep, raveling bluffs into serpentine.

Nail Keg Creek: The headwaters of Nail Keg Creek are pervasively faulted and sheared, containing slivers of serpentine, Cretaceous sedimentary rocks, and a high grade, slaty metasedimentary rock that may be gradational between Jurassic Galice and Colebrooke schists (Ferrero, 1991). Large slide scarps and cracks, hummocks and benches characterize this area, as well as sag ponds and wet areas, steep inner gorges and numerous leaning trees. Both small debris slides and larger slump/earthflows were mapped in the area (Jones and Ferrero, 1990).

Management Opportunities: Road systems in the headwaters of this drainage should be evaluated for stability concerns and possible decommissioning or storm proofing.

Wakeup Rilea Creek: Wakeup Rilea drainage is underlain by Colebrooke schist, and bounded on the southeast by Wildhorse Ridge, which is made up of a harder, and more resistant volcanic unit within the Colebrooke. Much of the drainage can be characterized as a slump/earthflow terrain with a series of scarps, benches, and sag ponds. Several earthflow lobes appeared active on aerial photo investigation. Debris slides and raveling slopes are common where the larger slump/earthflow deposits toe out and offset the stream channel. The stream appears aggraded on aerial photo review.

Management Opportunities: Conduct more intensive mapping, activity rating and hazard analysis of the landslides in this drainage, and review roads in the upper drainage for stability concerns and possible decommissioning or storm proofing.

Bradford Creek: Bradford Creek follows the trace of the Mountain Wells Fault zone, which divides the drainage between Colebrooke Schist on the east and west, with rocks of the Dothan Formation in the center. Volcanic units within the Colebrooke underlie the rocky, resistant ridges that define the watershed divides. Debris slides are common off steep slopes in the headwalls. Older failures may be related to bedrock fractured and weathered from faulting, or a possible stand-replacing wildfire. Recent landslides in the upper drainage, however, appear to be related to harvest activity, especially where roads have undercut unstable slopes. Streams appear aggraded on air photo review. See Bradford Creek Watershed Analysis for more detail.

***Management Opportunities*:** Evaluate roads in the upper drainage for stability concerns and possible decommissioning or storm proofing.

Jim Hunt Creek: The headwaters of Jim Hunt Creek are underlain by Colebrooke schist that has been thrust over younger rocks of the Otter Point mélange. Within the mélange terrane, volcanic units form ridges and buttes, with more gentle slopes underlain by fine-grained, pervasively sheared metasedimentary rocks and serpentine. Debris slides are common within the creek's steep, inner gorge. Both the metasedimentary rocks and serpentine produce fine-grained soils that are prone to gully erosion.

Kimball Creek: Similar to the geologic structure of Jim Hunt Creek, the lower portion of Kimball Creek watershed is underlain by Otter Point metasedimentary rocks, in fault contact with Colebrooke schist found in part of the headwaters. The trace of the thrust fault is a zone of sheared and fractured rock within the already pervasively sheared and convoluted rock that characterizes the Otter Point mélange. Erosional processes include deep-seated slumps or slump/earthflows, and shallow debris slides. Rounded ridge tops are often underlain by capstones of more resistant conglomerates. Many of the meadows in the area are a result of the shallow, droughty soils derived from this rock type. The ridges are scalloped by steep, arcuate headwalls of ancient slides, with some more recent debris slides within the headwalls. In many areas, mudstone underlies the conglomerates. Flat benches of slump deposits have deep, poorly consolidated soils that exhibit deep gully formation. Wet, swampy areas and small sag ponds are present on some benches. Numerous debris slides can be mapped below benches where streams have undercut slopes. Inner gorges are deeply incised and unstable.

Management Opportunities: Although many of the landslide headwalls within the drainage are ancient and inactive, an area in Section 7 near Kimball Hill shows active instability and should be designated as unsuitable for timber management (TML). It may have potential as an interpretive site to demonstrate geologic and mass-wasting interactions.

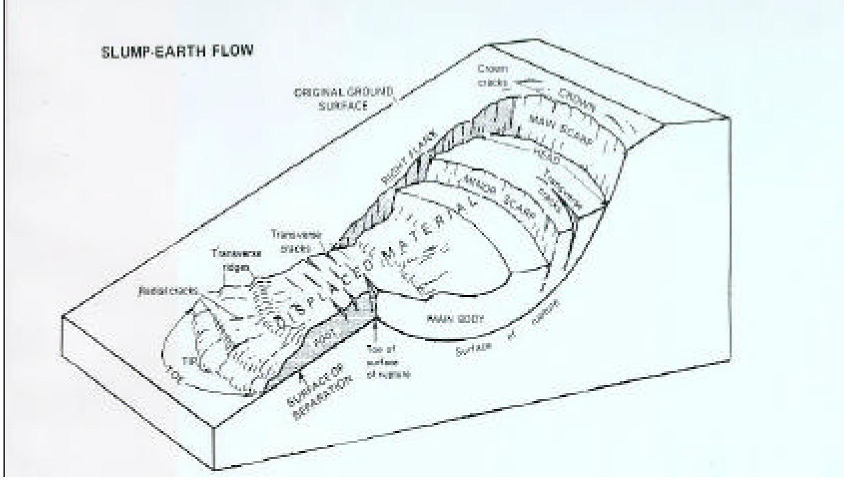
Bill Moore Creek: The entire Bill Moore Creek drainage basin was mapped in 1984 as a large slump/earthflow complex containing ancient to recent landslide features (Schlicker, 1984). Mica schist, phyllite, fractured quartz inclusions and pods of in-faulted serpentine underlie the area. Bedrock is highly sheared, deformed, and deeply weathered into moderate to deep clay-rich soils. Schlicker divided the basin into distinct areas: upper and side areas of steep slopes (head and lateral scarps of ancient slides), middle areas of flatter slopes (slump benches), and lower areas of steep slopes and active landslides (secondary scarps and/or terminal slide deposits). The lateral margins of the ancient slide are composed of more resistant rock within the Colebrooke. They affect the movement of the earthflow complex by acting as buttresses on the lower slide masses, and by protecting the toe of the deposit from erosion and undercutting by the Rogue River. Bill Moore Creek and its tributaries are actively downcutting through the weathered bedrock and slide deposits, creating steep, unstable inner gorges.

Monitoring using survey stake transects was implemented from 1984 through 1990 to help determine effects of harvest activities on large, deep-seated earthflows. Transects were located below a proposed harvest unit and road on an area ranked ancient, inactive. Average movement noted after five to six years of monitoring suggested a very slow, but steady movement of soil down slope. Within such a large earthflow complex, however, it is difficult to predict exactly where the next catastrophic failure will occur, and it is financially infeasible to cover an entire 800-acre landslide basin with monitoring equipment. An approximately 12-acre failure occurred in the winter of 1996-97 immediately adjacent to a 19-acre harvest unit that had been clear-cut in 1988, but not within the area being monitored. Since the harvest unit is located on the opposite side of a ridge from the landslide scarp, it is not likely that harvest activity influenced the timing or initiation of the recent failure, but rather that the landslide was triggered by the storm event that occurred that winter. Debris from the recent failure was deposited on an area mapped in 1984 as a landslide debris deposit, suggesting a mode of recurrent and periodic failures that are common in this earthflow complex.

Management Opportunities: Numerous geologic reviews and reports have been completed in the Bill Moore watershed. The basin can be characterized as a large slump/earthflow complex bounded and buffered by more resistant bedrock ridges to the east, south and west. The feature is composed of multiple scarps, basins, and lobes of deposits of landslide activity levels ranging from ancient inactive to recently active. The earthflow features move into and merge in the center of the basin, much like glacial morphology. Risk analysis and hazard zonation mapping have been done on the basin in the past to determine areas suitable for timber harvest. Although parts of the basin are currently designated as suitable for management activities (matrix), it may be reasonable to reclassify the entire earthflow complex as unsuitable for timber management (TML) in the next Forest planning effort. Roads within the basin should be evaluated for decommissioning or storm proofing based on past history and resource concerns.

Painted Rock, Sundown and Stonehouse Creeks: The area north of Copper Canyon on the Rogue River is a classic example of how rock type, geomorphic processes and tectonic activity combine to produce conditions of slope instability. Ferrero (1992) mapped large slump/earthflow complexes that define the three watersheds, all with typical cross-sections showing the characteristic scarp, slump bench, and debris deposit morphology. Pervasively sheared, fine-grained schist and phyllite with fractured quartz filling or interbeds underlie the watersheds. The material is deeply weathered, highly faulted, and structurally weak. The area is a shear zone created by a series of older thrust faults, more recently cut by the Coquille River Fault and several other north-trending high

Figure 1. Slump Earth Flow Diagram



angle faults. Slopes have moderate to deep, poorly drained soils. Shallow groundwater tables are expressed as numerous wet benches, sag ponds, and seeps. Lake of the Woods is a sag pond located in the headwall of the large Painted Rock slump/earthflow complex.

es, 1978.

There is a wide range of landslide activity levels within the complexes, from ancient, inactive benches to recent movement. Recent activity can be rapid to slow creep, or steady slumping and creeping of earthflow lobes. Cracks in the ground, hummocky terrain, and leaning or tipped trees are indications of recent activity. Stream undercutting (either because of erosion of deeply weathered and weak materials, or tectonic uplift, or a combination of both) has created inner gorges and oversteepened deposits that fail as debris slides and ravel. Numerous debris slides and smaller slumps within inner gorges were mapped by Ferrero. Although the debris slides are smaller components of the larger slump/earthflow complexes, larger slides have scoured portions of Stonehouse and Bridge Creeks.

Management Opportunities: Slopes north of Copper Canyon are characterized by large slump/earthflow complexes with ranges in landslide activity levels from ancient to very recent. Roads within this area will be long-range maintenance problems. Failures in road crossings will also contribute to resource concerns in the drainages, adding more sediment to systems that already receive large amounts of sediment from natural sources. The comprehensive mapping of the geology and landslides that exists for the area will serve as a valuable tool to identify and prioritize roads for decommissioning and/or storm proofing.

Meadows on these slopes are underlain by serpentine soils or shallow, droughty soils derived from fine-grained metasedimentary rocks. Some of the meadow areas were enlarged through logging activity or pasture use and maintenance. These land use practices make it difficult to determine the extent of a meadow ecosystem from aerial photo interpretation alone. If meadow enhancements are intended to be maintained over long time frames, it is important to verify the soil, geomorphic and vegetative parameters of a meadow ecosystem. The LRMP identifies meadows areas and gives direction for enhancement projects. The soil inventory done for Curry County is a tool that can help determine where specific meadow enhancement techniques would be most effective. Roads are a lasting feature on fragile, meadow soils and should be evaluated for innovative restoration techniques based on topography and soil types.

Figure 2. Stream Profile Tom Fry Creek

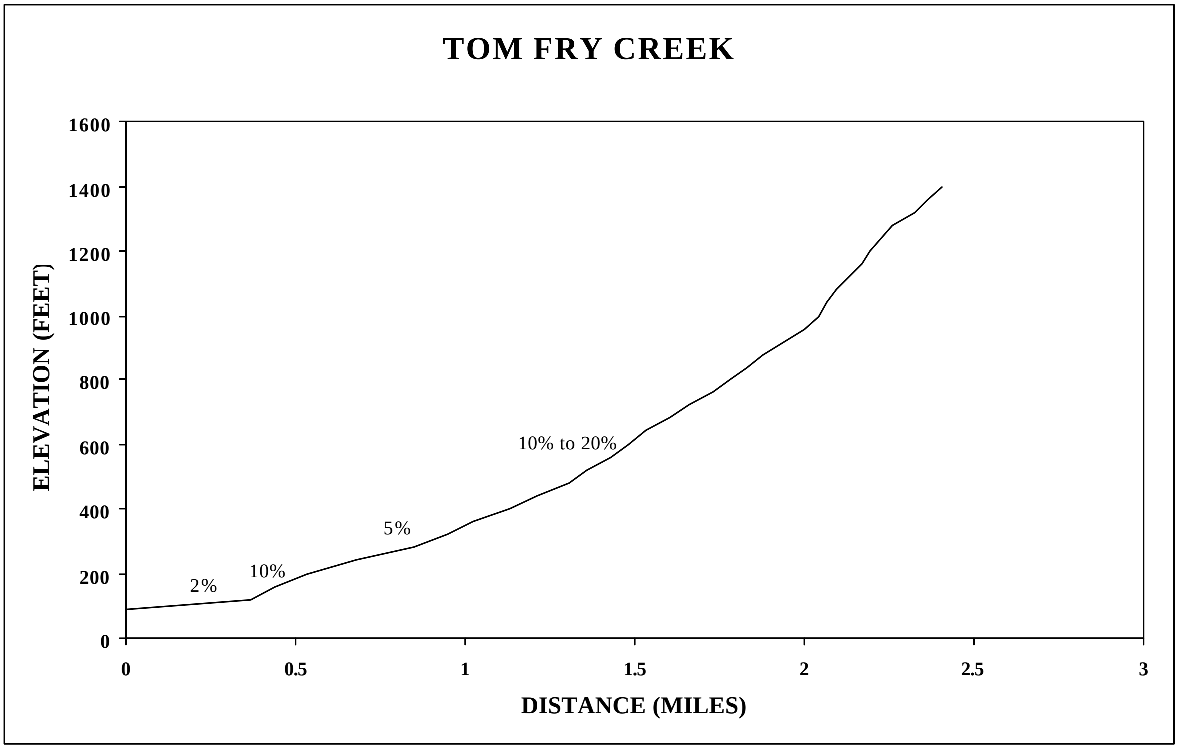


Figure 3. Stream Profile Rilea Creek

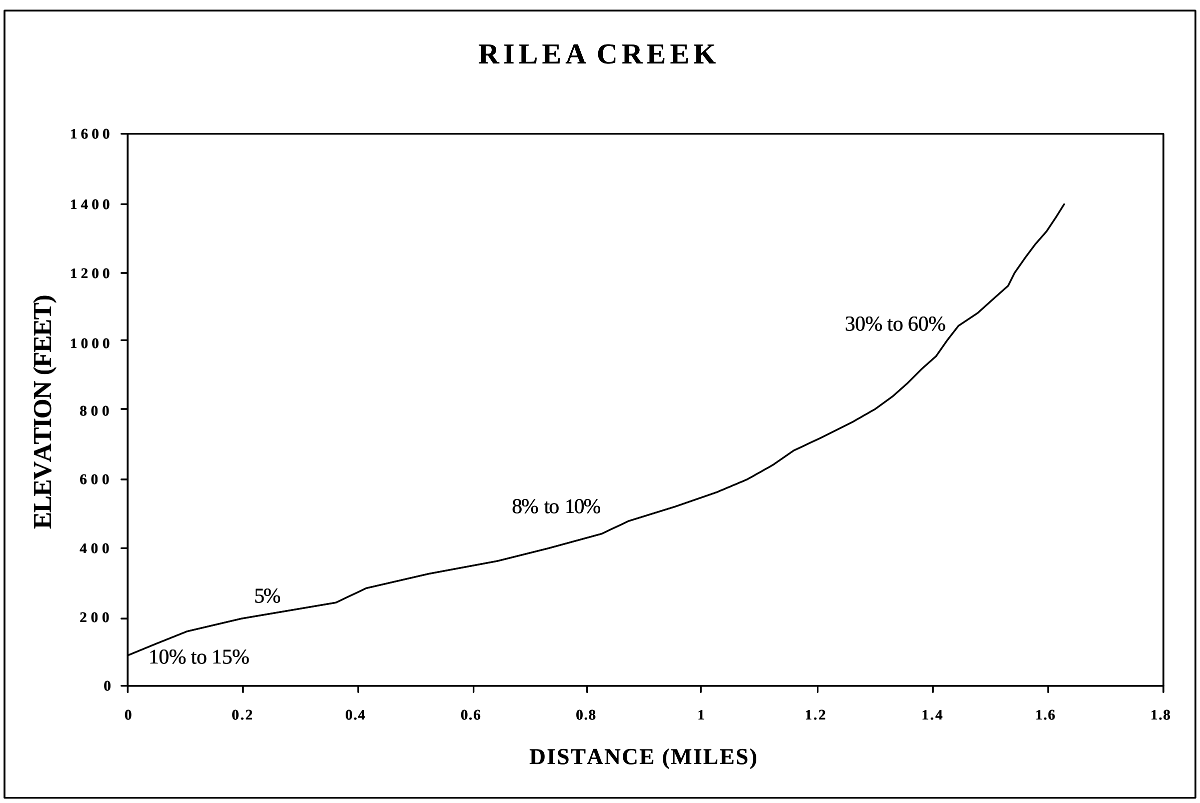


Figure 4. Stream Profile Nail Keg Creek

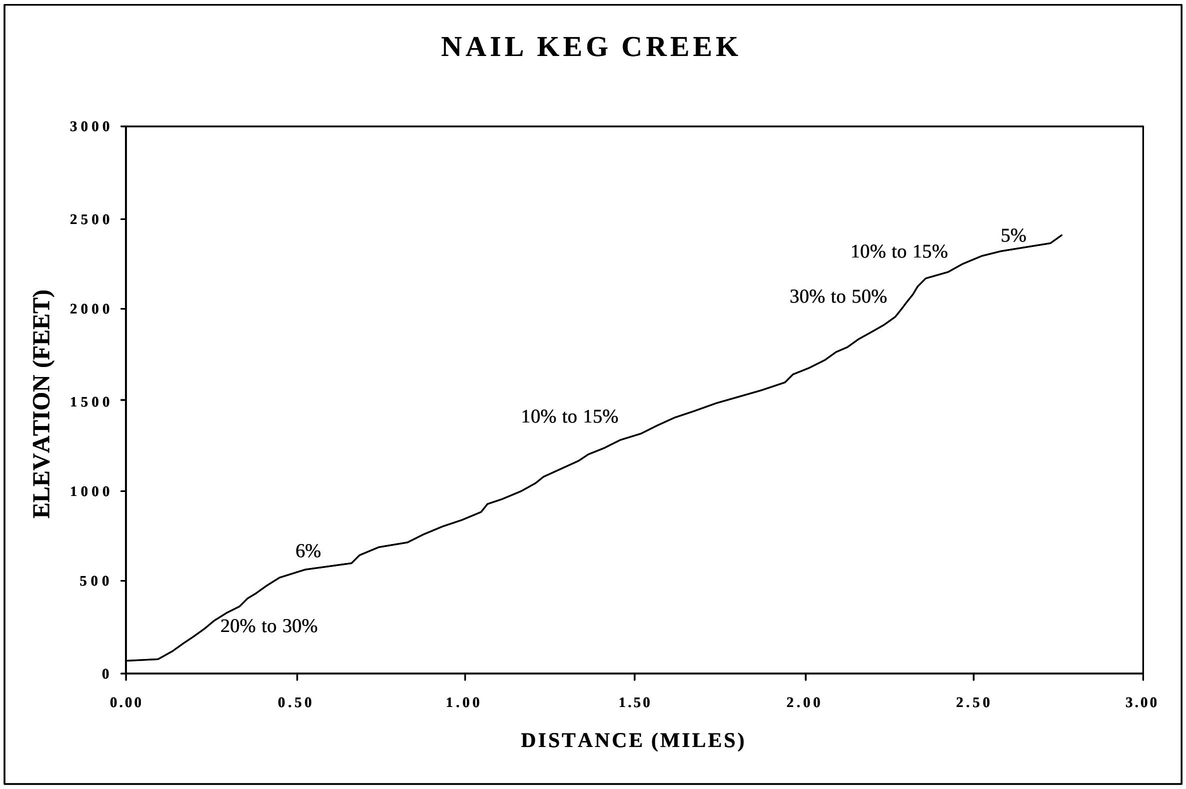


Figure 5. Stream Profile Painted Rock Creek

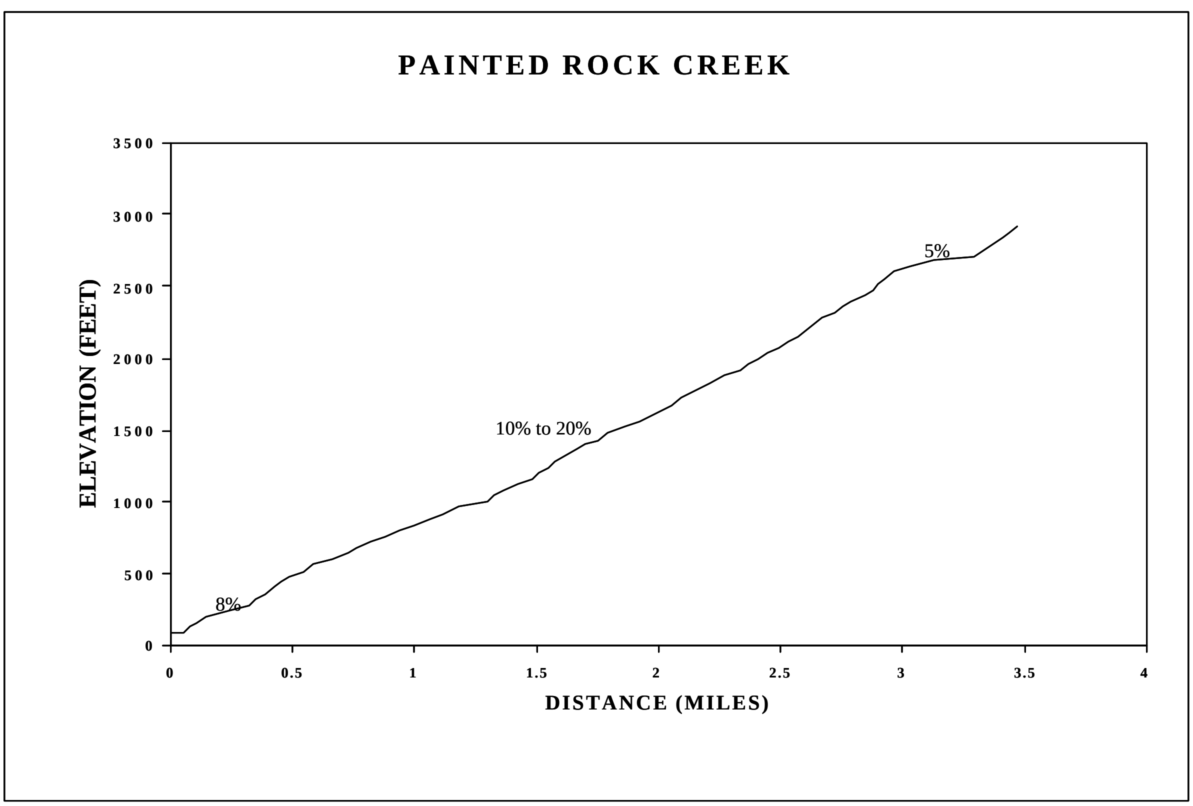


Figure 6. Stream Profile Wakeup Rilea Creek

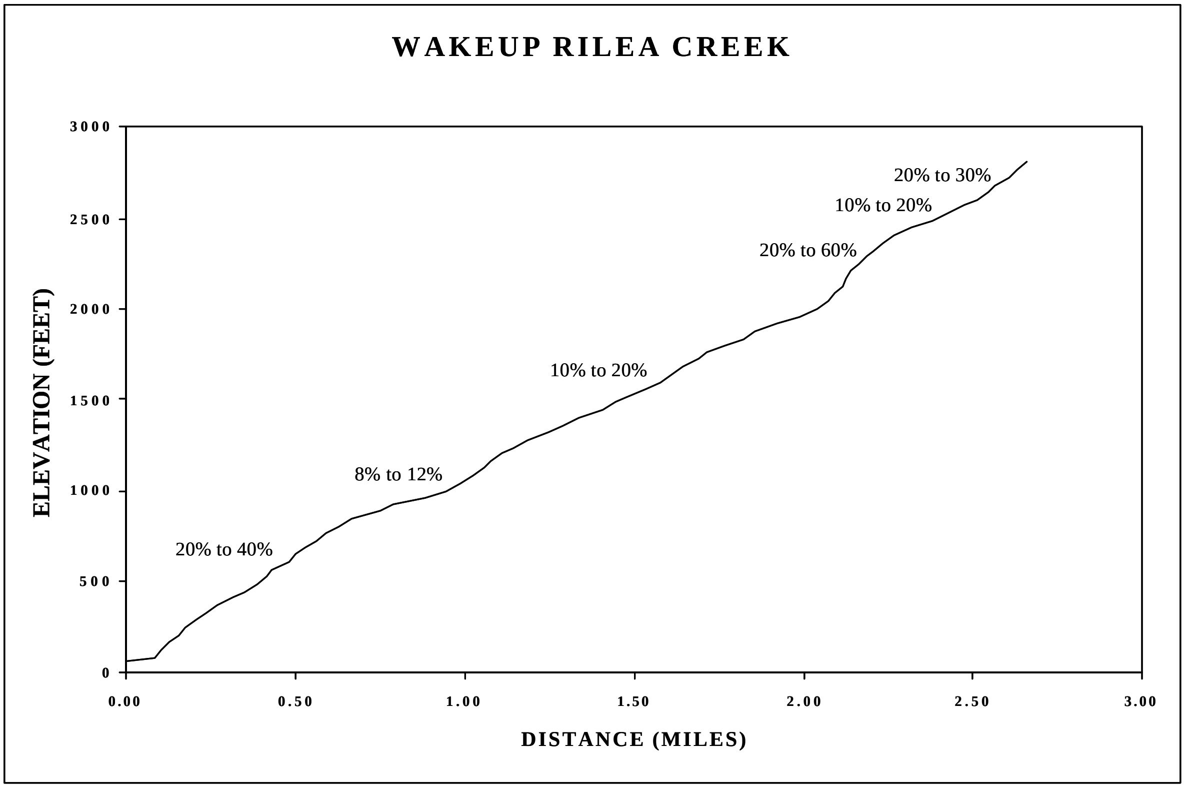


Figure 7. Stream Profile Silver Creek

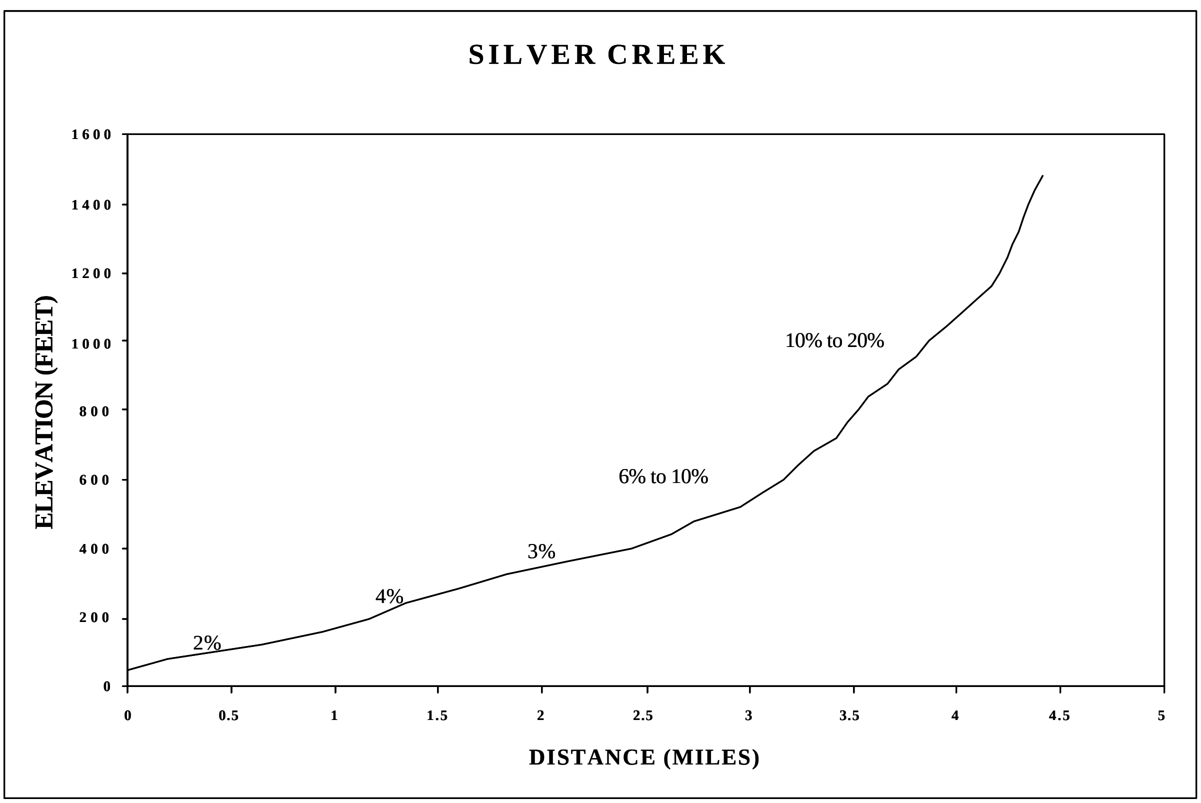


Figure 8. Stream Profile Kimball Creek

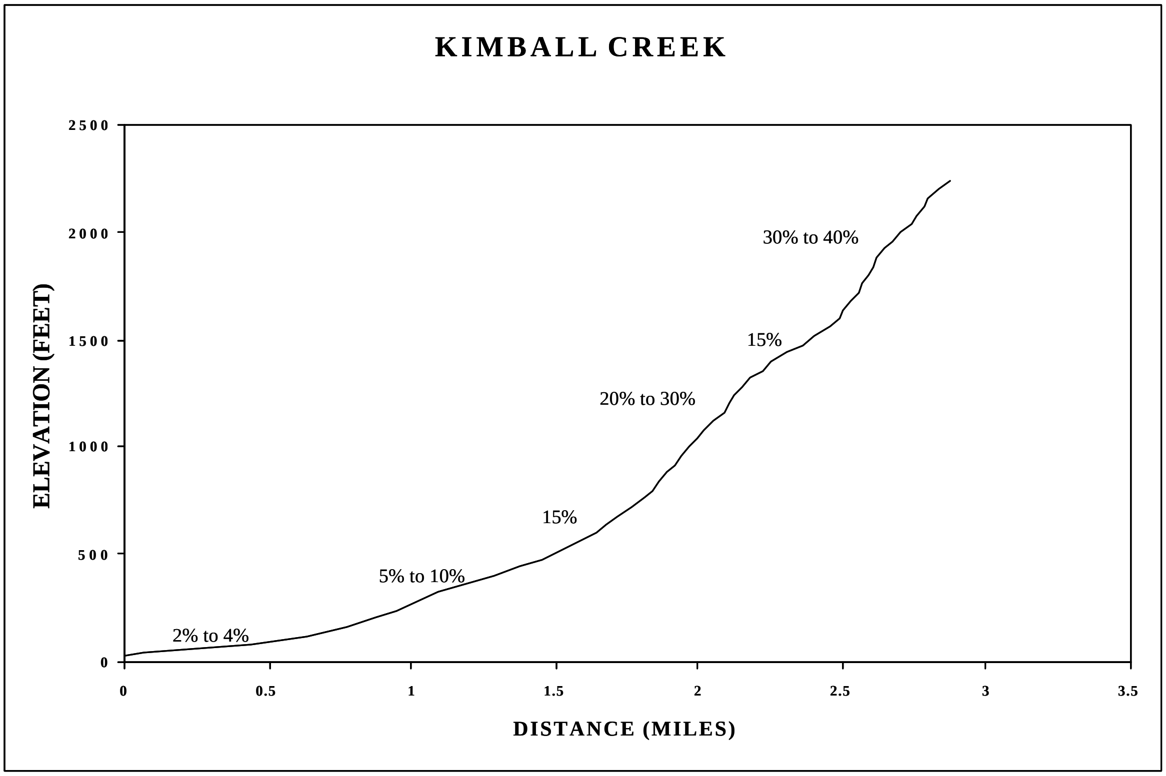


Figure 9. Stream Profile Jim Hunt Creek

Hydrology

Rogue River Basin

Climate

The climate of the Rogue River basin varies because of its steep topography and interception of moisture from the Pacific Ocean. Lower temperatures and more precipitation occur on the west slope of the Cascades and in the Siskiyou Mountains. The valleys between these slopes are generally drier with high summer temperatures. Annual precipitation is high on the coast (over 100 inches near Gold Beach) and low in interior valleys (19 inches at Medford). About 80 percent of this precipitation occurs between October 15 and May 15. Snowfall is prevalent at Crater Lake with an average of more than 500 inches per year. Near the coast, cool and humid weather prevails throughout the year. Farther upstream, the effects of the marine climate are less pronounced and the weather is often hot and dry during the summer.

George Taylor, the State of Oregon Climatologist, compiled annual rainfall data for Oregon that has been collected since 1850. By comparing each year's annual precipitation to the average for the period of record, he found a precipitation cycle of 20 to 30 years. These precipitation cycles are reflected in streamflow records and fish population records (Taylor, 1999).

1896-1916	wet
1916-1946	dry
1946-1976	wet
1976-1996	dry

River Flow

The Rogue River had an average annual discharge into the Pacific Ocean of 5,661,000 acre feet prior to the construction of the Applegate and Lost Creek dams (Federal Register, 1972); and 3,974,000 acre feet per year since 1978. The Rogue River Basin has 24 gaging stations currently measuring stream flow. Fifteen of these also record water temperature.

Moderate to heavy runoff throughout the winter and early spring typifies stream flow patterns with low flows during the summer and fall. Many of the small tributary streams become completely dry during the fall.

Stream flow at the mouth of the Rogue River has varied from under 1,000 cubic feet per second (cfs) in the record drought years of 1931 to 1940 (before Lost Creek and Applegate Lake flood control projects) to over 500,000 cfs in the December, 1964 flood event. During the dry summer most of the stream flow is attributable to the high mountain snowpack areas in the Cascade and Siskiyou Mountains.

The largest flood of historical record occurred in 1861 and the second largest in 1890 (Federal Register, 1972). More recent flood events were in 1955 and 1964. Gaging station number 14361500 at Grants Pass began collecting stage and flow data in 1938. Extreme peak flow stages from before 1938 are based on information from local residents.

Year	Month	Grants Pass Stage height (feet)
1861	December	43
1890	February	36
1927	February	32
1955	December	30
1964	December	35

From the 1920s through the 1950s storage reservoirs were constructed to supplement irrigation withdrawals (Fish Lake, Emigrant Lake, Agate Lake, Howard Prairie, Hyatt Lake). Timber harvest and road building were increased in the upslope, steep headwater areas of the Cascade and Siskiyou mountains after World War II. By 1955 there was considerable settlement in the interior and coastal valleys of western Oregon. Agriculture development channelized many streams and removed instream scour elements like large wood and boulders. Much of the meandering and side channel habitat historically present was eliminated.

Roads were also constructed in association with timber harvest in the lower elevations by 1955. Many roads were located in the lower stream valleys. Logging practices included tractor skidding over compactable soils and in stream channels, low standard roads, and log stream crossings.

Following flood events, the reaction measures were perhaps as catastrophic to fish habitat as the floods themselves. Anecdotal accounts speak of debris removal and machine work in stream channels. Long sections of streamside roads that washed out were replaced with riprap fortification. A strong bias against large wood in streams and stream meandering persisted from this period to today. In the 1970s and 1980s, the Lost Creek Dam and Applegate Dam were constructed with the objectives of flood control, recreation, and increasing summer streams flows for fish and irrigation. All of these activities had cumulative effects on sediment delivery to streams, summer and winter flows, stream temperatures, the range of anadromous salmonids in the basin and other freshwater fish habitat components.

Channel Morphology

The river has three general morphology types. From its headwaters in the Cascades it flows through steep bedrock gorge terrain. As it crosses the central portion of the basin, the Rogue River meanders through a flat valley, known as the Rogue Valley, with agricultural, rural residential, and urban developments including Medford and Grants Pass. Below Grants Pass, the river once more enters a bedrock gorge, with sharp ridges and steep tributary canyons that gradually open to rounded hills near the estuary and ocean.

Water Quality

Bacteria counts in the Rogue River have exceeded State standards for many years. The Oregon Department of Environmental Quality listed the Rogue River as water quality limited under 303(d) in 1996 and 1998. Segments that do not meet the standards are:

Table 1. Rogue River Water Quality Limited Segments

Rogue River Segment	Parameter
Little Butte Creek to Grave Creek	fecal coliform
Evans Creek to Rogue River Mouth	temperature
Applegate River to Rogue River Mouth	pH
Illinois River, California border to Rogue River mouth	temperature

Rogue River Watershed, below Agness

What are the dominant hydrologic characteristics and processes in the Rogue River watershed below Agness?

Natural Processes

From the State Precipitation Isohyetal map, average annual precipitation varies from 80 inches along the Rogue River to 130 inches near Signal Buttes. This falls primarily during the winter months, and primarily as rain, with 89 percent of the watershed in the rain-dominated zone, and 11 percent in the transient snow zone (see Map 8, Elevation Zones). Winter storm intensities can range from 8 to 11 inches in 24 hours during a 25-year event to 9 to 13 inches in 24 hours during a 100-year event. Lower storm intensities lie along the Rogue River, with higher intensities along the ridges bordering the watershed.

Rogue River

There are no gaging stations within the watershed analysis area, but there have been gages on both the Rogue and the Illinois just above their confluence. Gage No. 14372300, Rogue River near Agness, records streamflow and temperature, which are transmitted to the USGS office in Portland, and available over the Internet. The period of record began in October 1960. The maximum flow recorded by the gage was an estimated 290,000 cfs on December 23, 1964. The minimum recorded flow was 608 cfs July 9 and 10, 1968. The flood event of January 2, 1997 was 250,000 cfs.

The 1964 calculated flow of 290,000 cfs would be slightly less flow than a 25-year event, according to the USGS Statistical Summaries of Streamflow Data in Oregon. The calculations used to estimate this flow may have overestimated the effects of ponding on the river stage, and the actual Rogue River flow may have been much larger.

A gaging station near the mouth of the Illinois River was maintained from October 1960 to September 1981. During the period of record the river had an average annual discharge into the Rogue River of 2,966,000 acre-feet per year, nearly half the discharge of the Rogue River prior to the construction of the Applegate and Lost Creek dams (Moffatt, Wellman, and Gordon, 1990). The maximum flow estimate was 225,000 cfs in December 1964; the minimum recorded was 125 cfs in September 1975.

Since the Rogue at Agness gage was installed in 1960, five peak flows have exceeded the 181,700 cfs calculated by USGS to approximate a recurrence interval of five years. The first four of these, 1964, 1966, 1971, and 1974, were during a decade corresponding to the end of a wet cycle (see Climate under Basin Characterization, above). The fifth, 1997, was near the beginning of the following wet cycle. No flows exceeding the five-year recurrence were recorded during the intervening dry cycle. These data indicate that peak flows, as well as annual water yield, may reflect the cyclical weather patterns.

Tributaries to the Rogue River

Tributaries of the Rogue River experience more frequent flood flows than the Rogue River, as they respond to smaller scale, local winter rainfall and rain-on-snow events. An example of the interactions at the mouths of these streams was during the flood events of water year 1997. The November 1996 storm was a coastal rainfall event that caused streams with headwaters near the first orographic divide east of the ocean to rise rapidly from their characteristic low autumn flows to overflowing their banks within 24 hours. The South Fork Coquille River, with headwaters adjacent to the northern boundary of this watershed, recorded a 75-year flood at the gaging station near Powers. The Rogue River below Agness did not exceed its banks during this event. Tributaries were observed shooting flow out into the river as if from a high-pressure hose.

The "New Year's flood" January 1 and 2, 1997 was a rain-on-snow event in the Cascades and higher elevations east of the Rogue Valley. The gaging station on the Rogue River near Agness recorded approximately a 12-year flood event. Tributaries to the Rogue in this section did not exceed their banks, and backwater from the Rogue River extended upstream in tributary channels.

Human Influences on Streamflow

Rogue River, below Agness

Flow on the Rogue River has been regulated since February 1977 by Lost Creek Lake and since December 1980 by Applegate Lake, with numerous diversions for irrigation and urban and domestic use. On the Illinois River and its tributaries water withdrawal permits for irrigation, domestic, and municipal use, total 217 cfs.

On the Rogue River below Agness, permits for individual uses are minimal, totaling 0.71 cfs. For municipal use, the City of Gold Beach has two withdrawal permits totaling 10.0 cfs from the Rogue River near river mile 5.0, 1.45 cfs from a well near the same location, and 0.77 cfs from Indian Creek. The Nesika-Ophir water district has withdrawal permits for 0.7 cfs from wells near river mile 5.

The Oregon Department of Fish and Wildlife has an instream water right on the Rogue River for 2,000 cfs for fish, dating from May 7, 1962.

Land use and developments also have the potential to affect the timing and magnitude of flows. Land clearing for agricultural and residential use, timber harvest, road construction, and urban pavement may concentrate flows. In a river system as large and complex as the Rogue, it is difficult to determine how much effect these activities may have had.

Tributaries to the Rogue River, below Agness

Water withdrawal permits for domestic, irrigation, livestock, and recreation uses have been issued for streams and springs tributary to the Rogue River. The extent to which these permitted withdrawals are utilized is unknown.

Table 2. Water Withdrawal Permits.

Stream	Cubic feet per second (cfs)
Rilea Creek	0.12
Tom Fry Creek	0.01
Blue Jay Creek	0.07
Taylor Creek	0.29
Smith Creek	0.40
Tom East Creek	0.10
Aubrey Creek	0.10
Silver Creek	0.01
Unnamed streams	0.07
Springs	0.08
Squaw Creek	0.30
Edson Creek	0.05
Saunders Creek	0.02
Indian Creek	0.12
Unnamed streams	0.90
Springs	0.15
Total	3.43

The other primary human influences on hydrologic processes are effects of roads and vegetation removal on peak flows. The following factors are indicators of areas where effects may have occurred (USFS, 1993) (see Map 9, Subwatersheds and Streams and Map 21, Regeneration Harvest and Roads).

- More than 15 percent of a watershed analysis area (WAA) harvested in a 30-year period may have increased water yield and minor peak flows; more than 30 percent harvested is likely to have increased flow. Predominant hydrologic recovery is probable after 30 years.
- More than 20 percent of the transient snow zone harvested is likely to increase peak flows during rain on snow events. Hydrologic recovery is dependent on tree height in relation to surrounding forest, and is probable after 50 years.
- Road density less than 3.0 miles per square mile is considered low risk for channel network expansion sufficient to increase peak flows; 3.0 to 5.0 miles per square mile is considered moderate risk; over 5.0 miles per square mile is considered high risk for contribution to increased peak flows.

Several tributary watersheds have levels of harvest or road density that would fall within these parameters (see Table 6, Timber Harvest and Roads by Watershed Analysis Areas). The watershed analysis area (WAA) within the National Forest that is most likely to have flow alterations as a result of management activities is 21L05W, Wakeup Rilea Creek. In addition to the 37 percent harvested in the past 30 years, 53 percent of the transient snow zone has been harvested, and it has a road density of 5.0 miles per square mile.

Unusual in this analysis area is that the fifth and sixth field watersheds are displaying moderately high road densities and levels of harvest. The usual pattern on the west side of the Siskiyou National Forest is that some seventh field watersheds or WAAs will have moderate to high prior management levels, but others will be undisturbed or have low levels of management, so that the average over the larger sixth and fifth fields will be low. With the configuration of this analysis area in parallel small tributaries to the Rogue River, instead of convergent tributaries to a single mainstem, the effects of these moderately high management levels would be primarily to the individual streams in which they occur. The cumulative aspect of the effects would tend to be dispersed, rather than concentrated.

Information Needs: Stream channels need to be evaluated in the field to determine whether they have been affected by timber harvest and road construction. Watersheds in order of priority (based on data in Table 7) are Wakeup Rilea Creek, Nail Keg Creek, Rogue Face drainages, Silver Creek, Bradford Creek, Painted Rock Creek, Bridge Creek, Rilea Creek, and Jim Hunt Creek.

Management Opportunities: Improve the road drainage on roads that are necessary for present and future access. Decommission roads that present a risk of resource damage and are no longer needed.

Table 3. Timber Harvest and Roads by Watershed Analysis Area (National Forest Land only).

Watershed	Name	Acres	Percent National Forest Ownership	Road Density Miles/SquareMile	Percent Harvested before 1970	Percent Harvested after 1970	Percent of Transient Snow Zone Harvested
19F	Lower Rogue face	18683	0	unknown	unknown	unknown	No T-Snow Zone
19F01W	Jim Hunt Creek	3790	28*	**3.1**	0	10	8
19F02W	Kimball Creek	2359	44*	1.7	10	12	12
19F03F	Face between William Miller and Kimball	4072	37*	**4.2**	0	7	No T-Snow Zone
19F04F	Face between Quosatana and William Miller	2391	55*	**4.0**	0	12	No T-Snow Zone
TOTAL 19F		31295	16*	**3.6**	2	10	7
19Q	Quosatana Creek	16416	84	2.6	10	10	**21**
21L01F	Rogue face above Quosatana	4299	76*	**3.3**	8	6	No T-Snow Zone
21L02W	Silver Creek	6047	5*	**4.2**	**36**	6	No T-Snow Zone
21L03W	Bradford Creek	2350	93	2.0	**22**	12	**34**
21L04W	Bill Moore Creek	825	99	1.9	2	6	3
21L05W	Wakeup Rilea Creek	1907	86	**5.0**	**22**	**37**	**53**
21L06F	Rogue face above Wakeup Rilea	3441	92	**3.3**	13	11	**37**
21L07W	Tom East Creek	2241	74*	2.7	0	14	10
TOTAL 21L		21110	62*	**3.5**	12	13	**30**
21U01W	Nail Keg Creek	2292	100	**4.3**	4	**26**	18
21U02F	Rogue face above Nail Keg	3120	99	2.7	10	**15**	**20**
21U03W	Bridge Creek	1691	99	**3.3**	2	13	3
21U04W	Stonehouse Creek	1479	100	1.4	0	10	15
21U05W	Painted Rock Creek	1420	100	**3.3**	2	**23**	**36**
21U06F	Rogue face above Painted Rock Creek	2649	71*	**4.0**	**23**	5	**56**
21U07W	Tom Fry Creek	890	92	2.6	**21**	5	No T-Snow Zone
21U08W	Rilea Creek	380	71*	**3.7**	0	5	No T-Snow Zone
TOTAL 21U		13921	93	**3.2**	8	**15**	18
TOTAL 19+21		82742	54*	3.3	9	12	**22**

*Harvest outside of National Forest land may influence flows in these watersheds.

What are the basic morphological characteristics of river valleys and channels and the sediment transport and deposition processes in the watershed?

The analysis in this section is based primarily on review of aerial photos on file at the Gold Beach Ranger Station. These photo flights began in 1939. The portion of the watershed analysis area that is on National Forest land is covered in aerial photos of all years on file. The portion outside the National Forest, roughly from the mouth of Lobster Creek to the mouth of the Rogue River, is only covered in the 1940 series and 1997 photos, with additional coverage of the entire Rogue River corridor in 1969.

1939-1940-1941: This photo series is used as a reference condition. The last flood on the Rogue River prior to these photos was in 1927, but there is little evidence of flooding on tributaries. The overwhelming evidence of disturbance in the watershed is from fire. Vegetation is noticeably smaller over much of the landscape, and miles of ridgetops are bare. Small trees are beginning to grow in along edges of meadows.

Terraces along the Rogue River and high gently rolling prairies have been settled, but there is little to no inland development, and no timber harvest on National Forest land.

1956-1957: This photo series is after the 1955 flood. There is still little to no harvest or road construction on National Forest land. The photos show the effects of the flood event on channels and riparian areas in a natural condition.

1964: Harvest and road construction have begun on National Forest land, but there have been no major storms since 1955. These photos show the pre-1964 flood channel and riparian conditions.

1969: Harvest and roading are extensive. There was a major flood on both the river and the tributaries in December 1964. Comparison of areas with and without harvest and roads as they appear on 1964 and then 1969 photos shows the effects of a flood event on stream channels and riparian areas in a harvested and roaded landscape, compared to effects in an undisturbed landscape.

1973 infrared photos: These have particularly good resolution, and the infrared coloring helps to distinguish vegetation types and eroded ground. More timber harvest and road construction has taken place since 1969, and there was a major storm in watersheds of tributaries during the winter of 1972-73. These photos show additional effects of storms on stream channels in a harvested and roaded landscape.

1979 true color photos: These were 1:24,000 photos, with poor resolution. There was little increased harvest on National Forest land, and no major storms. Although stream channels and riparian areas probably experienced some recovery, it is difficult to determine with the poor photo quality. Therefore, this photo series was not used for this analysis.

1986: These were 1:12,000 photos, with good resolution. They show recovery of channels and riparian areas during an era of lower harvest and road construction, with no major storms.

1997: These were also 1:12,000, with good resolution. With the rate of road construction and timber harvest greatly slowed, these photos show the existing condition including the few additional roads and areas harvested in the late 1980s and early 1990s. The first major storm since 1973 was in 1996-97. These photos also show where this storm caused increased landslides and channel activity.

Rogue River, below Agness

Channel Morphology

Illinois River to Blue Jay Creek, river mile 27.0 to 25.2: The Rogue River is confined here, but has terraces nearly half a mile wide that slope up for 100 feet elevation. These may have been formed by extreme flood events in the geologic past, where flows from the Rogue and Illinois backed up behind Copper Canyon and deposited their sediment loads.

Blue Jay Creek to Painted Rock Creek, river mile 25.2 to 24.0: This is Copper Canyon, a narrowly confined segment that acts as a bottleneck during flood events. Overall orientation is east to west, with sharp bends as it flows between the irregular rock walls of the canyon. The elevation of major flood events can be seen reflected in the sharp vegetation line on the south bank between Blue Jay and Morris Rodgers; and on the north bank below Painted Rock. The amount of small vegetation within the scour line varies between photo years, but the location of the line appears unchanged.

Painted Rock Creek to Bill Moore Creek, river mile 24.0 to 17.0: The slope of the canyon walls decreases. There are riffles in the channel, but no large depositional bars. Orientation is northeast to southwest.

Bill Moore Creek to Lobster Creek, river mile 17.0 to 11.0: The river is confined, but valley walls continue to widen, with narrow depositional bars interspersed along the channel. Channel orientation is east to west.

Lobster Creek to Ferry Hole, river mile 11.0 to 5.0: The valley walls continue to widen. The channel meanders between gravel bars, but the meanders have fixed locations. The bars change volume, but not location or shape. Orientation fluctuates, but overall is northeast to southwest.

Photo coverage from Lobster Creek downstream is 1940, 1969, and 1997. In these photos, the only obvious changes are between 1940 and 1969, and are probably the result of the 1964 flood. On the 1969 photos the vegetation line is noticeably higher, and gravel bars appear more extensive.

Rogue River Estuary, “the ferry hole” at river mile 5 to mouth: The river is moderately unconfined in this segment. The channel meanders, with the low water channel moving laterally as it erodes and deposits material, and two or three active channels in some areas. The extent of meandering is limited by hills rising on both sides of a mile wide valley (see Map 6, Slope Classes). The orientation of the river flow is to the southwest.

In this estuary area where the river level rises and falls with the tides, changes at the mouth have the potential to reflect upstream to changes in river meander and deposition patterns. Channel changes between 1940 and 1969 photos could reflect effects of the floods of 1955 and 1964, plus effects of the construction of the north and south jetties at the mouth. Channel changes between 1969 and 1997 photos could reflect effects of the lesser flood of 1997, plus effects of construction of the boat basin jetty.

Following the channel from its fixed location at the mouth of Jim Hunt Creek (river mile 6.0) downstream over the 1940, 1969, and 1997 photos, the river appears to be attempting to add meanders. The main channel flows along the right bank in a single smooth curve from Squaw Creek (river mile 5.5) to the ocean in 1940. In 1969 the main channel is beginning to migrate to the left bank near river mile 4.0, and a portion of the 1940 channel is reduced to backwater near river mile 2.0. By 1997 the channel has shifted left near the mouth of Saunders Creek (river mile 3.2), shifted to the right near river mile 3.0, then split and crossed back to the left bank above a rocky point (river mile 1.6).

At this rocky point, the valley narrows to a half mile wide. From here to the mouth another process appears to be shaping the channel. The river has deposited material that stabilized and vegetated with large willows, forming a bank with a continuous line from the rocky point to the boat basin jetty, effectively cutting the active channel width in half, except during bankfull events.

Sediment transport

The river descends with an average gradient of 0.06 percent through the 27 miles of this analysis area. Although this gradient is low, large flows give the river the stream power to transport boulder-sized sediment and regularly move material in depositional bars of cobble-sized material.

Sediment transport in the river interacts with flows and sediment in tributaries. Following the flood event on tributaries of the lower Rogue in November 1996, large alluvial fans were observed at tributary mouths. In December there was a storm that produced bankfull flows on both the Rogue and its tributaries. Following this event, the alluvial fans were greatly diminished or removed entirely, as the Rogue transported the material downstream. Following the January 1997 Rogue River flood, midstream and lateral gravel/cobble bars in the river had increased in depth an estimated 6 feet, as the river brought sediment from higher in the basin. The backwater often created as high flows from the river extend upstream in the tributaries complicates these interactions.

Tributaries to the Rogue River, below Agness

Only those streams with National Forest land in a portion of their watershed will be discussed here. Most of these tributaries to the Rogue River in this analysis area are steep, transport streams with gradients from 4 percent to over 50 percent (see also Subwatershed Descriptions under Geology, pages 10-12, and Stream Profiles, pages 13-16). Characteristically, the sediment delivered from the erosion processes described in the Geology section is transported through these streams to the Rogue River. Several streams have flatter depositional reaches near their mouths, and these are discussed below.

Field observations from the Lower Rogue River Trail in spring 2000 found that tributaries entering the north bank of the Rogue River appear to be actively downcutting, regardless of development history (agricultural, timber harvest, road construction, or undisturbed). This downcutting may be related to rapid rates of tectonic uplift discussed in Geology, page 7, and the soil types through which they flow, primarily Colebrooke schist. Smaller streams appear more incised, with vertical exposed soil banks. Larger streams, primarily named streams, tend to have well-developed channels that appear moderately active, armored with boulders to six feet diameter.

Tom Fry Creek has an average gradient of one to two percent for debris from the ravelly slides in the upper drainage the first 0.4 mile upstream from the mouth. This would be expected to be a depositional reach. The riparian vegetation is primarily small hardwoods above Agness Road 33, and large conifers below.

Rilea Creek has little apparent change in riparian condition over the photo series, other than portions with harvest and road construction. Roads closely paralleling the channel appear on the 1957 photos; in 1973 portions of the lower channel that have been recently harvested are exposed, and sediment is visible. In 1997 the riparian area has a closed canopy, with large hardwoods in the lower channel, small hardwoods midchannel, and a mixture of hardwoods and conifer in the undisturbed upper channel.

Blue Jay Creek had a closed canopy of mixed conifer and hardwood in 1940 and 1957. In 1964 a road crosses mid channel, and the canopy has been removed from much of the lower half of the channel. The harvested portion of the channel has unstable banks in 1973, with several small slides in this section and downstream. By 1986 these banks are revegetating. In 1997 the lower half has a closed canopy of small hardwoods, and the upper half is mixed hardwood and conifer.
Morris Rodgers Creek is short, steep, and bounded by steep slopes. The lower west slope is sparsely vegetated with small, scattered hardwoods in 1940. Vegetation has increased by 1955. The slope shows progressive ravel from 1964 to 1969, with this entire portion of slope raveled and devegetated by 1973, and sediment deposited in the channel. The first harvest unit in the Morris Rodgers drainage was in the early 1970s, but there is no apparent erosion from the access road or the clearcut channel, and there is over a mile of undisturbed riparian canopy between the harvest and the first ravel site. By 1997 the ravelly slopes are revegetating with small hardwoods, and the stream channel has a dense canopy of the same.

Painted Rock Creek has several nearly parallel channels draining the headwaters, one of which flows directly out of Lake of the Woods. The stream profile of this creek reflects the slump earthflow topography discussed in the Geology section. In 1940 the channel was well vegetated with mixed hardwood and conifer. There were narrow openings or chutes from the western ridge to the channel, just below the lake. In 1964 the ridgetop road had been constructed. A landslide into the main channel, downstream of the chutes, had created an opening in the riparian canopy extending about a half mile downstream. This opening appears to have widened in the 1969 photos. By 1973 the first timber had been harvested from a unit above the slide, which included removal of the riparian canopy from the channel draining the lake. The channel below the slide was revegetating with small hardwoods. The chutes from the ridge to the channel appear much wider. A true color flight in 1977 shows trees removed from corridors along the chutes and the adjacent ridgetop road. In the stream channels, all but the landslide have grown in. By 1997 the channels have revegetated, except the area that was harvested in the early 1970s, the landslide, and two small slides into channels below the late 1980s harvest units.

An unnamed stream that flows into the south bank of the Rogue River across from Painted Rock Creek has an unstable bank in some places, with old bare slopes. A dense hardwood canopy obscures most of the channel. The headwaters channels were clearcut in the early 1980s. These channels have scattered small vegetation in 1997.

Stonehouse Creek has a dense conifer canopy along channels on the west side of the drainage in 1940, and moderately dense mixed hardwoods and conifer on the east side. In 1957 there are some new stream bank slides. In 1973 the canopy along the upper, eastward flowing main channel is partially open. By 1997 these areas have revegetated, the channel has a closed canopy and appears stable, in spite of road construction and timber harvest between 1980 and 1990.

Sundown Creek has a closed canopy of conifer on the west bank, and a moderately closed canopy of hardwoods on the east bank.

Bridge Creek (also called Ram Creek): The outline of a 40-acre landslide that enters the creek about a mile up from the mouth can be seen on the 1940 photos. By 1957 the slide has reactivated, and the area has little standing vegetation. In 1997 there is a large bare scarp at the top, and the area is vegetated with alder, except for a small streambank slide at the toe. Throughout the aerial photos, there is no apparent change in riparian canopy in Bridge Creek below the slide.

Three parallel roads cross steep perennial streams in the headwaters of Bridge Creek: 3340900, 905, and 907. Although road gradients are nearly flat and diversion potential is low, the multiple crossings of the same streams create the potential for cascading effects. The two upper spurs are growing in with vegetation and are no longer drivable, increasing the potential for culvert problems to go unnoticed.

Along the streams crossed by these roads, all of the large conifers were removed from the riparian area in the early 1970s. No apparent effects on stream bank stability are visible in 1973 or subsequent aerial photos. By 1997 these riparian areas have revegetated with a dense hardwood canopy.

Schoolhouse Creek has a dense conifer canopy throughout the photo period.
Nail Keg Creek has a closed canopy over the entire photo period, except where Agness Road 33 loops around the creek near the mouth. This area was harvested between 1973 and 1977, with a narrow strip of hardwoods left in the channel. By 1986 it had grown in with alder. The gradient reflects the slump earthflow features

A pond in the headwaters of this creek was enlarged through construction of a dam in 1988. The following winter a small landslide occurred below the pond. A field investigation determined that the increase in water level in the pond increased both ground and surface water flowing through an unstable swale, triggering the landslide.

Tom East Creek has a large depositional fan at the mouth. It is unknown how much of this material is from the creek, and how much from the Rogue River. Stream channels are vegetated with a dense canopy of alder, and conifer forest outside the riparian area. This appears little changed in the lower channel over the photo period from 1940 to 1997. In the middle portion of the channel, and one tributary flowing from the west, there are riparian openings and small bank failures on the 1957 and 1964 photos.

The headwaters slopes, including small tributary channels, were clearcut harvest both inside and outside the National Forest beginning in the late 1960s. Nearly a mile of riparian area along the headwaters tributary paralleling Road 3340900 was harvested in the early 1970s, but no effects on stream bank stability are visible in the 1973 photos. The riparian openings are revegetating with hardwoods by the next series of aerial photos, and the canopy is closed by 1997.

Slide Creek in 1940 had a riparian canopy of small dense vegetation. In 1957 about one third of its channel length has open canopy, with bare ground underneath. By 1997 the riparian area has revegetated.

Wakeup Rilea Creek in 1940 had a closed canopy of large conifer, with some hardwoods in the channel. Most of the lower mile of this stream and tributaries were harvested and tractor yarded in the late 1960s and early 1970s. On the 1973 photos there is no apparent stream bank instability or other effects to channels. By 1997 the riparian canopy is closed, primarily with hardwoods. The lower watershed is a mosaic of different ages, densities, and species of stands; the upper watershed is a patchwork of managed and natural stands.

This creek has the undulating profile characteristic of slump-earthflow terrain. Changes in gradient are much more pronounced on site than they appear on the stream profile, which was plotted from a 40-foot contour interval map. Channels appear stable on the aerial photos, but field investigations found evidence of large sediment loads. Gravel-sized material enters the channel from slump-earthflow features, is transported through steep, 10 to 40 percent gradient reaches, and deposited in flatter 2 to 4 percent reaches. Deposits are subsequently remobilized by peak flow events and streambanks are eroded, contributing to the volume of sediment.

The channel also has many pieces of large wood that help to organize sediment deposits. Earthflows deliver mature trees; twisty cascades and flat landslide deposits trap the logs. Various decay stages, from trees with needles to almost totally decomposed remnants attest to the ongoing nature of this process, and suggest that few pieces of large wood are delivered out to the Rogue River.

Bill Moore Creek has an active slump-earthflow feature, referred to in Forest Service files as the "Moorsky Slide" (see discussion in Geology section). The lateral streams bordering this earthflow are Bill Moore and Tom Moore Creeks. Their confluence is on the downhill side of Agness Road 33, just before they enter the Rogue River.

On the 1940 photos, there is little riparian vegetation on Bill Moore Creek. In 1969 a large alluvial fan appears at its mouth in the Rogue River. By 1997 the channel has revegetated and the fan is shorter.

Bradford Creek: Detailed information on this creek and its watershed are in the Bradford Creek Watershed Analysis, 1996. The creek drops steeply into the Rogue River, but has a depositional reach with a 4 percent gradient about a quarter mile upstream. In 1997, following the November 1996 storm, field observations found changes in this reach. The riparian canopy had opened, the channel had widened by about 50 percent, and a portion of the terrace that was deposited in the 1960s had been removed. Tree boles that had been covered for 30 years were exposed, with noticeably smaller diameters in the previously buried portion than further up the stem.

Silver Creek has a gradient of 1 to 4 percent for the first 2.6 miles upstream from its mouth. The first quarter mile has an open canopy in the 1940 photos, with sediment in the channel. Riparian vegetation above there is small hardwoods. This was prior to timber harvest and roaded access, and appears to be the natural condition. An alluvial fan at the mouth appears in all photo series. It pushes a small curve into the low water channel of the Rogue River, forming a riffle.

Quosatana Creek: Detailed information on this creek and its watershed are in the Quosatana Creek Watershed Analysis, 1996. The storm event of November 1996 activated landslides along inner gorges of tributaries and the mainstem, delivering large amounts of sediment to stream channels. Two washouts on Road 3313 contributed relatively minor amounts of sediment. Much of the increased sediment was deposited in the 2.5-mile depositional reach that ends at the mouth. In the summer of 1997 pools had filled in and flow was often subsurface in this reach. Willows and other small riparian vegetation were buried. By 1999 the channel and pools were reforming, and vegetation was recovering.

Kimball Creek has a gradient of 2 to 4 percent for the first half mile upstream from its mouth. At the time of the 1940 aerial photos, neither harvest nor road construction had occurred within the drainage. There were two landslides into the stream channel near the headwaters. The first 0.25 mile above the mouth was aggraded with a wide riparian opening, and there was an alluvial fan in the Rogue River at the mouth. These would indicate that the stream naturally receives and transports a large amount of sediment.

On the 1957 aerial photos, harvest and road construction had begun, and by the 1964 photos most of the acreage west of Kimball Creek and some east of the creek had been harvested. Sediment trails from roads, skid roads, and clearcuts led into the creek and its tributaries. The riparian area at the mouth had been clearcut, and the aggradation is noticeably increased. After the 1973 winter storm event, a debris flow approximately 100’ long by 300’ wide appeared on the photos, entering Kimball Creek near the center of Section 18. By the 1986 photos, most of these areas appear to be recovering. Although present condition appears stable on photos, the actual stream channel condition is unknown.

Harvest of riparian vegetation along most of the length of the Kimball Creek mainstem and its tributaries on the west removed sufficient shade that stream temperatures may have increased following harvest. These harvested riparian areas appear to have grown back with hardwoods. The amount of streamside shade today and stream temperatures are unknown.

Riparian harvest also removed large wood both in the channel and future large wood. It is unknown how much of the revegetation is coniferous. If the conifer component is comparable to pre-harvest levels, it will be another 50 years before it is large enough to provide stream structure. If conifers are a smaller riparian component than before harvest, recovery of large wood and the channel structure it provides will take longer.

Jim Hunt Creek has an undulating profile suggestive of slump-earthflow features, but may be caused by different weathering rates of the different rock types in this subwatershed. The gradient of one percent for the first half mile upstream from its mouth appears aggraded in 1940. By 1969 deposition has increased, with a large fan in the Rogue River. This could be a result of flood events in 1955 and 1964, or harvest and road building activities, or both. By 1997 the amount of sediment in this reach appears similar to 1940.

Most of the lower watershed appears harvested on recent aerial photos. However, the natural vegetation in 1940 was mixed conifer, hardwood, and brush, so many areas were partially cut. Riparian vegetation appears small, with few tall conifers in the 1940 photos. In the 1982 photos vegetation in the channel also appears small, with some small inner gorge landslides.

The natural condition in this stream may have been a moderately heavy sediment load, with moderate shade and large wood.

The Signal Butte grazing allotment includes the headwaters of Jim Hunt Creek. Field observations in 1995 found that cattle appear to be using old, deeply rutted and undriveable roads as trails, dispersing out onto meadows in the headwaters of Saunders and Hunter Creeks. Jim Hunt Creek had densely brushy slopes, with the channel entirely shaded by shrub species. No cattle paths were found leading into the creek.

Information Needs: Stream channels need to be evaluated on site, to determine if roads or other management activities are affecting them. Increased flows from timber harvest and concentrated flows from roads could destabilize stream banks; increased sediment could aggrade or destabilize channels. Roads need to be evaluated for potential stream crossing failures and stream diversions. Priority watersheds are Wakeup Rilea Creek, Nail Keg Creek, and Bridge Creek.

Management Opportunities: Treat roads that are causing or have the potential to cause damage to stream channels, by improving drainage and stormproofing roads that will be left open, and decommissioning roads that are determined to have little future need.

What beneficial uses dependent on aquatic resources occur in the watershed? Which water quality parameters are critical to these uses?

The Rogue River and its tributaries in this watershed provide habitat and migration routes for anadromous fish, some species of which are listed as Threatened or Endangered (see Fisheries section). They also provide water for domestic use and irrigation. The river provides recreational boating, fishing, and swimming, including habitat for commercial fishing guides and tourboats.

Turbidity

Turbidity in the Rogue River varies over the course of the year, but is never absent. River color changes from green to brown with influx of sediment from storms or landslide activity in its major tributaries. Its turbidity has been attributed to algal growth in the summer, or to the various human activities on the land it drains: agriculture, urban, mining, timber harvest. It may be a natural condition, the cumulative effects of its geology and landforms aggregated over a basin of its size. One theory on the origin of its name is that it was a misspelling of "rouge" or red, from its reddish muddy color during storms. At the upstream end of this analysis area, the confluence of the Rogue and Illinois Rivers, the characteristic clarity of the Illinois contrasts with the Rogue as they flow side by side.

The tributaries are typical of coastal Siskiyou streams, running clear during most of the year. Turbidity during winter storms clears within a few days. Exceptions are the streams with large slump-earthflow features or other active landslides, which may contribute fine sediments at any time. Turbidity related to landslide activity is episodic and quite noticeable against the background water clarity.

Temperature

This section of the Rogue River was listed as water quality limited for temperature and pH in the 1996 and 1998 Oregon Department of Environmental Quality listing. Quosatana Creek was listed as water quality limited for temperature, exceeding the state standard of 64 degrees for this area. Recording thermometers have monitored temperatures since 1991 (see Map 10, Temperature Monitoring Sites).

Table 4. 7-Day Average Maximum Temperatures

Stream	Site	Years	Range of 7-Day Max
Rogue River	Crooked Riffle	1993-1998	72.3 to 77.6
Rogue River	Near Bradford Cr	1996	75.4
Rogue River	Kimball Bend	1994-1996	74.3 to 75.8

Bradford Creek	Near mouth	1992-1999	59.5 to 61.73
Quosatana Creek	West Fork mouth	1995	63
Quosatana Creek	East Fork mouth	1995	64.4
Quosatana Creek	River mile 2.5	1993-1997	63 to 66.9
Quosatana Creek	Near mouth	1991-1999	66.4 to 70.9

Release of water from dams constructed at Lost Creek and Applegate during the summer months may affect stream temperature in the Rogue River. Increased flow and release of water from the lower portions of the reservoirs would both have a cooling effect. Data on pre-dam temperatures have not been found.

Along tributaries, removal of riparian shade through timber harvest may have caused stream temperatures to rise (see discussion of riparian condition under Riparian Ecosystem).

Information Needs: Riparian vegetation should be evaluated for actual versus potential effects on stream shade.

Management Opportunities: Treat riparian stands that have the potential to increase shade by thinning overstocked areas and/or planting trees in under-stocked areas.

Fisheries

What is the character of fish populations in Rogue River below Agness?

Salmon and trout in the Rogue River below Agness are members of the lower Rogue River stocks. They share life histories and population trends with salmonids produced from the mouth of the Rogue River upstream to near Stair Creek at river mile (RM) 43 of the Rogue, excluding the Illinois River, which enters at Rogue RM 27.

Nearly all fish production in the lower Rogue basin occurs in tributaries. Winter flows in the mainstem are too powerful and can mobilize the stream bottom of the mainstem, destroying eggs laid in the gravel. The lower Rogue River flows through a narrow canyon with short, steep tributaries. Few tributaries have well-developed habitat for salmonids. Below Agness, only Lobster and Quosatana Creeks offer extensive salmonid habitat. These two watersheds are covered in separate Watershed Analyses. The tributaries covered in this discussion are short and steep and generally provide steelhead, anadromous cutthroat and resident trout spawning and rearing.

Characteristics of lower Rogue River salmonids are that fish spawning here tend to enter the river at the end of the adult migration runs, the juveniles enter the ocean earlier than upriver fish and in the ocean, they migrate south and stay close to shore (Rivers, 1991 and Meehan and Bjornn, 1991).

Lower Rogue River fish have shared the historic decline in numbers witnessed throughout the Rogue River since the late 1800s. The most telling example of the decline is the output of the salmon canning industry centered out of Gold Beach, at the mouth of the Rogue. Fish caught in the river from the mouth up to Lobster Creek were the basis of the industry. In 1861, entrepreneurs in the fish canning industry labeled Rogue River runs as large, or larger, as any in Alaska. A canning industry thrived at Gold Beach into the 1930s. At the peak of fish canning, packs contained up to 82,500 adult chinook in 1917 and 50,500 adult coho in 1928. However, when the state legislature finally banned commercial fishing on the Rogue River in 1935, the action was virtually unopposed because fish were so scarce the canning industry could not support itself (Rivers, 1991). Besides over harvest, factors contributing to this initial steep decline of Rogue River fish included climatic changes and dams, mining and water diversions in the upper basin (Rivers, 1991). From 1922 to 1935, 6 million pounds of salmon were canned (Jerry's Rogue Museum).

Four species of the genus *Oncorhynchus* (Pacific salmon and trout) use the Rogue River below Agness. Coho (*O. kisutch*) and chinook (*O. tshawytscha*) are the traditional Pacific salmon. All individuals must migrate to the ocean and each adult is capable of making only one spawning run from the ocean, after which it must die. *O. mykiss* (the Latin name for both steelhead and rainbow trout) and *O. clarki*, cutthroat trout, have more flexible life histories. Both resident and anadromous populations of each exist in the lower Rogue River. Individuals of these species can make more than one return migration to freshwater and can spawn more than once in their lifetime. These life histories are typical of the species throughout their ranges, not just in this section of the Rogue River.

Because of the diversity of salmonid stocks, which use the upper Rogue River, there are adult fish below Agness throughout the year. These fish are the basis of both a world-class sport fishery and of the culture of the human communities along the Rogue River. Anglers support a large portion of the economies of the communities of Agness and Gold Beach. Numerous lodges and guide businesses have developed to serve these anglers.

Non-salmonid species of fish in the lower Rogue River include the anadromous Pacific lamprey (*Lampetra tridentata*), whose populations are suspected to be in decline throughout their range, yet about which very little is known. There are potentially three species of sculpin (genus *Cottus*) in lower Rogue River: coast range (*C. aleuticus*), prickly (*C. asper*) and reticulate (*C. perplexus*). Redside shiners (*Richardsonius balteatus*), a non-native minnow, were first detected in Jump Off Joe Creek near Grants Pass in the 1950s (Rivers, 1991). Three-spined sticklebacks (*Gasterosteus aculeatus*), brook lamprey, squawfish, and small mouth bass also occur in the lower Rogue River (Ernie Rutledge, personal communication).

In addition to naturally spawning fish, culture has long been a part of the watershed. A hatchery has existed in Indian Creek, along the estuary of the Rogue River since the mid-1850s. Fall chinook adults return to the mouth of Indian Creek and are collected there as broodstock. Historically, however, this hatchery used upper Rogue spring chinook as broodstock.

Coho Salmon

Coho in the Rogue River are part of the Southern Oregon/Northern California group, which was listed as Threatened in 1997 under the federal Endangered Species Act. The distribution of these coho extends from the Elk River in Oregon south to the Mattole River in California. The estimated abundance of these coho ranged from 150,000 to 400,000 spawning fish. Today, the group is down to approximately 10,000 naturally produced adults. The Rogue River is one of the major remaining coho producers (NMFS, May 6, 1997). Within the Rogue River, coho predominantly spawn and rear in the upper Rogue and the Illinois Rivers. The upper Rogue population is mostly hatchery fish. Most wild coho production in the Rogue occurs in the Illinois River tributaries. The population of adult spawners in the Rogue River was calculated for the years 1990 through 1996 based on mark and recapture seining at Huntley Park, river mile (RM) 8. During that time, coho adults averaged 3401 individuals, with a low of 174 in 1993 and a high of 5386 in 1996 (Nickelson, 1998). The same report estimates that a total of 5400 adult spawners are needed to fully seed the best habitat. Because of the historic lack of classic coho habitat features, lower Rogue coho spawners are believed to be strays from the upper Rogue River or Illinois River groups and not remnants of a discrete lower Rogue River population. Below Agness, coho spawn in low numbers in the South Fork Lobster and in Silver Creek. Coho have also been seen in a tributary to Quosatana Creek. However, it is likely that when coho populations were higher, a larger number of strays used the marginal habitat available in lower Rogue River tributaries.

Adult coho enter the Rogue River in the late fall to spawn. Eggs incubate in gravel streambeds until early spring when the fry emerge. Juvenile fish will stay in their natal streams for over one year congregating in the medium-sized streams. They migrate out of the system in late spring of their second year of life. Most Rogue River coho spend two years in the ocean before returning to spawn (Rivers, 1991). Since juvenile coho spend a full year in mid-sized streams they depend on high quality habitat features throughout that year. High summer water temperatures (in the upper 60 degrees Fahrenheit), little instream cover or slackwater areas to escape high flows in winter and a general low-density of instream wood are habitat features of the mid-sized streams that do not promote coho production (see Temperature Section). These conditions are typical of mid-sized streams in the coast range of southern Oregon, where coho production is low. These conditions do not affect other salmonids to the degree that coho are affected. Chinook migrate out of tributary streams by mid-summer and do not overwinter there, avoiding both high summer water temperatures and high winter flows. Steelhead and cutthroat rely on smaller tributaries, which are cooler than larger streams in summer and have lower flows in winter.

Fall Chinook

Rogue River fall chinook are part of the Southern Oregon and Northern California Coastal Evolutionarily Significant Unit (ESU). The range of this ESU is from Cape Blanco, Oregon south to the Klamath River in California. This ESU was proposed for listing as Threatened under the federal Endangered Species Act, but was determined to not warrant listing in September 1999.

Fall chinook salmon in the upper Rogue River were identified by NMFS, March 9, 1998 as the only relatively healthy population in the entire ESU. This is a stream-type stock, meaning that juveniles typically enter the ocean during the second year of life, migrate further distances in the ocean, enter freshwater as spawners early in the fall and then migrate long distances to headwater streams (Healy, 1983). Lower Rogue River chinook are ocean-type fish. They enter the ocean within the first year of life and stay relatively close to shore, then enter freshwater to spawn late in the fall of their third year of life and spawn in streams low in the system.

During the late 1980s, the combination of drought, stream habitat degradation, low ocean survival and high ocean exploitation rates in the Klamath Management Zone resulted in a severe decline in chinook populations in all of the Oregon coastal basins south of Elk River. River angling for chinook in several southcoast basins, including the lower Rogue River, was closed during this time. Populations began to improve in 1991 with a sharp curtailment in ocean harvest coupled with the end of drought conditions by 1993 (ODFW, 1997). Juvenile trapping data show a positive trend in smolt production in lower Rogue River tributaries since the early 1990s. The sport-angling season in the lower Rogue River still closes on September 30 to protect these chinook. Prior to September 30, the fishery in the lower mainstem is targeting spring chinook, which spawn in the upper Rogue River.

Adult fall chinook enter the Rogue River in late summer and disperse throughout the watershed to spawn as streamflow allows. Spawning is usually completed by the end of December, after which all chinook die. Fry emerge from the gravel in the spring and start migrating downstream almost immediately. Downstream migration peaks between the end of May and the middle of July and then continues at a declining rate throughout the summer (ODFW, 1997). During mild winters some juveniles can stay in the river. In the spring of 1998, 123 one-year old chinook were caught in the Lobster Creek juvenile migrant trap (ODFW, 1998). After migrating out of freshwater, these chinook will spend two or three years in the ocean before returning to spawn.

Winter Steelhead

Winter steelhead in the Rogue River are part of the Klamath Mountains Province (KMP) ESU. This ESU was proposed as Threatened under the Endangered Species Act in 1996. However, in 1998 the ESU was determined to not warrant such a listing, based on recovery efforts in the states of Oregon and California. The ESU extends from the Elk River in Oregon south to, and including, the Klamath River in California. The NMFS estimates the current abundance of this ESU to be 85,000 with an historic abundance of greater than 275,000 (NMFS, July 1996). The ODFW estimates that the population of winter steelhead in the Rogue River between 1970 and 1987 averaged 44,000 adult spawners annually. The same estimate since 1990 is 55,000 adults, which indicates a positive trend in the population (RVCOG, 1997).

Winter steelhead spawn in tributaries throughout the lower Rogue River. Steelhead have a more variable life history than coho or chinook. They can spend one to several years rearing in freshwater and can survive reproduction to return to the ocean. In streams their sleek body proportions allow them to ascend steeper gradients and use smaller streams for spawning and rearing. They also roam more within a basin to locate suitable spawning habitat. Winter steelhead enter the Rogue River to spawn in the late fall and spawning continues into April. Fry emerge from late spring to early July. Most steelhead will spend almost 2 full years rearing in tributaries before smolting and migrating to the ocean in the spring. After typically 2 years of ocean rearing they will return to spawn. A small percentage of the population will return to freshwater after only one year. These so-called “half-pounders” are sexually immature and will return to the ocean again before making a spawning run.

Summer Steelhead

The Rogue River produces the largest run of summer steelhead in Oregon, outside of the Columbia River system. The only other Oregon coastal streams that produce summer steelhead are the Hood, Siletz and North Umpqua Rivers. The Rogue River is also unusual in that it supports three forms of *Oncorhynchus mykiss* sympatrically: resident rainbow trout, winter steelhead and summer steelhead.

Adult summer steelhead enter the Rogue River from the ocean between May and October. An early run, 10 percent of the population, enters in May, June or July. The late run, 90 percent of the population, enters in August, September or October. Adults hold in pools, completing sexual maturation, until they spawn in the winter (December through March). Fry emerge from gravel nests between April and June. Juveniles rear in tributary streams for two to four years before migrating to the ocean. Summer and winter steelhead have some overlap in time and space for egg laying and rearing activities. They are distinguished from each other mainly by the timing of their adult runs and the degree of gonad maturity upon entering freshwater.

Summer steelhead do not spawn or rear in the segment of the Rogue River below Agness, nor its tributaries. They are a middle and upper Rogue River fish, with important spawning and rearing grounds in tributaries including the Applegate River.

Adult summer steelhead migrate upstream through the Rogue River between May and October. Pre-smolt juveniles migrate downstream from their natal streams to the estuary between April and June.

Rogue River summer steelhead also exhibit an interesting, non-spawning migration known as the "half-pounder" run. Half-pounders are small, sexually immature steelhead 11 to 16 inches long. They return to freshwater with the late-running adults in August and September, after only three to four months in the ocean. Instead of migrating upstream to spawning tributaries, half-pounders stay in the lower and middle Rogue River mainstem over the winter, then return to the ocean in the spring. Half-pounder steelhead are found in the Rogue River below Agness during the autumn and winter.

While 95 percent of summer steelhead exhibit the half-pounder migration pattern, it is not exclusive to them. Approximately 30 percent of the winter steelhead population in the Rogue River will also make a half-pounder run. The reason for the half-pounder run is not well understood. One theory is that these fish follow spawning spring Chinook into the rivers to take advantage of the large food resource provided by Chinook eggs. Another is that the half-pounders are escaping adverse ocean conditions. Other than the Rogue River, half-pounders are found only in the Klamath and Eel Rivers of Northern California.

Summer steelhead use many of the same streams winter steelhead use for spawning and rearing but also spawn in smaller streams, often spawning in streams that dry up during the summer.

Because summer steelhead are in freshwater as adults during the time of lowest flow and highest temperature, they require pockets of cool water. In the section of the Rogue River below Agness, summer steelhead will hold up in deep pools or at the mouths of tributaries that have cool water. Before the Lost Creek Dam was completed in the early 1970s, the summer water temperature of the mainstem Rogue River was two to three degrees warmer than the Illinois River, which enters immediately downstream of Agness. Summer steelhead would stay in the lower Illinois River until the Rogue River cooled in the fall, and then continue up the Rogue River. Now Lost Creek

Dam reserves and releases cool water into the Rogue River, and summer water temperatures are usually cooler in the Rogue than the Illinois. As a result, summer steelhead no longer hold up in the Illinois River.

Summer steelhead that spawn in the Rogue River system, especially in the middle Rogue, are the weakest population of the Klamath Mountains Province steelhead ESU. Census information collected at Huntley Park shows a 25 percent decrease in population size since the mid-1980s. Both summer and winter steelhead are propagated at Cole Rivers Hatchery and released into the Rogue River. Wild fish are not incorporated into the brood stock and little interaction between wild and hatchery stock is thought to occur on the spawning grounds.

Anadromous Cutthroat Trout

Both resident and anadromous cutthroat trout occur in the lower Rogue River. Multiple age-classes of cutthroat are consistently present in coastal Oregon streams, and forces driving their complex life histories are poorly understood (ODFW, April 1997). Anadromous cutthroat usually rear in freshwater for two, three or four years before smolting. Yearling cutthroat appear to be displaced from prime habitat by other salmonid yearlings, probably because they emerge later and are, therefore, smaller. They commonly return to freshwater to overwinter without spawning. Females begin spawning at age 4 and can survive to spawn up to 4 or 5 times. Spawning occurs in late winter and early spring (Trotter, 1997).

Resident Trout

Both rainbow and cutthroat trout occur in resident forms in the lower Rogue River. They occupy the uppermost reaches of most tributaries and commingle with the anadromous forms throughout the basin.

What is the character of fish habitat in the watershed?

Fish habitat in the analysis area is shown on Map 11, Salmon and Trout Distribution, and can be grouped into three general categories: the mainstem Rogue River, the large tributaries and the small tributaries. Each has a distinct physical and biotic regime.

Mainstem Fish Habitat

The dominant habitat feature in the watershed is the mainstem Rogue River, which provides 27 miles of primarily migration habitat for fish. This is a major river, with a low stream gradient, a wide active channel and powerful winter streamflows. It flows through a narrow canyon from river mile 27 down to river mile 17. Active floodplain development is minimal. Perched terraces are remnants of an older baseline. Downstream of river mile 17, the river valley opens up, the gradient decreases further, and extensive gravel bars form. Downstream of river mile 5 tidal waters influence the flow. Large islands form and the river flows through multiple channels. These are important rearing and smolting habitat for salmon and trout (see also Channel Morphology section).

The region receives a high amount of precipitation between October and June and very little the remainder of the year. This results in a flow regime of extremes to which fish respond. During peak flows in late autumn, winter and spring the entire channel is submerged, with only the largest estuarine islands remaining. Further upstream only the inactive terraces are above water.

To escape the force of the flow, fish hold on the margins of the channel, in submerged tributary mouths and in eddies behind boulders. Spawning is restricted to the tributaries, where streamflows are lower and do not wash away fish eggs incubating in gravel streambeds.

By late summer the wetted channel is, in many places, reduced to only a fraction of the total channel width, revealing wide gravel bars as well as islands in the estuary. Exposed to the sun, mixed water temperatures rocket into the low 70s during late summer (see Temperature section), and fish hold in cooler water found at the bottom of deep pools and at the tributary mouths. During low flow conditions, the wetted channel is separated from the influences of forest riparian vegetation by bare rocks. Seasonal emergent rushes, willows and herbs line the channel margins. By mid-summer, mats of filamentous green algae have developed in shallow water and provide nutrients and structure for photosynthetic, invertebrate and amphibian organisms.

Large wood is absent from the mainstem channel. Powerful storm flow and a wide channel result in large wood being flushed downstream, out of the watershed. Structural habitat diversity is provided by boulders and bedrock outcrops. Deep pools and turbidity provide instream cover. In the lower 5 miles of the river, where islands disperse the force of the river, pockets of large wood accumulate at river bends. These are important rearing structures for juvenile and smolting salmonids.

Boat Use

A highly visible element of mainstem fish habitat is the extensive boat use. Boaters are drawn to the lower Rogue River for its celebrated fishery, scenic beauty and whitewater reputation. They bring a wide variety of watercraft and dominant uses change with the seasons.

During the summer small rafts, kayaks and canoes make day trips down the lower Rogue River. Adventure seeking kayakers and rafters occasionally ply the mainstem during high spring and winter flows. Anglers use drift boats during all angling seasons from Agness downstream. Motorized angling boats travel both upstream and downstream during the fishing seasons. Boats access the lower Rogue River from the Port of Gold Beach, near the mouth of the river, and from boat ramps scattered throughout the lower Rogue River. On the National Forest, boat ramps are located at Lobster Creek Campground (river mile 11) and at Quosatana Campground (river mile 14).

Tour boats, take visitors up the Rogue River to view the scenery and wildlife and experience the white water. These are larger craft, carrying up to 60 passengers. From May through October, several trips are made daily. They leave from the port of Gold Beach and travel through the entire lower Rogue River. Small, personal use jet boats travel the mainstem year round for transportation. This level of boat use is not limited to the section of the Rogue River below Agness. Upstream of this section, both rafting and motorized boating continue up into the Grants Pass area.

Studies of the effects of boats on fish have been made, some specifically on the Rogue River. Direct observations were made on fish subjected to a variety of boats in the Rogue River. Fish greater than 5 meters away from a boat generally had no response, fish respond more to oar boats than to motorboats and no fish were found stranded on the bank in the wake of a boat (Satterthwaitte, 1994). In Alaska, it was found that in shallow water jet motors can destroy redds (Horton, 1994). Horton also observed that adult sockeye salmon seldom responded to motorboats, and when they did, they returned to their redds within seconds. He also observed that adult sockeyes always moved off their redds when bears or people walked into the river and did not return for several minutes. Considering the width and depth of the Rogue River, it is unlikely that boats are individually causing serious harm to adult or juvenile fish. The cumulative effect is undocumented. Intuitively, the continued presence of fish after decades of extensive boat use suggests that boats, while likely adversely affecting fish, do not constitute an insurmountable negative force.

Boat docks and launch pads exist in several places throughout the watershed. From a human convenience standpoint, the first choice for launch locations are at cobble and gravel bars, which are abundant throughout the watershed. These are naturally resilient places and the launch facilities rarely require much habitat modification or limit biological productivity. In other rivers with banks of fine, easily eroded soil, motorized boats have decreased bank stability and increased turbidity (Lindsay, 1992). This is not a concern in the Rogue River, where banks are either armored with cobbles or solid bedrock.

Large Tributaries

Two tributaries in the section of the Rogue River below Agness are large enough to allow significant salmon spawning and/or significant trout rearing. The remaining tributaries have very small drainage areas and are generally too steep to support fish in all but their very lowest reaches. The large tributaries are Lobster and Quosatana Creeks, which enter the Rogue River at river mile 11 and 13, respectively. Each of these creeks has an individual Watershed Analysis completed and neither is discussed in this document.

Smaller Tributaries

Other than Lobster and Quosatana Creeks, the remainder of the tributaries in the Rogue River below Agness are short, steep and provide limited fish habitat (see Stream Profiles). Jim Hunt, Kimball and Silver Creeks provide limited Chinook, steelhead, and possibly coho habitat. Bradford, Wake-Up Rilea, Nail Keg, Tom East and Painted Rock Creeks provide short segments of steep habitat for resident trout. Tom Fry Creek provides a short segment of Chinook and possibly coho habitat at its very mouth, and more extensive steelhead, anadromous cutthroat and resident trout habitat.

Estuary

The estuary of the Rogue River extends 5 miles upstream of the Pacific Ocean and contains large islands and multiple channels. This is important rearing habitat for juvenile coho and Chinook. It is also important holding habitat for adult salmon and trout which wait for high winter flows before migrating further upstream.

Information Needs: Culverts on small tributary streams need to be investigated for the degree to which they block or impede fish migration.

Management Opportunities: There is a need to prevent sediment delivery from roads throughout the basin, especially in those tributaries known to support fish. Many culverts are reaching the end of their life and threaten streams with mass delivery of sediment. Many roads are no longer needed and can be modified or decommissioned to reduce hydrologic effects.

Riparian forest conditions, which have experienced previous harvest and are now overstocked and stunted, especially adjacent to fish-bearing streams, need to be thinned to allow growth of large conifers. This would increase the potential for shade and large wood in streams.

Culverts determined to be barriers or impediments to fish should be replaced with fish-passing structures, where practicable.

Fire suppression has increased the amount of forested land and decreased the amount of meadow or grasslands in the watershed. Streams that flow through meadows provide different aquatic and riparian habitat and nutrients than those which flow through forests. Restoring meadows to their former range in the watershed would recover the meadow aquatic and riparian processes that have been lost to fire suppression. Aquatic and riparian diversity in the watershed would be restored.