Salmon River Subbasin Restoration Strategy: Steps to Recovery and Conservation of Aquatic Resources

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Summary

This strategy aims to accelerate rehabilitation of watershed conditions within the Salmon River subbasin by targeting collaborative restoration and protection efforts at high priority drainages. Using an ecosystem-based foundation, the proposed approach focuses on restoring the biological, geologic and hydrologic processes which ultimately shape the quality of aquatic habitat within the subbasin. Building upon information gathered through watershed analyses, transportation planning documents (road access and travel management plans or roads analysis process), and other administrative investigations, this strategy articulates an action plan focused upon reduction of upslope hazards in drainages retaining high quality aquatic habitat and intact native fish communities. This approach embraces the philosophy that protection of healthy watersheds and initiating preventative actions where water resources are threatened provides the most cost-effective path to meeting anadromous fish recovery goals. Multi-year restoration objectives as well as recommendations on target watershed conditions are included in this action strategy. Implementation of this action plan will result in conditions, which leave the Salmon River subbasin less vulnerable to the adverse effects of future floods and severe wildfire. Comprehensive roads and fuels treatments, applied subbasin wide, are estimated to cost $48 million, emphasizing the critical need to employ a priority base strategy for future restoration investments.

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Introduction

Throughout much of the Pacific Northwest natural runs of anadromous salmonids have significantly declined both in number and geographic range (Nehlsen et al. 1991; Higgins et al. 1992). Causes of these declines are often numerous, however, elimination or degradation of habitat essential to support the life history needs of these species is frequently a contributing factor. The financial, technical, and geographic scope of watershed rehabilitation needs is enormous while the distribution of naturally reproducing intact anadromous salmonid communities is in decline. This dilemma, and relative failure of past approaches to reverse the loss of anadromous fish and their habitat has resulted in development of new, priority-based approaches to watershed rehabilitation and protection (USFS 1993; Bradbury 1995; Frissel 1997).

The Salmon River subbasin has some of the highest anadromous fisheries values in the Klamath River basin. It is part of a network of Key Watersheds that serve as refugia for at-risk salmon and steelhead stocks in the Pacific Northwest, due in part, to its remarkable habitat quality. The Salmon River is somewhat unique among watersheds in California in that it still retains viable runs of anadromous salmonid species that have disappeared from much of their historic range within the state. These values combine to highlight the importance of a systematic restoration strategy that secures and maintains the watershed integrity of the Salmon River and its tributaries.

The Salmon River subbasin is an ideal candidate for development of a restoration strategy at this time. Considerable information is available pertaining to the natural resources of the Salmon River, having been compiled through administrative studies, Watershed Analyses, Late-Successional Reserve Assessments, and research investigations. The Salmon River has been identified as a high priority (key watershed) by the Northwest Forest Plan (USFS 1994a), and Klamath River Basin Assessment (USFS 1997a). In addition, enthusiasm and commitment for cooperative stewardship of the Salmon River subbasin exists among local citizens, the Salmon River Restoration Council, the Karuk Tribe, California Department of Fish and Game and the Forest Service.

This strategy builds upon information gathered through ecosystem analyses (USFS 1994b; USFS 1995a; USFS 1995b; USFS 1997b; USFS 1999), road access and travel management plans (USFS 1996; USFS 1997c; USFS 1998), and other administrative investigations (de la Fuente and Haessig 1994; Olson 1996). Notable progress has been made within the Salmon River subbasin in habitat rehabilitation and understanding of salmonid habitat relationships. In addition, the proposed actions complement recommendations of previous action plans focused upon recovery of salmon and riparian habitats (West 1991; USFS 1992).

The Klamath River Restoration Task Force (Task Force) has embraced the need for comprehensive subbasin restoration planning with identified goals, priorities, and actions in order to efficiently apply funds to watershed rehabilitation efforts. Through interagency agreement 14-48-11333-98-H019, this project (1) integrates information from Watershed Analysis and other subbasin investigations, and (2) provides an ecosystem-based, strategic watershed restoration approach for the Salmon River subbasin.

In addition to providing a basis for evaluating proposed projects submitted to the Task Force for funding consideration, subbasin planning can be used to focus watershed restoration activities sponsored through other funding sources in order to accelerate and complement desired outcomes. The *Salmon River Subbasin Restoration Strategy* can assist in: (1) identifying current watershed conditions and assessment needs, (2) identifying the intensity of watershed restoration necessary to meet Desired (Target) Conditions, (3) targeting geographic areas with the potential to provide the most sub-basin benefits, (4) focusing limited funding on high priority restoration needs, and (5) promoting education, cooperation and mutual support among subbasin stakeholders.

Background and General Characterization

The Salmon River is one of the most biologically intact ecosystems left. It remains the largest cold water-producing subbasin in the Klamath Basin. Located in remote northwestern California, the headwaters of this 751 square mile riverine system flow predominantly from the Marble Mountain, the Trinity Alps, and the Russian Wilderness areas (**Figure 1**). The Salmon River has long been known for its exceptionally high quality waters and high value fisheries as well as boasting one of the richest regions of species diversity in the temperate zones.

Cultural

The Forest Service administers an estimated 98.7% of the Salmon River subbasin land base with the remaining 1.3% in other ownership (private, state and county). Of the National Forest lands within the subbasin, 45% are managed as federally designated wilderness and approximately 25% as Late-Successional Reserve (**Figure 2**). The Karuk Tribe of California's Ancestral Territory occupies 60% of the subbasin. Several thousand acres of public lands are reserved as mining claims in accord with the 1872 Mining Law that entitles the claimant to mineral rights.

There are approximately 250 people that currently reside within the subbasin. Residences are dispersed throughout the subbasin with concentrations located in, or near, the towns of Sawyers Bar, Cecilville, Somes Bar and Forks of Salmon. In addition the community is made up of several outlying small neighborhoods and isolated forest residencies. There are currently several interest groups in the Salmon River subbasin: the United States Forest Service; California Department of Fish & Game, California Department of Forestry and Fire Protection; Siskiyou County, Karuk Tribe of California, resource users (mining, logging, grazing, recreation, fishing and others) and various community entities such as: Salmon River Restoration Council, Volunteer Fire & Rescue, schools and stores.

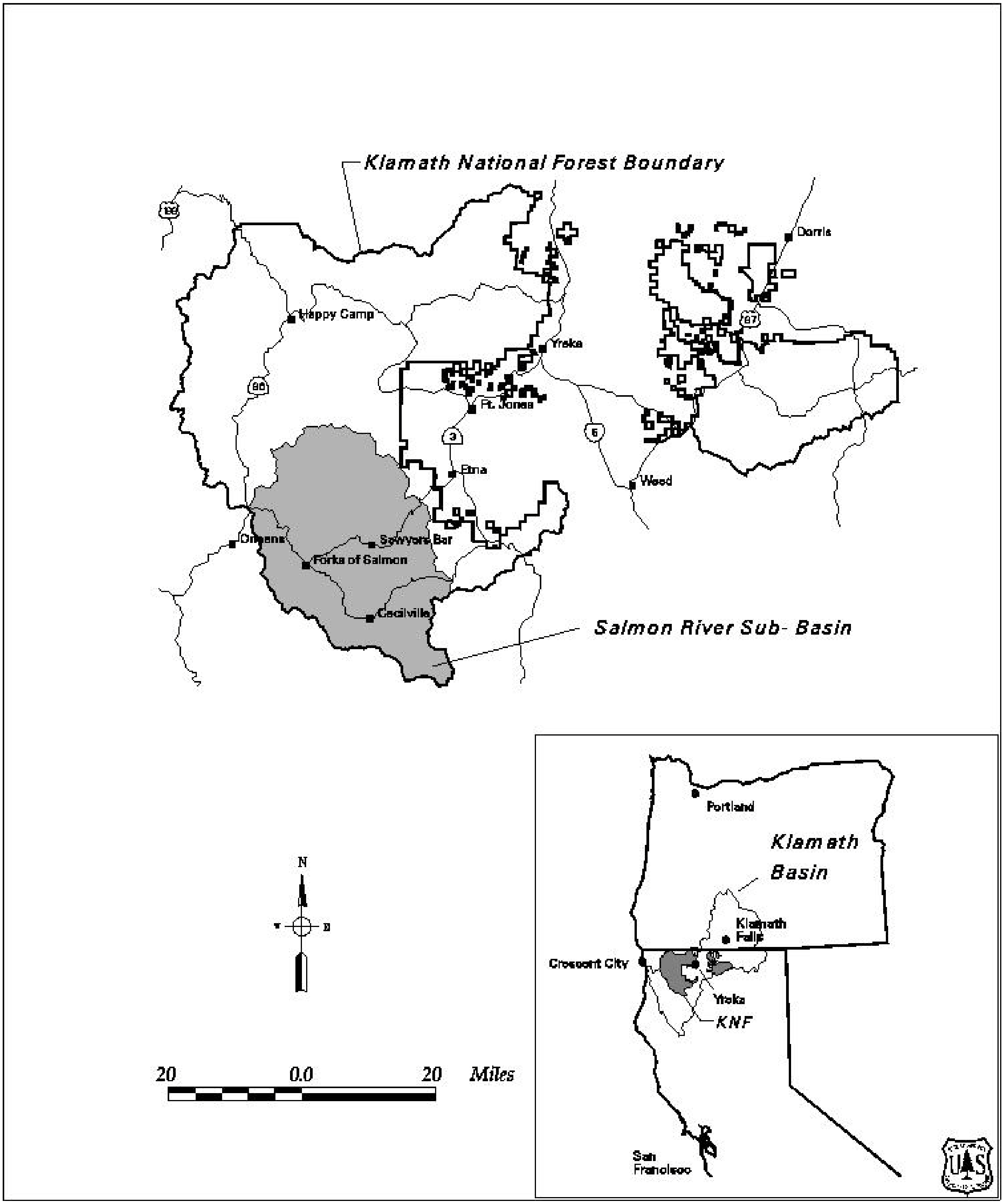

Figure 1. Salmon River subbasin, Siskiyou County, California.

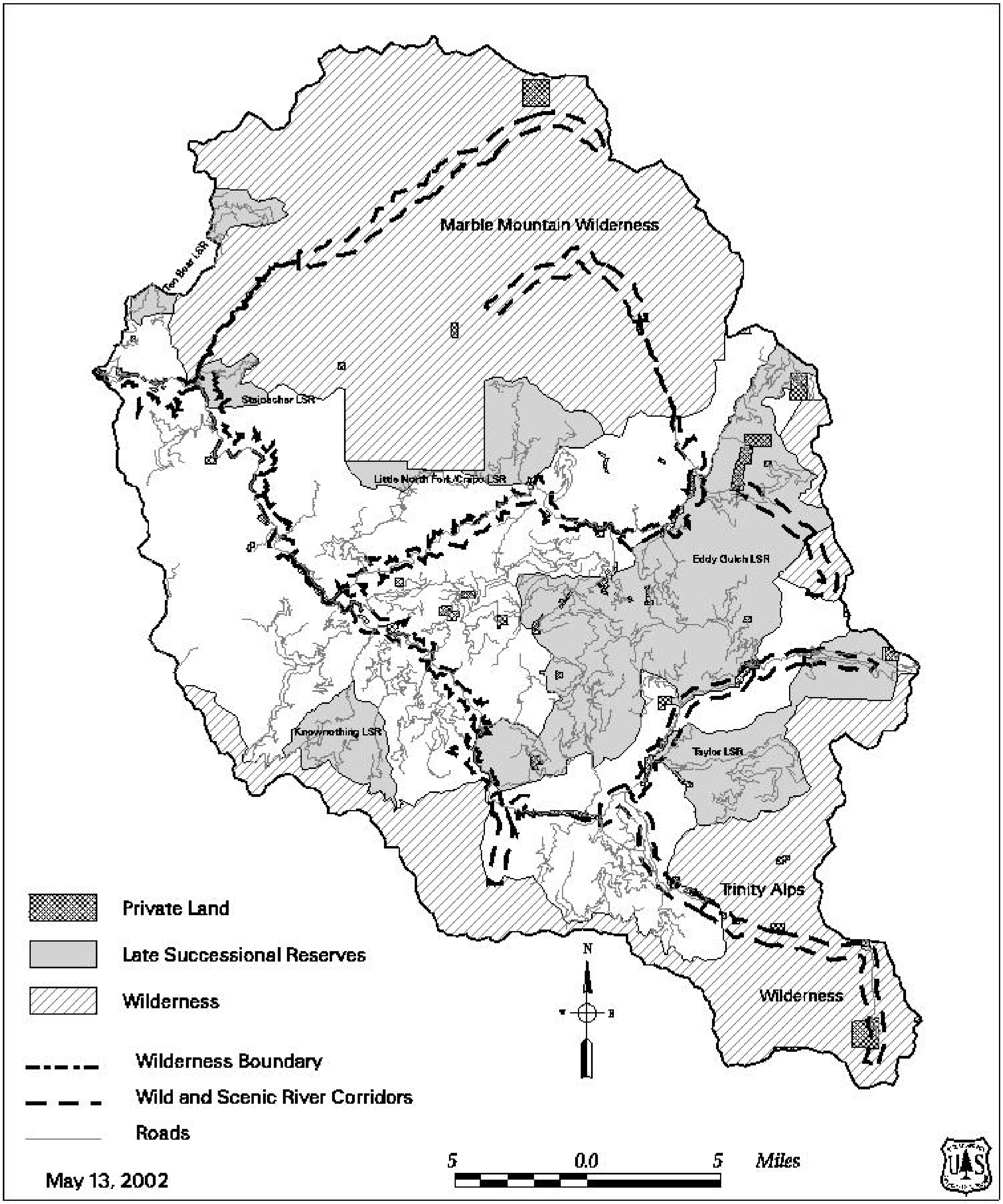

Figure 2. Ownership and major Forest Service land allocations within the Salmon River subbasin.

Hydrology

The Salmon Basin (4^{th} field hydrologic unit) is subdivided into four major watersheds (5^{th} field hydrologic units), North Fork (130,468 acres), South Fork (185,608 acres), Wooley Creek (95,188 acres) and Main Stem (69,362 acres). Approximately 1,414 miles of stream drain these watersheds. The largest of the watersheds, the South Fork has 509 miles of stream or 36% of the total. The Salmon River subbasin contains sixty-three drainages (7^{th} field hydrologic units), ranging in size from 3,300 to 14,500 acres, while averaging 7,625 acres (**Figure 3**). Elevations range from 500 feet to 9000 feet.

Along much of its course, the river flows through a rugged gorge in which rock outcrops and bluffs are common. Several temporary landslide dams have formed along the Salmon River and its tributaries this century, with local influences on in-channel habitat and possibly fish passage. Periods of high precipitation, seismic events, and activities that disturb the soil or the vegetation can initiate landslide activity, which in-turn has resulted in major channel alterations through out the watershed. The hydrologic characteristics of the watershed are defined by climate and topography. Precipitation within the Salmon River Watershed varies from over 80 inches in upper Wooley Creek to less than 40 inches along the South Fork. Intense, localized summer showers frequently occur, and have been associated with soil erosion and debris torrents. Average annual discharge for the Salmon River is approximately 1.2 million-acre feet.

Geology

The Salmon River watershed is situated within the Klamath Mountains physiographic province, and includes three distinct rock belts. These are the Western Paleozoic and Triassic Belt, the Central Metamorphic Belt, and minor portions of the Eastern Klamath and Western Jurassic Belts (Irwin 1960). The belts consist primarily of metasedimentary rock such as chert, argillite, and marble, metavolcanic rock, (primarily basaltic lavas), and ultramafic rock such as serpentinite and peridotite. Numerous granitic batholiths are also present, the largest of which are the Wooley Creek and the English Peak Batholiths. The generalized geologic map shown in **Figure 4** illustrates important geologic units, which affect mass wasting and other surficial processes.

At various locations in the river basin, ancient terrace deposits as well as older erosional surfaces are preserved. The older river terraces occur up to several hundred feet above the present river channel and are identified by their deeply weathered, red, clayey soils. More recent terrace deposits occur near the active channel of the streams and consist of sand, gravel, and boulder deposits. Landsliding is a dominant geomorphic process in the area. Large slump/earthflow deposits occupy much of the Western Paleozoic and Triassic Belt, particularly along Blue Ridge that forms the divide between the north and south forks of the Salmon River. Active slumps and earthflows up to 20 acres in size occur within these deposits. Debris landslides and avalanches are common in some areas, particularly in headwall areas and within the inner gorge.

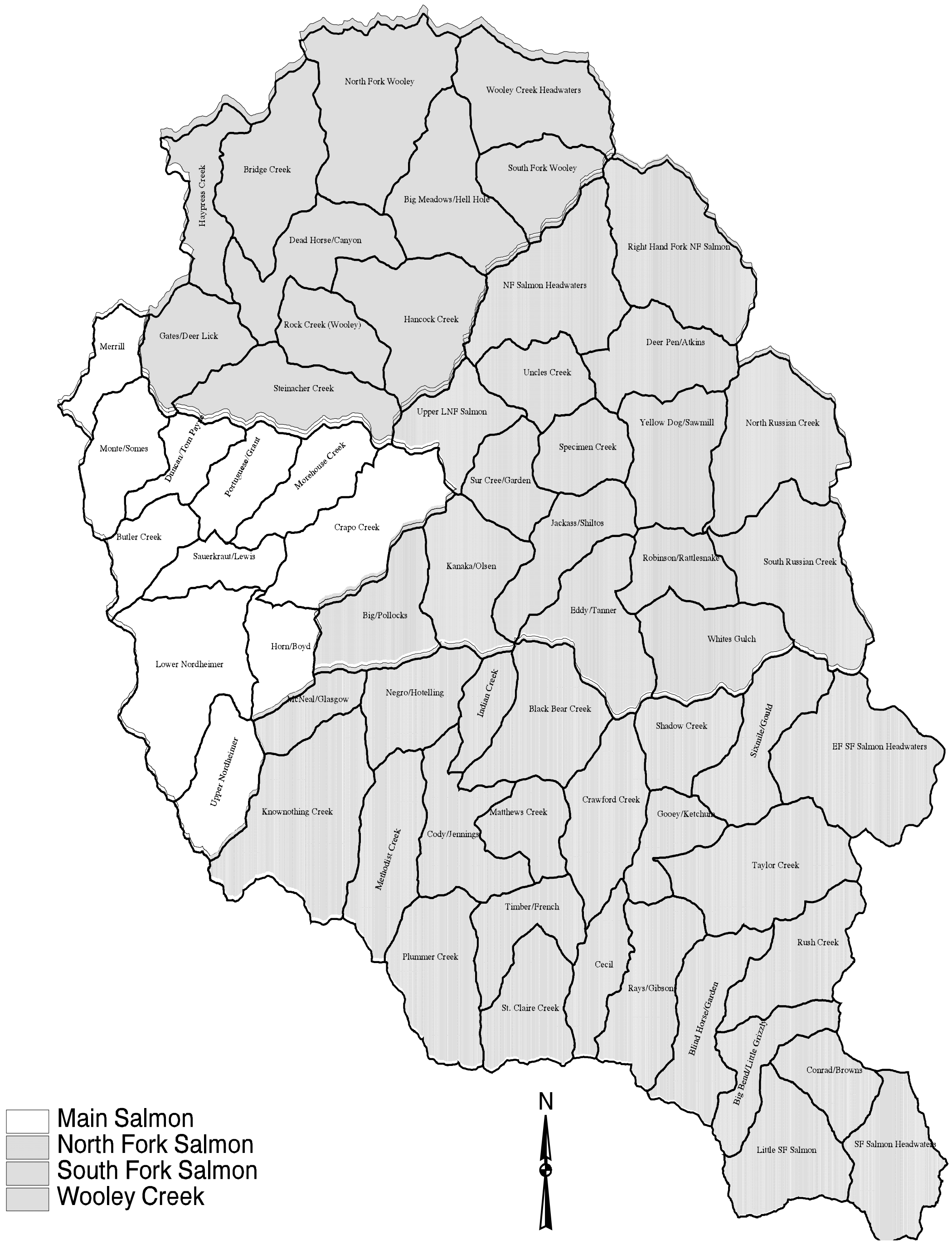

Figure 3.. Hydrologic units at the watershed and drainage scale of the Salmon R subbasin.

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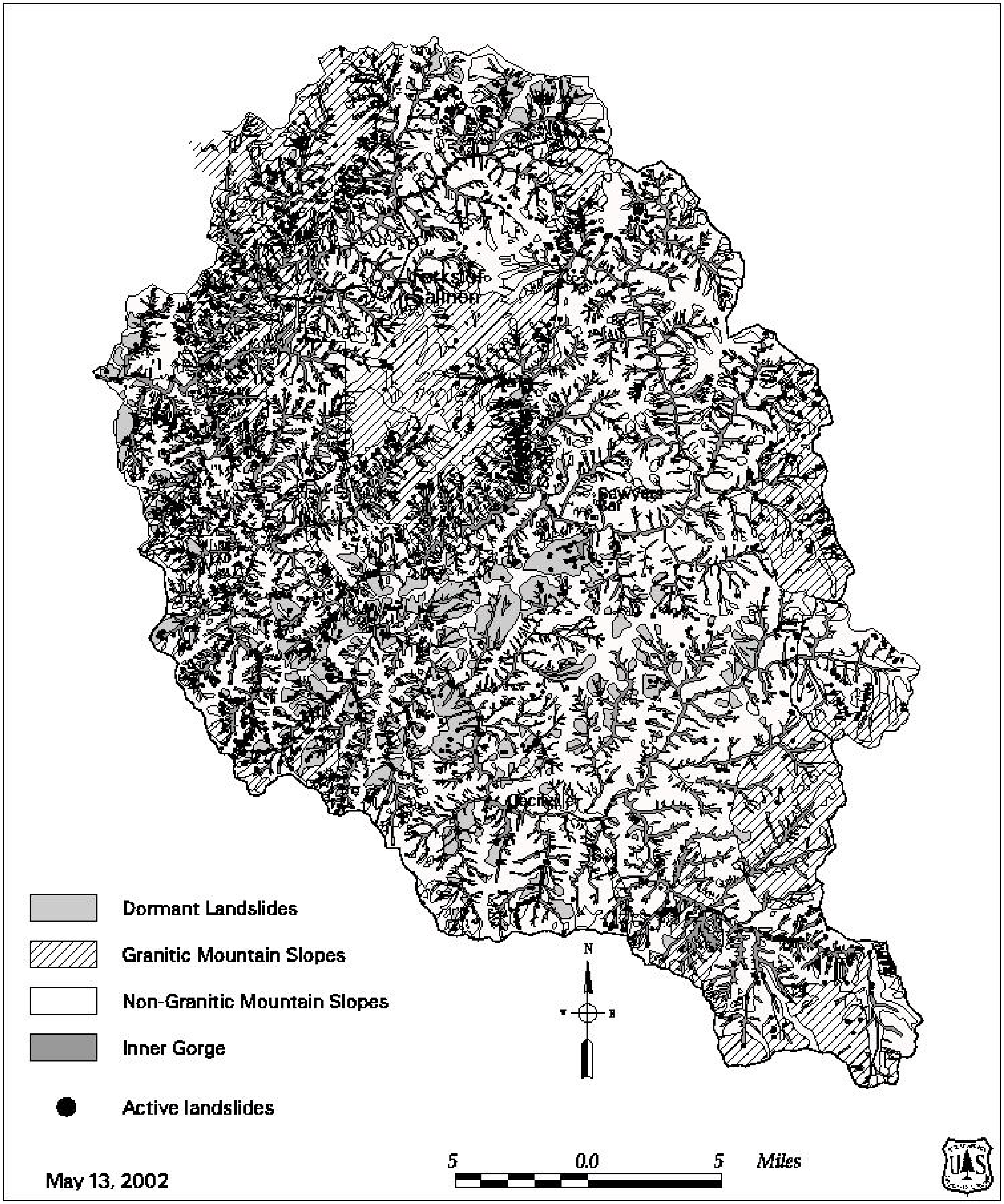

Figure 4. Geologic features within the Salmon River subbasin.

Fisheries

The Salmon River subbasin supports a coldwater resident and anadromous fishery which includes: spring and fall run chinook salmon (*Oncorhynchus tshawytscha*), summer and winter run steelhead (*O. mykiss*), coho salmon (*O. kisutch*), sea run Pacific lamprey (*Lampetra tridentata*), and green sturgeon (*Acipenser medirostris*). Non-anadromous species include Klamath speckled dace (*Rhinichthys osculus Klamathensis*), Klamath small scale sucker (*Catostomus rimiculus*), and marbled sculpins (*Cottus klamathensis*). Threespine sticklebacks (*Gasterosteus aculeatus*) may be present in the subbasin, but their use of the habitat is unconfirmed. Introduced fish stocks include American shad (*Elosa sapidissima*), brown trout (*Salmon trutta*), and brook trout (*Salvalinus fontinalis*). An estimated 376 miles of coldwater fish habitat exists within the Salmon River subbasin, including approximately 175 miles of habitat supporting anadromous salmonid fish species. Anadromous habitat is distributed among tributaries of the Main Stem, Wooley Creek, North Fork and South Fork Salmon River (**Figure 5**). Resident fish habitat is also distributed among the many perennial lakes (estimated 530 acres) and although some nature reproduction occurs, trout populations are largely maintained through an active stocking program by the state.

The subbasin provides habitat for the largest wild run of spring Chinook salmon in the entire Klamath River system; it is possibly the largest remaining wild spring Chinook run remaining in California (West 1991). Many experts believe Salmon River subbasin to be one of the major refugia for spring Chinook salmon in California (USFS 1993; Campbell and Moyle 1991). Snyder (1931) provided an early account of spring Chinook within the Klamath River, which suggested that although once plentiful enough to support commercial cannery operations, these runs were in decline by the turn of the century. Historic accounts of run size information for spring Chinook in the Salmon River is largely unknown, however Moyle (1995) cites the Klamath-Trinity drainage once supported populations of 100,000 or more. Recent census records indicate run size has varied between 132 and 1,473 since quantitative counts began in 1980 (**Chart 1**). Annual escapement for spring chinook remains highly variable with no clear trend evident. In some years, escapement is low enough to place the population at elevated risk of significant mortality due to stochastic events.

Fall and spring-run steelhead are the most widely distributed anadromous fish species within the subbasin, often occupying small tributaries and steeper gradient channels not commonly utilized by coho and chinook. Adult summer steelhead are frequently found occupying holding habitats similar to adult spring Chinook: the mainstem and both forks of the Salmon River. Quantitative information on winter-run steelhead population abundance is incomplete and information on population trends unavailable. Quantitative assessment of summer steelhead adult holding has been conducted since 1980 for the sub-basin and tributary Wooley Creek since 1967. The overall population trend for summer steelhead abundance appears to in decline since 1980, largely due to depressed numbers since 1990.

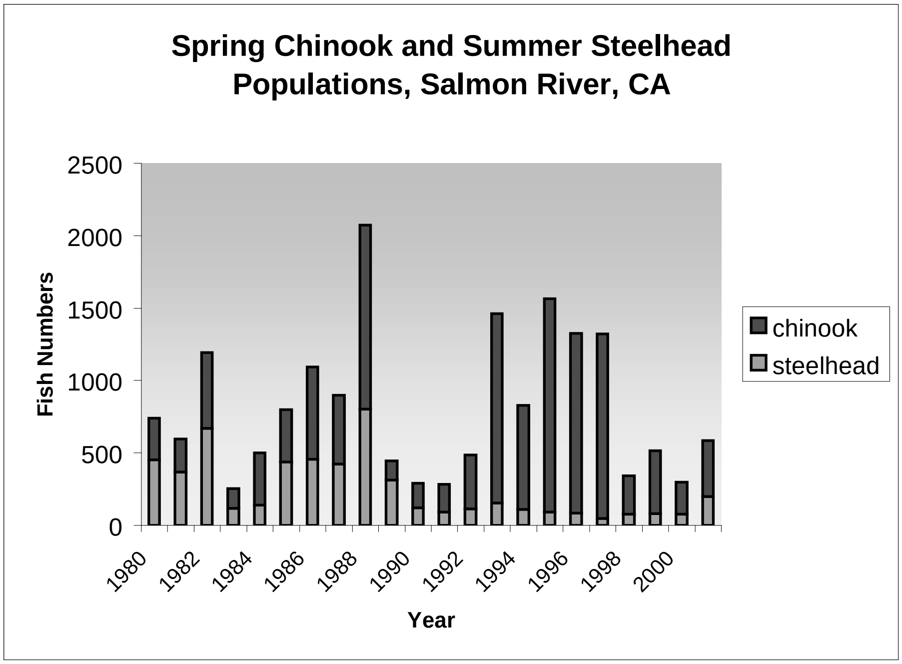

Chart 1. Summer steelhead and spring chinook population trends 1980 – 2001.

The escapement of fall-run chinook salmon has been monitored since 1978 in the Salmon River subbasin and largely reflects little hatchery influence. Because of the overlap between fall and spring-run chinook spawning habitat utilization in the lower reaches of the North Fork and South Fork, fall-run numbers may be inflated. Although there have been periodic sharp declines in some return years, the general population trend has been an increase in number (**Chart 2**).

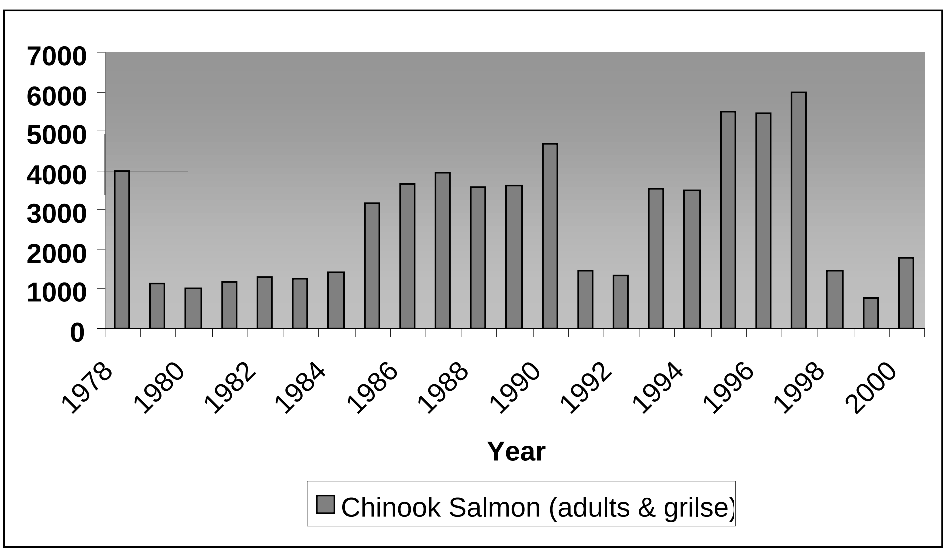

Chart 2. Fall chinook salmon population trends 1978 – 2000.

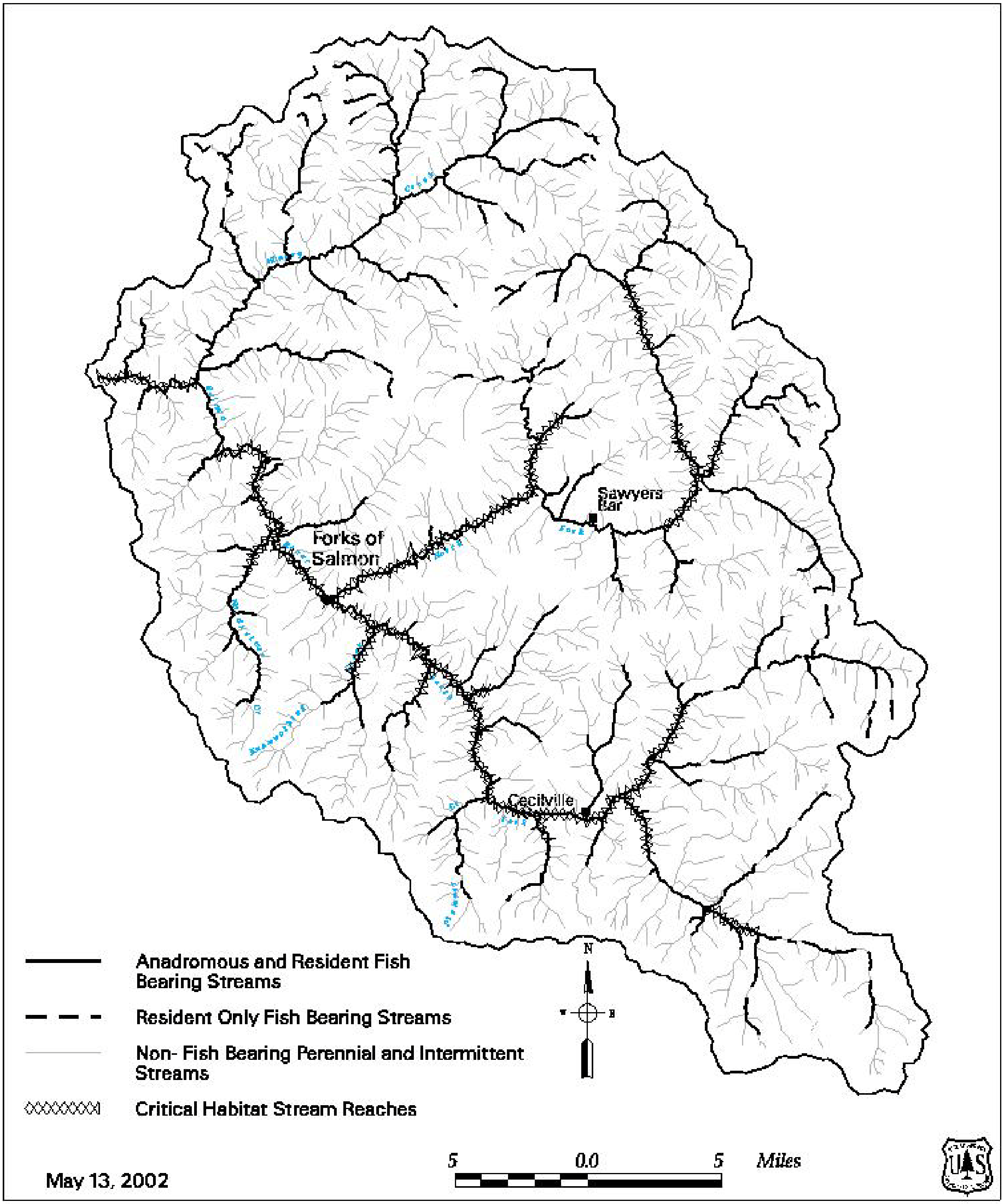

Figure 5. Geographic range of anadromous and resident fisheries and critical anadromous fish habitat within the Salmon River subbasin.

Vegetation

The Salmon River is known as one of the richest regions of species diversity in the temperate zone. The Salmon River basin is primarily a forested landscape with about 90% in forest cover. The majority of the forested land (81%) is coniferous forest with 9% in hardwood forests. The coniferous forests can be divided into the mixed conifer, Douglas fir, and true fir types. There is also a small amount of knobcone pine forest type (> 1%).

Fire/Fuels

The frequency, extent, and severity of fires strongly influence development patterns of forests dominated by Douglas fir in the Pacific Northwest. Disruptions in natural fire regimes by human intervention in suppression have influenced vegetation and sediment delivery patterns in the Salmon River subbasin. High fuel loading and densely stacked forest stands has increased the likelihood of frequent or extensive stand replacing wildfires. It is estimated that 29% of the Salmon River subbasin has burned since the early '70s (**Figure 6**). Catastrophic fires in this area are known to denude riparian and upslope areas, which increases water temperatures and sediment production.

Wildlife

The Salmon River watershed is home to many wildlife species such as: fishers, northern spotted owl, wolverine, and more recently elk. More than 25% of the Salmon River is designated as Late Succession Reserve (**Figure 2**). It is known for having rich botanical diversity, boasting one of the most diverse coniferous stands on the planet. The recent trend of frequent large fires will make it difficult to maintain late-successional habitat or grow early-seral stands to late-successional habitat.

Education and Cooperation

The US Forest Service is involved in various cooperative efforts. Several federal, state, county agencies, tribes, academic entities, community interests, and other private and public interests have and are participating in various cooperative efforts.

One active entity is the Salmon River Restoration Council (SRRC). The goal of the SRRC is to "promote cooperative planning, education and management efforts between the agencies, the local tribes and the community for protection and restoration of the Salmon River". A short-term goal is to "Increase 'stakeholder' support for ecosystem management through planned educational and cooperative activities." (SRRC Community Restoration Plan, 1999).

The Karuk Tribe of California and the United States Forest Service have a government-to-government relationship and a Memorandum of Understanding for cooperative fire management of areas within the Karuk Ancestral Territory. Various cooperative restoration and adaptive management projects and activities have resulted.

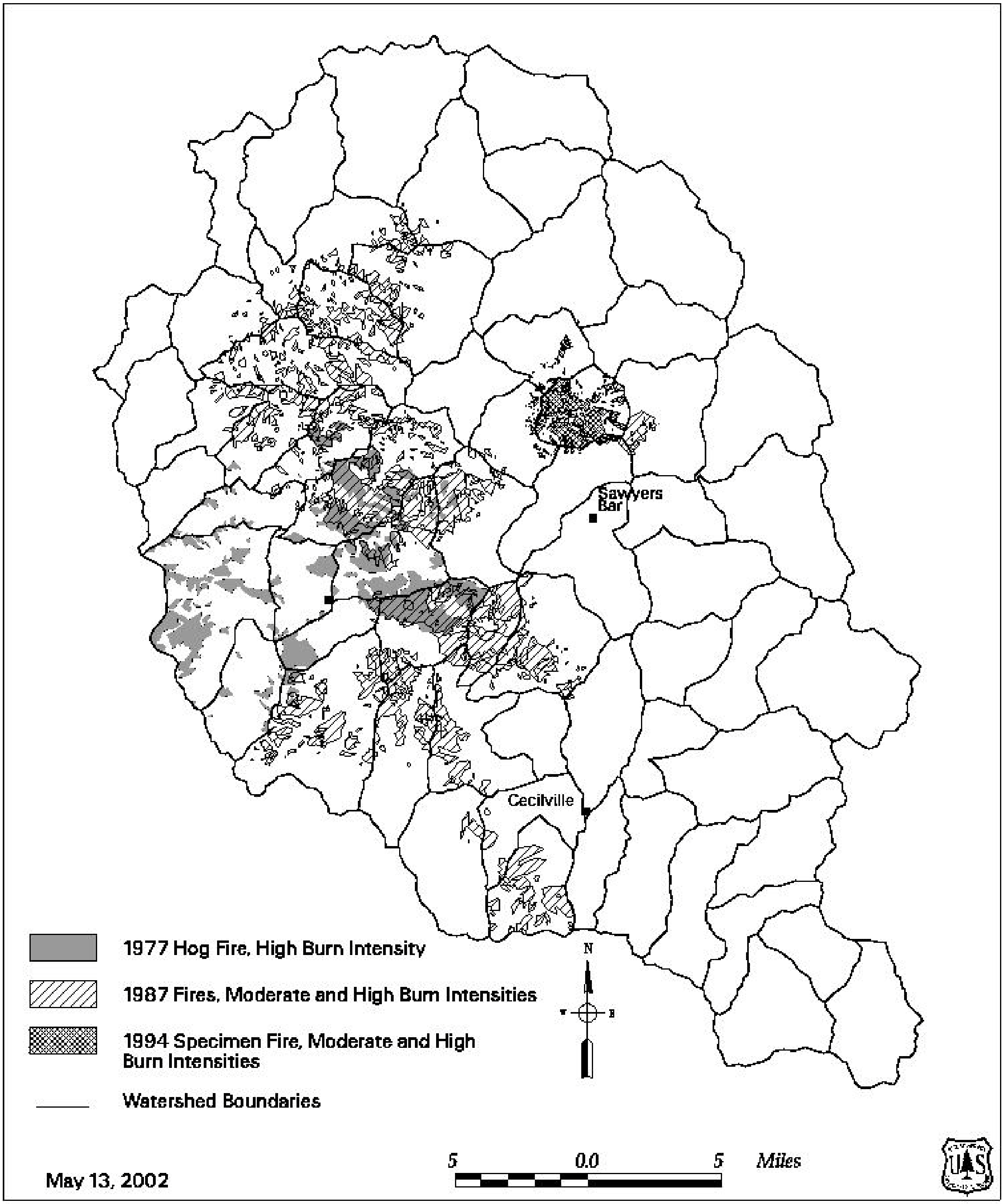

Figure 6. High intensity wildfire history within the Salmon River subbasin.

Current and Reference Conditions

Cultural

Humans have been an integral part of the area ecology for thousands of years. Early use and settlements that followed have been in low elevations in the river canyons and contributing streams. The region's past ethnographic cultures are the most complex in the United States, reflecting diverse prehistoric and historic use patterns, and human adaptations.

In the past, the Karuk, Shasta, and Konomihu Indians inhabited the area. The Salmon River is still historically significant to the Shasta and Karuk people. Landscape features and elements of the landscape are all inherent and important to current use and ceremonial activity by the Karuk. The Karuk believe that the Main stem Salmon watershed is one of the most culturally significant watersheds within the Klamath National Forest.

The area economy has progressed though several eras. In the 1800s, the economy was influenced primarily by the explorer-fur traders and gold-seeking adventurers. After the turn of the century, agriculture and timber became the primary source of income.

Europeans, Chinese, and Euro-Americans moved into the area beginning in 1850. News of the discovery of gold triggered a substantial immigration to the region in the summer of 1850. By the 1920s, mining declined substantially and rural life was reduced to a core of established families. Mining activities increased slightly again during the depression years and continues to influence the local economy.

Human uses are occurring within the watershed in the traditional use areas of mining, ranching, and recreation. Current recreation uses include camping, fishing, hiking, hunting, mountain biking, recreational dredging, sightseeing, kayaking, swimming, and woodcutting.

There are portions of seven grazing allotments and two livestock use permits in the Salmon River subbasin. The season ranges from April 15 to October 15.

The North Fork Salmon River is a designated component of the National Wild and Scenic Rivers system, based on its anadromous fisheries values. The river contains both Recreational and Wild River Segments.

Mine tailings, waste and discharge are possible sources of water contamination. Of concern are the fine-grained mine tailings from milling or other chemical-based processes used to extract gold from ore. Most, if not all, mill tailings produced from mining in the 1800's and early 1900's have been flushed through the stream system. Arsenic is commonly found in detectible concentrations in many of the natural waters of the area, as well as from mine discharge. It is not considered a water quality concern because of low concentrations. Currently, the known threat to water quality is from natural and disturbance-related sedimentation. There are more than 400 mining claims in the Salmon River subbasin. These include both placer and lode claims.

For more details, see Klamath National Forest Ecosystem Analyses and other pertinent documents listed in the reference section below.

<u>Hydrology</u>

In the late 1800's several large gold mines and mining towns were carved into the watershed of only 4 towns remain today. Major channel modification occurred in many areas, particularly in the upper South Fork of the Salmon River. Between 1870 and 1950 over 15 million cubic yards of sediment was washed off the mostly riparian hillsides with water cannons and sent down the river. The areas disturbed by hydraulic mining activities include an estimated 1,220 acres of land. Many large tailing piles still exist today, limiting riparian function.

It is suspected that water quality deteriorated, upon the influx of miners, due to mining activities that began in the 1850s. The river and streams were dammed, diverted and drained for mining activities. Estimates indicate about 15.8 million cubic yards of sediment were discharged into the Salmon River between 1870 and 1950 as a result of gold mining activities; primarily hydraulic mining. Hydrologic mining impacts are still apparent today by bare slopes and large tailings that still exist within the subbasin. One of the most disturbed areas was the upper South Fork Salmon River, above its junction with East Fork. There is little to no data on the historical amounts of chemicals used to extract the gold.

Information from historical accounts indicates that there were major floods in 1861-62 and again in 1889-90 (McGlashan and Briggs, 1939). The flood of 1861 was apparently larger then the 1964 flood. Analysis of the 1944 aerial photos reveals that at that time, most stream channels were fully vegetated with a mixture of conifer and hardwood species. Major floods occurred in the Salmon River in 1953, 1955, 1964, 1970, 1971, 1972, 1974, and 1997. The floods of 1955, 1964, and 1970 to 1974 are associated with landslide episodes on the Klamath National Forest. The 1964 flood had major impacts on many of the stream channels of the subbasin resulting in major stream channel widening and modification. In the beginning of 1997, a large flood event took place on the Salmon River and elsewhere in the region. Impacts particularly in the South Fork of the Salmon River included loss of pool depth and frequency as well as channel scouring and loss of the riparian vegetation.

Roads are an on-going source of sediment to the river by surface erosion and landslides. By 1944, there were about 188 miles of roads; by 1989 the miles of road on federal lands had increased to 762 miles or 3,639 acres. It is estimated that more than 90% of the human caused sediment is associated with roads (USFS 1993). In the Salmon Subbasin, roads account for 43% of the model-estimated surface erosion (Appendix A: A-9).

The importance of rain-on-snow effects during flood events is contentious. It is the position of this paper that the rain-on-snow influence has been greatly exaggerated by hydrologists. According the Army Corps of Engineers' *Snow Hydrology* manual and based on empirical data, it would take about 10 inches of rain at 48°F to melt one inch of snow water content. In other words, huge quantities of rain are necessary to melt relative small quantities of snow; snow will "absorb" rain until high specific gravity saturation is reached and melt can begin. Warm air can melt snow packs – not necessarily rain-on-snow.

For more details, see Klamath National Forest Ecosystem Analyses and other pertinent documents listed in the reference section below.

Geology

Landslides and other forms of erosion are natural processes, which formed the landscape long before European settlement. The extent of hillslope erosion has been dependent on the complex interactions of fires, climatic conditions, seismic events, tectonic uplift and stream adjustment, and the natural sensitivity of the rock and soil to erosion. Floods and landslides have periodically occurred. Deep-seated, slow-moving landslides (typically slump and earth flows) dominate on landscapes underlain by metamorphic bedrock, while shallow, fast-moving landslides (debris slides) are the chief mode of mass-wasting failure on granitic bedrock. Deeply weathered granitic bedrock exists in the subbasin and is prone to debris slide/debris flow mass-wasting failures and accelerated fluvial surface erosion.

During the 20th century, most of the landslide-derived sediment (75%), which entered the stream system, was associated with flood and storm events that occurred from 1964-75. This time period includes the 1964 flood and other significant storm events during the following 10 years. Roads produced landslides at a rate much higher than undisturbed land. Harvested or burned areas produced landslides at a rate much lower than roads, but still higher than undisturbed lands. Higher road densities associated with lands sensitive to accelerated erosion from mass wasting are of particular concern due to elevated risk of sediment production (**Figure 7**).

Prior to 1955, a considerable amount of landslides with channel scour were visible in higher elevations of the subbasin, above the 5,000-foot elevation, with smaller amounts of channel scour in the lower elevations (1944 photos). Later stream scour events (the floods between 1955 and 1974) show different patterns with most landslides at lower elevations. The reasons for the differences are probably strongly tied to climatic variables with a secondary consideration of disturbance history.

A total of ~216 miles of stream were scoured by debris flows associated with landslides from 1944-1988. This consisted of 221 acres in Wooley Creek, 222 acres in the Main Stem, 240 acres in the North Fork, and 208 acres in the South Fork of the Salmon River. During the interval 1965-1975, the acres of channel damage amounted to 42 miles and 127 acres. In 1997 the South Fork Salmon River and Wooley Creek again experienced channel scour and aggregation. Some of the stream reaches have scoured multiple times over the past 60-70 years. There is no significant correlation between the scoured channels and recent human disturbances. The majority of disturbed channels are natural features, related to natural sensitivity, and local runoff patterns.

For more details, see Klamath National Forest Ecosystem Analyses and other pertinent documents listed in the reference section.

<u>Fisheries</u>

It is difficult to determine the historical population size of salmon and steelhead in the Salmon River subbasin, however fish numbers were sufficient to supply the primary subsistence food and be the basis for the economy of the indigenous people prior to the mid-1800s. By the mid-1930s it was reported that anadromous fish populations within the Klamath Basin were already significantly jeopardized (Taft and Shapovalov, 1935).

Within the Salmon River subbasin, there were several historical water diversions and dams, which blocked fish migration (Taft and Shapovalov 1935, Handley and Coots 1953). A dam near Sawyers Bar on the North Fork of the Salmon River prevented fish from migrating above the town until the 1950's. Another dam located four to five miles above the Forks of Salmon on the South Fork of the Salmon River, blocked migration for approximately 50 years or more.

Presently, water temperature is a concern for fish. Tributary temperatures are below lethal levels, however the main stems can get well above lethal levels. This was observed in the summer of 1994 during a very low flow year. Fish kills were observed during the annual spring Chinook/summer steelhead count. Mortality was observed in adult as well as juvenile fish, and Pacific giant salamanders. Much of the subbasin is bedrock controlled, therefore affecting the amount of direct shade created by riparian vegetation on the main tributaries (North Fork, South Fork, and Main stem). In addition, the stream bank full and channel flood prone width is so wide, even old growth trees would not provide effective shade. Another factor working against maintaining sub-lethal temperatures in the river is aspect. The North Fork , South Fork, and Main stem flow west, therefore having a prolonged exposure to thermal input from the sun. This in effect, heats the water as well as creates a heat sink in the bedrock banks. Most shade provided to the main tributaries is from topography. Therefore, maintaining low temperatures in smaller tributaries is critical, particularly in low flow years.

Seasonal migration barriers (natural) are present in several tributaries and are most noticeable in low flow years. These barriers appear to segregate the spring run fish above from the mix of fall and spring fish downstream. The consequences (good or bad) of modification of these seasonal barriers during the last two decades are unknown.

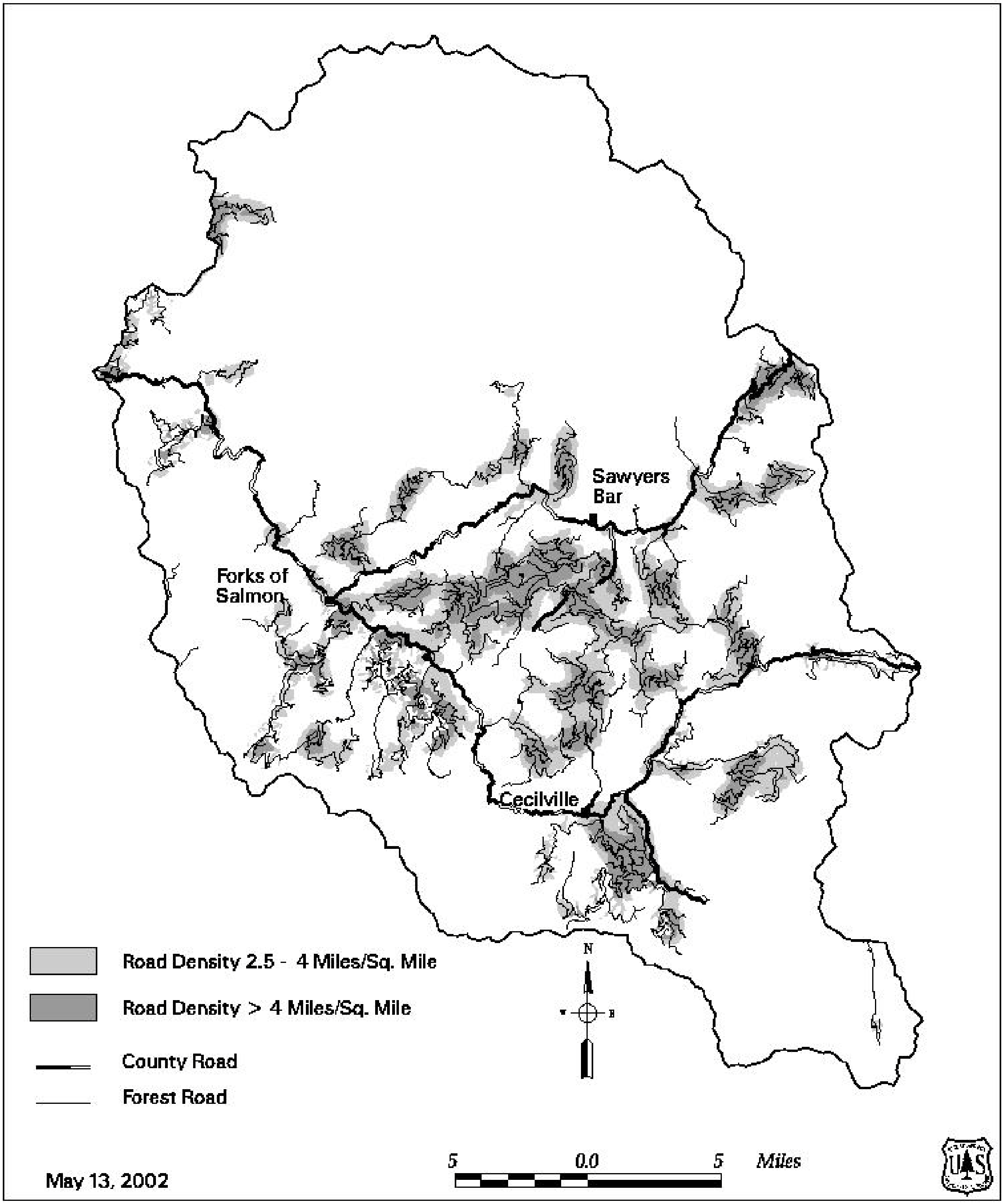

Figure 7. Areas of higher road density coinciding with lands sensitive to accelerated sediment delivery within the Salmon River subbasin.

Within the Salmon subbasin, Coho salmon are listed as *Threatened and* steelhead are listed as a *Candidate* species under the Endangered Species Act (ESA); summer steelhead and spring Chinook are managed as *Sensitive* species by the Pacific Southwest Region Forest Service.

For more details, see Klamath National Forest Ecosystem Analyses and other pertinent documents listed in the reference section below.

<u>Vegetation</u>

Evidence taken from Forest repeat photography, air photos and personal accounts, leads to the conclusion that forest settings 200 years ago were generally more open than today. Denser stands of conifers were found on north aspects, good soils, and in drainages. South aspects generally supported less dense stands of conifers with more hardwoods. Areas more intensely modified by American Indians generally are located within deep canyons adjacent to the Salmon River and tributaries.

The earliest timber harvest occurred in conjunction with mining and homesteading activities. Commercial harvest on public land did not begin until the 1950's. By 1974, there were about 7,500 acres of harvested public land in the watershed, and by 1989, there were about 30,000 acres (**Figure 8**). In several logged areas where little or no fuels treatment occurred, catastrophic fires have occurred over the landscape increasing erosion and water temperatures. The 1989 figures include about 18,000 acres of harvested land burned by the fires of 1977 and 1987. Several thousand acres are currently in plantation. These densely stocked plantations have a high likelihood of being consumed by wildfire before reaching maturity. They also increase the chance for stand replacing fires in adjacent larger stands.

In many lower and mid elevation areas and in high elevation areas that have not burned in the last 45 years, current vegetative structure and patterns have been greatly influenced by fire suppression policies, past logging and other management activities, and the wet climatic conditions that have been present for the majority of this century. With the combination of these influences, species composition has changed in those areas from more open stands of conifers and hardwoods on southeast to southwest aspect slopes to stands of a mixed conifer-hardwood overstory. Northern exposures generally support denser vegetation and have been less influenced by human activities, including fire suppression. Encroachment from shade-tolerant conifers creates a multi-storied stand. Fire-adapted and shade-intolerant species are not regenerating because of the increased shading and lack of fire to create openings.

More recently, noxious weeds have established themselves primarily in disturbed areas in the subbasin. There is concern that these weeds will displace native plant communities and the recovery of disturbed areas will be hampered, possible increasing the sediment budget [Community Restoration Plan 1999-SRRC].

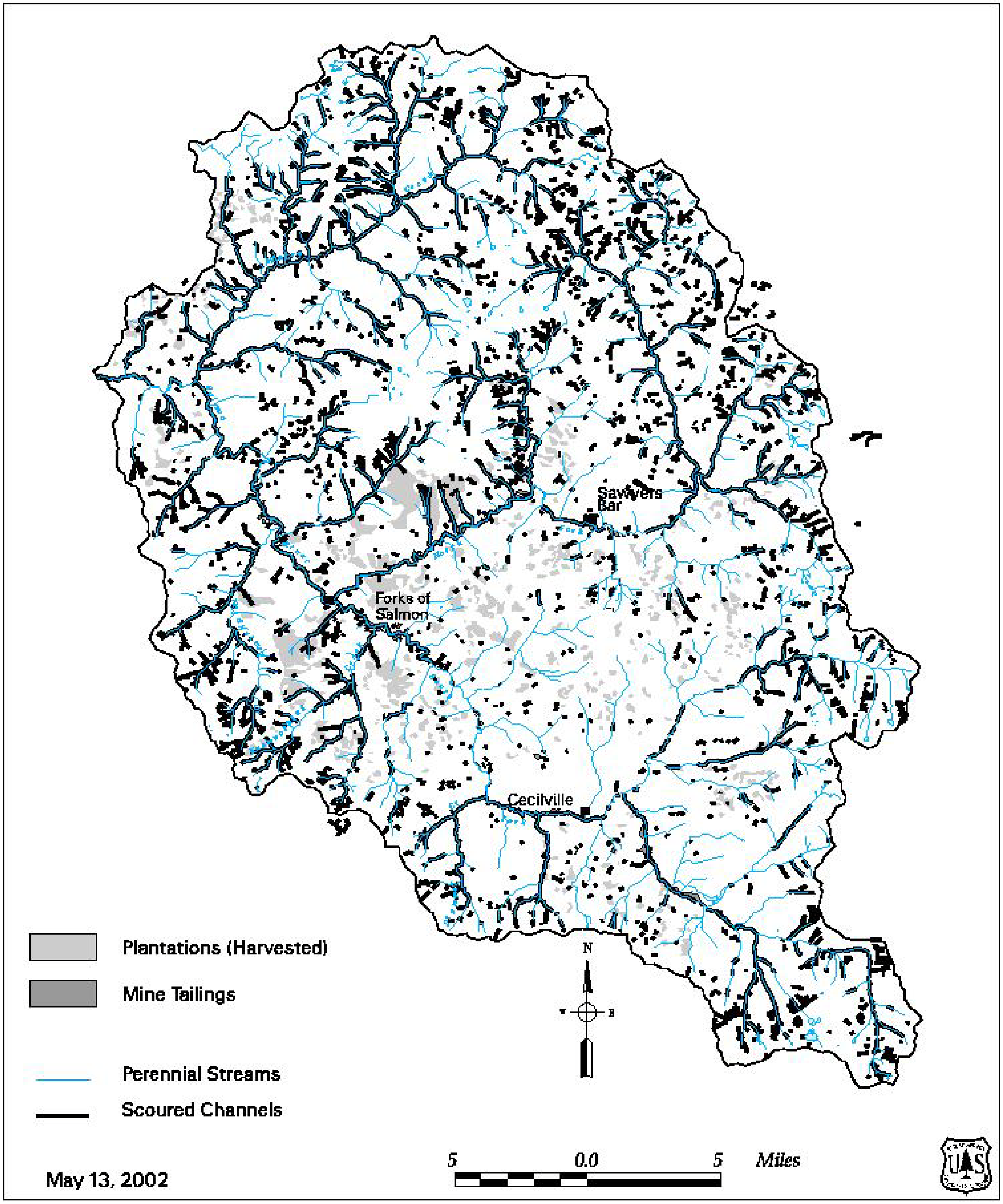

Figure 8. Distribution of timber harvest, mining, and scoured channels within the Salmon River subbasin.

Current risks to forest health include vegetative stocking density, insects, and disease. The exclusion of fire, combined with climatic conditions, has created overstocked stands. These conditions are found throughout the subbasin. Overstocking is occurring throughout the area, including plantations, resulting in stagnation of growth and vigor.

Shallow soils and harsh site conditions are generally associated with south, southeast, and southwest aspects on the mountain slopes. These site characteristics tend to favor shrub and live oak dominated hardwood stands because of their low water holding capacity, fertility, and high transpiration rates. Scattered conifers are associated with these terrane types and aspects. The north, northeast, and northwest aspects on the mountain slope terranes have deeper soil, higher water holding capacity and fertility, and lower transpiration rates, supporting denser stands of conifers. Madrone, black oak, and tanoak are the hardwood species generally associated with these sites.

Current vegetative structure and patterns have been greatly influenced by fire suppression policies and the wet climatic conditions that have been present for the majority of this century. With the combination of these two influences, species composition has changed from open stands of conifers and hardwoods to stands of a mixed conifer-hardwood over story with encroachment from shade-tolerant conifers, creating a multi-storied stand. Fire-adapted and shade-intolerant species are not regenerating because of the increased shading and lack of fire to create openings.

Early seral vegetation (grass, forbs, brush, and saplings) is found in large homogenous blocks in the subbasin. Most of this vegetation has developed as a result of the effects of wildfires that have occurred in the past 18 years. These vegetative types are very susceptible to rapidly spreading fire.

Fire/Fuels

Pre-European fire regimes could be characterized as fires burning with low to moderate intensities in most areas, with some smaller areas burning with high intensities. Fire return intervals averaged 20 years; shorter on exposed sites and longer on sheltered sites. Fire worked as both a thinning and a decomposition agent.

The past fire regime, prior to European settlement, within the Salmon River subbasin is described as having frequent fires (1-25 year intervals). Two recent fire history studies looked at fire regimes for two vegetation types found in the Klamath National Forest. Wills (1991) did a fire history study on Hotelling Ridge, located in the South Fork Salmon River watershed. This study revealed a pre-suppression fire return interval of 10-17 years in Douglas-fir/hardwood stands. In the Thompson Ridge area on the Happy Camp Ranger District, Taylor and Skinner (1994) have estimated pre-suppression fire return intervals for Douglas-fir/sugar pine between 15 and 25 years. Lightning and American Indian burning were the causes of ignition. Stand-replacing events were common in the subbasin, occurring when vegetative conditions were susceptible and ignition and weather opportunities were presented. However, they were only a few acres in size to a few hundred acres.

The southern exposures and drier sites tended to burn with higher severity. Fire would burn into the crowns in some locations while burning only in the ground fuels in others. This created a mosaic of vegetation types, sizes, and age classes within the watershed. During this fire regime, the south slopes were usually in a more open condition. Fire-created openings were larger on south slopes than on north slopes. Also, the lower on the slope the fire started, the larger the opening created.

Large fires that burned in 1917 and 1918 burned 6,270 and 15,660 acres respectively. Effective fire suppression began in the 1920's and has continued through today. In recent years large fires have occurred, with much of their area being burned at a high severity. Recent fires that have occurred in the Salmon River subbasin include the Off Fire (1973), Hog Fire (1977), the Yellow, St. Claire, Glasgow, Hotelling, and Nielon Fires (1987), and the Specimen Fire (1994) (**Figure 6**).

In recent years the Offield Fire (1973) burned the area near the river confluence. The Hog Fire (1977) burned extensively in the lower North and South Fork watershed and in Nordheimer and Crapo Creeks. The total area was about 80,000 acres. In 1987, wildfires burned 90,900 acres in four separate areas, covering much of the Salmon River subbasin.

It is estimated that 29% of the Salmon River subbasin has burned since the early 1970s. Catastrophic fires in this area sometimes are known to denude riparian and upslope areas, which may increase water temperatures. The Salmon Subbasin Sediment Analysis, 1994 provides evidence that denuding of steep, granitic slopes drastically increases the amount of sediment entering the streams and rivers below.

The assumption that fire suppression is the principal cause of unnatural fuel loading conditions is contentious. Many believe that fire suppression has been ineffective during big wildfires and in remote high elevation areas.

At present, fuel loading is at a high hazard level in many areas of the watershed. This current fuel loading threatens to severely damage the more biologically intact and/or recovering landscapes in the subbasin. The USFS Little North Fork Blowdown Salvage Environmental Assessment (1996) stated that "this area is a fuel model 10 (Timber Litter with under story)... If this fuel model is left untreated, it will be consumed by a stand replacing fire." Many areas within the Salmon River subbasin are considered to be a fuel model 10.

Fire starts by 7th-field watershed are shown in Appendix A: A-1. These historic fire starts were from Individual Fire Reports (Form 5100-29) and date back to 1922. A total of 2,292 were reported in the Salmon Subbasin. No spatial pattern was statistically significant, except that human-caused fire starts tended to concentrate along the roaded river corridor and natural fire starts (lightning) were preferentially distributed adjacent to ridges. These data were used in one procedure to assign ‘risk’ factor, where ‘risk’ was equal to fire starts per decade per 1,000 acres (see Tables, Appendix A: A-1 to A-5). Differences between human- and natural-caused fire starts were not factored.

For more details, see Klamath National Forest Ecosystem Analyses and other pertinent documents listed in the reference section below.

Wildlife

As a result of the large fires in 1977 and 1987, logging, and road building, there is less late-successional habitat and that habitat is fragmented and more isolated. These conditions expose animals to increased predation and make dispersal more difficult. The recent trend of frequent large fires will make it difficult to maintain late-successional habitat or grow early-seral stands to late-successional habitat.

All of the wildlife species found in the Salmon River have adapted to the natural disturbance regime of infrequent large-scale disturbance and more frequent moderate and small disturbances. A return to a disturbance regime that more closely follows the natural regime should benefit most wildlife species.

For more details, see Klamath National Forest Ecosystem Analyses and other pertinent documents listed in the reference section below.

Synthesis and Prioritization of Restoration and Maintenance Needs

Analytical Approach and Rationale

Adoption of the *Aquatic Conservation Strategy* [ACS] through the "Record of Decision" for the Northwest Forest Plan (1994) and the Klamath National Forest Land and Resource Management Plan [LRMP] (USFS 1995c) set the framework for significant changes in the way ecosystems are managed, conserved, and restored. Among these changes is the application of focused and prioritized restoration and protection upon areas with the highest likelihood of recovery and retention of high quality aquatic habitat. In other words, the initial focus should be directed at watersheds exhibiting highest quality aquatic conditions and values. Within *priority watersheds*, active restoration should begin where the risks to the physical and biological integrity of the watershed are greatest. The *Salmon River Subbasin Restoration Strategy*, described in this document, uses this approach. Please note that this prioritization setting focuses on aquatic resources and does not include private property values.

This strategy employs a triage approach in identifying where investment of limited resources has the highest potential to be effective in habitat preservation and recovery consistent with other contemporary approaches (USFS 1993; Bradbury 1995; Frissel 1997). One of the most difficult philosophical hurdles to overcome in watershed restoration is the realization and acceptance that some watersheds (often those with the most recognizable problems) are poor investments early in a restoration program.

Examination of the extent to which human factors, pertinent to the Salmon River subbasin, which are most likely to have had past or may have a future measurable influence on ecosystem processes which effect the condition of aquatic systems can be visualized in Table 1. The most common threat to aquatic conditions in drainages throughout this subbasin include: (1) road-related sediment and runoff, (2) loss and degradation of habitat from high intensity wildfire. In localized areas, past timber harvest near streams and mining operations present restoration opportunities. Although noxious weeds have not had a large impact on aquatic and riparian systems to date, they are considered a high profile threat to future ecological integrity of these systems. Forest Service strategies for addressing noxious weed control and eradication exist for the Region and Province levels (USFS 2001; USFS 2000); these strategies provide a framework for addressing noxious weeds on a local level. While other opportunities for restoration exist and may be quite important in some localized areas, the *Salmon River Subbasin Restoration Strategy* focuses on addressing the most common and pervasive threats: roads and wildfire.

The process proposed in this restoration strategy to prioritize geographic areas for active restoration and maintenance incorporates information from three primary **data environments**: (1) Fuels, (2) Upslope, and (3) Aquatic (**Figure 9**). **Figure 9** schematically illustrates that each data environment is composed of two or more **data elements;** for example, the *aquatic environment* is defined by the state of relevant data

Table 1. Watershed Condition Processes and Pathways to Focus Restoration Opportunities pertinent to the Salmon River subbasin.

Ecosystem Processes		Stressors		Restoration Focus	
General Processes	**Key Processes**	**Natural Influences**	**Human Influences**	**Activities**	**Threat to Watershed Processes**
Hydrologic Regime	Water Storage and Yield	Precipitation, flood, drought, rain on snow, thunderstorms	Diversion, roads, logging, fire, grazing, recreation Diversion, impoundment	Roads Logging Fire Grazing Recreation Hydro Diversions Hydro Impoundments Hydroelectric	**High** Low **High** Low Low Low Low Low
Sediment Regime	Surface Erosion Landsliding	Climate, soil erodibility (texture, slope gradient) Rock type, degree of fracture & weathering, slope, climate, soil, landform, seismicity	Disturbance to soil cover: roads, logging, grazing, mining, fire, dams, recreation, agriculture Disturbance to soil or bedrock: roads, mining, harvest, dams, fire	Roads Logging Fire Grazing Recreation Mining Agriculture	**High** Moderate **High** Low Low Moderate Low
Channel Structural Dynamics	Sediment & Wood Transport and Routing	Scouring, deposition, wood interactions	Dredging, filling, roads, logging, mining, dams	Dredging/Filling Mining Roads Logging Dams	Low Moderate **High** Low Low
Energy Exchange Chemical/Nutrient Dynamics	Heat Transfer Chemical & Nutrient Cycling	Insulation, shading, climate Organic, wood input and erosion	Logging, grazing, recreation, fire Harvest, recreation, mining, fire, urbanization	Logging Recreation Fire Grazing Urbanization Mining	Low Low Moderate Low Low Low
Vegetative Succession, Growth, Mortality	Wood, Forage, Browse and Cover Production	Fire, insects, pathogens, wildlife, blow down, flood	Disturbance to vegetation: logging, grazing, recreation	Logging Grazing Recreation Fire	**High** Low Low **High**
Aquatic Riparian Faunal Ecology	Reproduction, Survival, Competition	Flood, drought, food and habitat availability	Forest and fishery management, grazing, recreation, mining, impoundments, diversions, exotics	Fishery Harvest Grazing Recreation Mining Hydro Impoundments Hydroelectric Diversions Invasive Plants Invasive Fauna	Low Low Low Low/Mod Low Low Low **High** Low

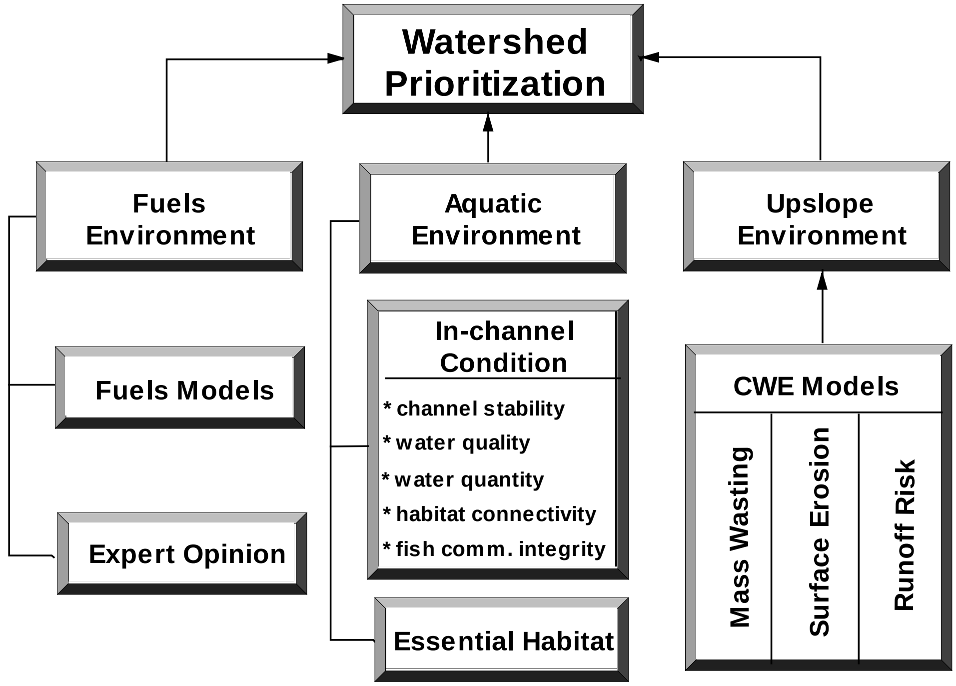

Figure 9. Schematic data model used to develop watershed restoration and protection prioritization scenario.

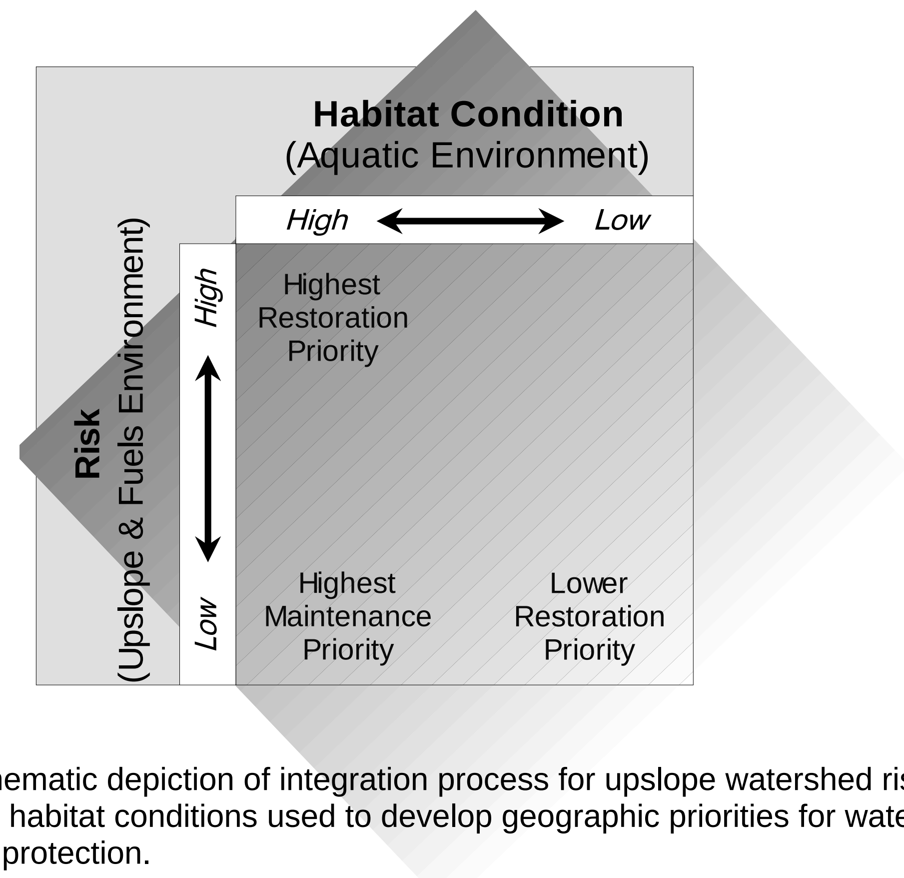

Figure 10. Schematic depiction of integration process for upslope watershed risks and existing aquatic habitat conditions used to develop geographic priorities for watershed restoration and protection.

elements including critical habitat and in-channel habitat condition. The geographic unit used in this restoration strategy in aggregating information for prioritization is equivalent to a 7th-field watersheds or *drainage*. The Salmon River subbasin contains 63 drainages, ranging in size from 3,300 to 14,500 acres, while averaging 7,625 acres.

The conditions of the various data environments are combined using the "prioritization matrix" shown **in Figure 10**. The prioritization matrix reflects the restoration strategy or philosophy expressed above. For example, a watershed exhibiting *high upslope risk* and *high fuels concerns*, where these conditions have not yet expressed themselves in-channel, because aquatic habitat conditions and values are still high quality, would rate the *highest priority for restoration*. Conversely, a watershed with *poor aquatic habitat conditions* and/or with *lower aquatic habitat values* would rate lower priority for restoration. A watershed with *low upslope and fuels risks and high aquatic habitat condition* would be highly desirable to retain in their current condition and subsequently would be identified as a *high priority for maintenance and protection* (**Figure 10**).

The prioritization scheme described above should be used as a rough guide only. It should be emphasized that project-specific planning, such as road management and fuels reduction activities, needs to encompass landscapes larger than 7^{th}-field watersheds. For example, a comprehensive roads program, from Roads Analysis Process (RAP), through NEPA & ESA planning processes, to implementation will typically consider road actions in groups of 7^{th}-field watersheds (e.g., Lower South Fork Salmon area).

<u>Description of Information Used in Setting Priorities</u>

A. Upslope Environment **–** Information driving the condition assessment for the upslope environment was integrated through a Cumulative Watershed Effects process. The process provides for the evaluation of current potential sediment delivery rates and runoff alteration as compared against background (pre-human disturbance) conditions. A detailed description of the cumulative effects process used can be found in Appendix A-13. The cumulative effects process used in this assessment evaluates three principle ecological processes, (1) mass wasting, (2) surface erosion, and (3) surface water runoff alteration.

B. Fire/Fuels Environment – Analysis of lethal (stand replacing) wildfire risks relied upon the integrated results of two fuels models and professional judgment; professional judgment accounted for 60% of the weighted ranking determination. Both fuels models depend upon spatial forest vegetation data in determining fire fuels profile. Because vegetation is not considered to be highly reliable indicator of the fuel profile at the site-scale, a heavy reliance upon field knowledge was considered necessary to accurately evaluate this data environment.

   The principle components of both fuels models include evaluation of: (1) lethal fire effects occurring; (2) containability (likelihood of initial suppression being effective);

(3) likelihood of fire ignition from human and lightning sources. Primary differences between the two models used include: (1) elimination of the "can't contain" element because this simply reflected road development within a drainage; (2) inclusion of plantations and areas with pest-related timber mortality [areas with special fuels concerns not captured in models]; (3) inclusion of fuels treatments - related to prescribed fire [timber activities-related & underburns] and wildfire [low intensity burns]; and (4) de-emphasis of "risk" factor [historic fire starts]. Results of this approach are shown in Appendix A-5; source information in Appendix A-1.

C. Aquatic Environment – Aquatic habitat conditions were characterized by a combining:

   a. *in-channel habitat condition* -- the composite of ranking of 5 equally weighted diagnostic indices for each drainage: (1) channel condition, (2) water quality, (3) water quantity, (4) habitat connectivity, (5) fish community integrity; and

   b. *essential habitat* -- stream reaches supporting habitat critical for anadromous fish life history, including spawning, rearing, and adult holding.

   This information was derived from stream surveys, water quality measures, biological evaluations, and professional judgment. Ranks for individual *in-channel habitat condition* indicators and results of the data integration are in Appendix A-6,7. A description of the procedure to identify *essential habitat* is found in Appendix C.

Analysis Results: Where should active restoration be targeted?

Results of the condition assessment yielded information on the relative status of each of the 63 drainages within the Salmon River subbasin with respect to upslope cumulative watershed effects, including lethal wildfire effects, and existing aquatic habitat conditions (**Figure 11;** Appendix A-17). Applying the prioritization approach schematically represented in **Figure 10**, watersheds were placed in one of six priority categories (*category 1-5* for restoration investments; *category 6* for priority protection and maintenance of existing conditions). **Figure 12** illustrates drainages priorities geographically. Those drainages indicated as *very high* priorities for *restoration* actions are typified as areas with the highest modeled cumulative effects, highest fuels concerns, and highest quality in-channel habitat in proximity to essential aquatic habitat for anadromous salmonids (Appendix A-12). The terms applied here (i.e., very high, high, low) are used to differentiate drainage conditions within the Salmon River subbasin on a *relative* comparison basis only.

Focusing on the characteristics of the highest priority drainages (12 of 63), which together account for approximately 12% of the subbasin by area, yields some interesting statistics. Based upon modeled results, the Salmon River subbasin has doubled (compared to background conditions) its sediment production potential through road, timber harvest, and wildfire disturbance. Thirty (30) percent of the total sediment production potential of the subbasin from mass wasting can be attributed to the 12 priority drainages. Using Equivalent Roaded Acre (ERA) methodology to estimate potential alteration to runoff patterns, these 12 drainages account for 38% of the disturbance presently modeled for the subbasin. In other words, nearly a third of the accelerated sediment production and surface runoff alteration is attributable to a relatively small proportion of the subbasin. Targeting aggressive treatments, particularly those addressing roads, in these 12 drainages alone could produce some significant subbasin-wide benefits.

What land treatments should be applied?

Watershed Protection -- In order for active restoration treatments to be effective, persistent use of existing protective land management tools is essential. The necessity for addequate project planning and implementation of standards and guidelines is equally applicable to restoration projects and other permissable land use practices. In some cases, short-term adverse impacts to water quality and fisheries habitat will need to be weighed against the long-term consequences of maintaing the existing conditions. Additionally, aggressive application of some land treatments (ie., road decommissioning and fuels reduction) in focused landscapes may necessitate incremental implementation in order to avoid adverse risks from high cummulative effects. Keep in mind that road decommissioning, for example will result in many of the same short-term impacts as road construction.

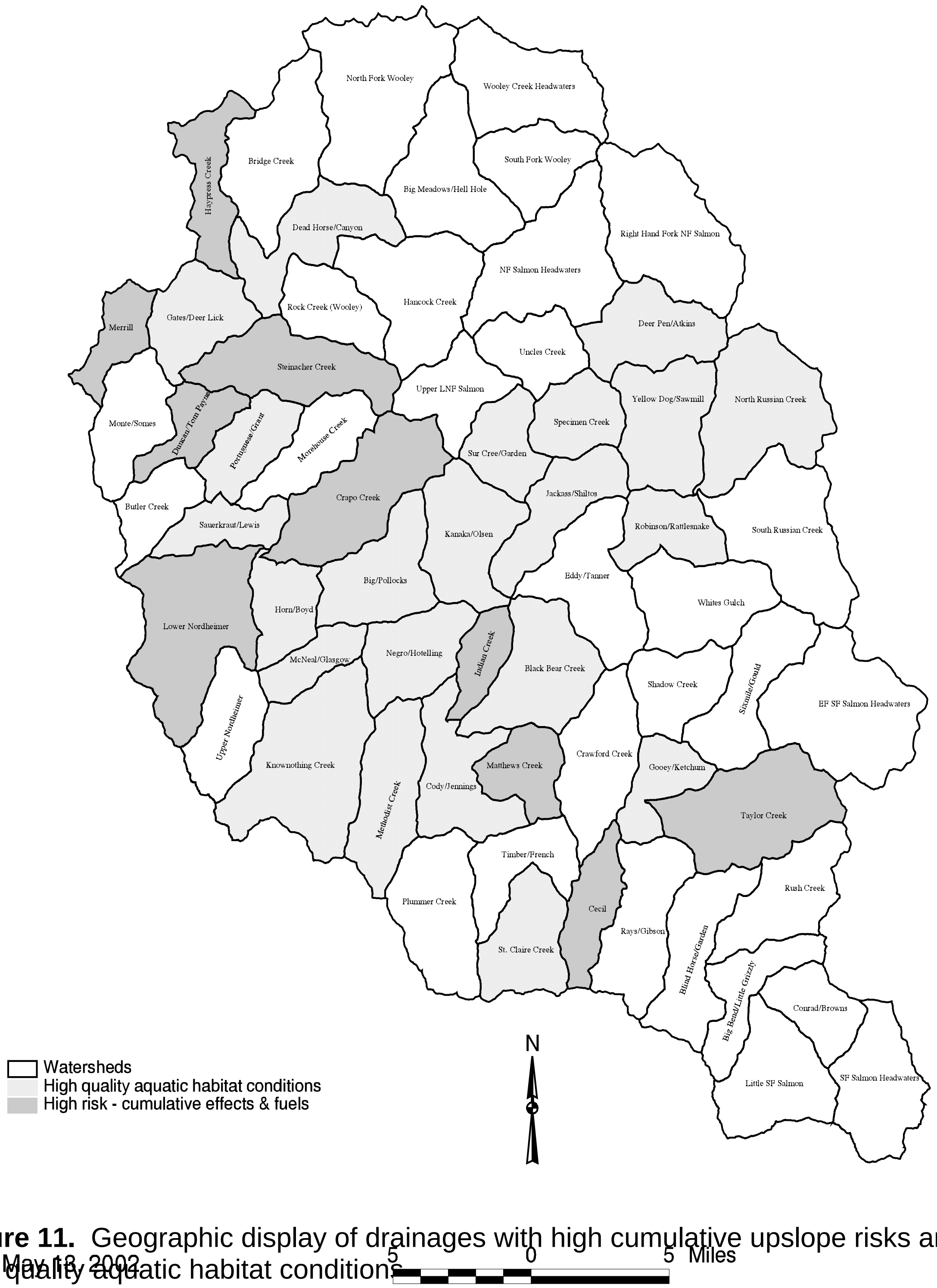

Figure 11. Geographic display of drainages with high cumulative upslope risks and high quality aquatic habitat conditions

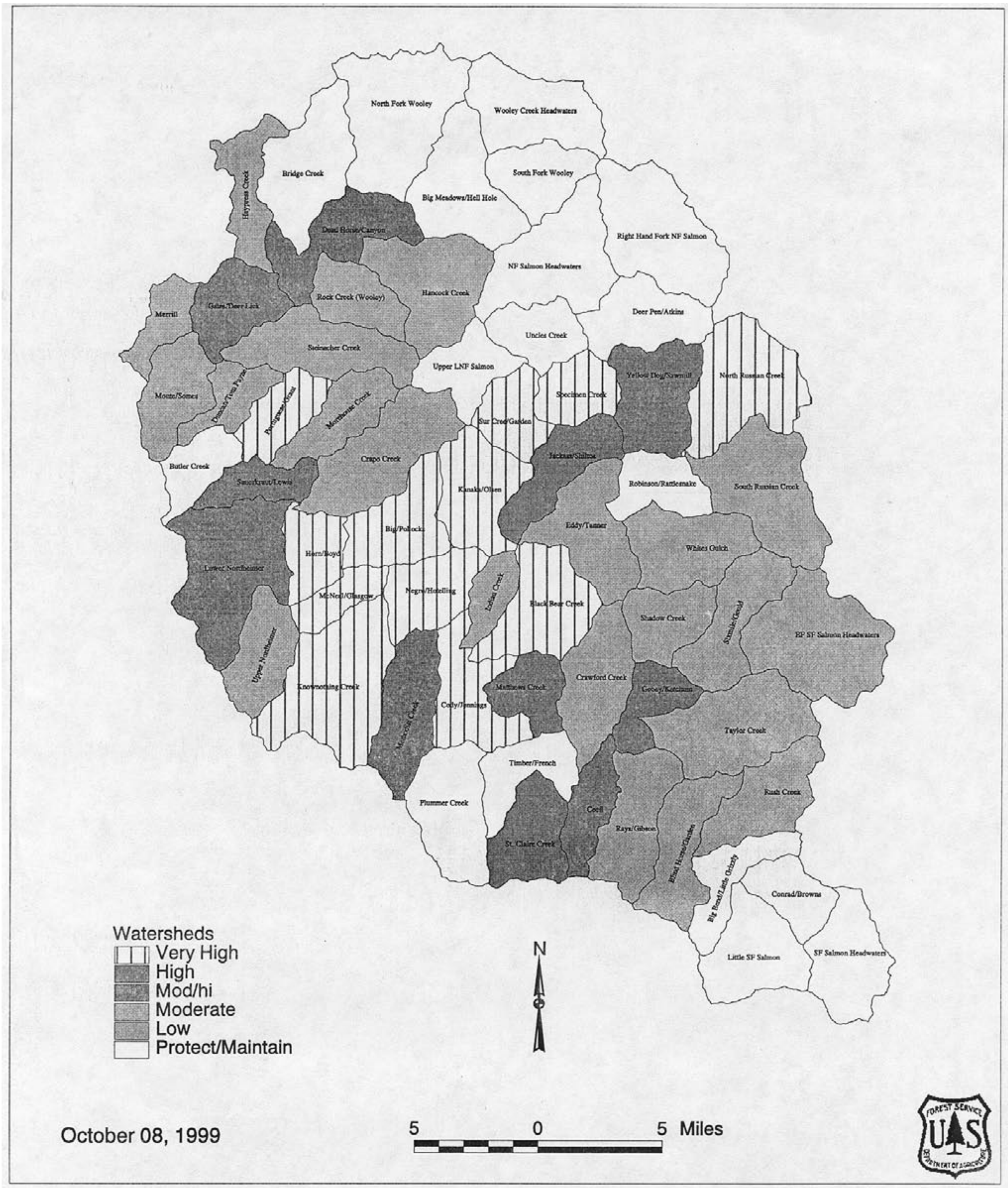

Figure 12. Catagorical priority classes for restoration and protection needs for drainages within the Salmon River subbasin.

Restore Natural Processes -- Focus restoration work on the cause of habitat degrradation, not the symptoms. Evaluation of the human alteration ecological processes, such as the sediment and hydrologic regime, will often lead to upslope remeadies to existing or potential downslope aquatic problems. Because "gravity works," in-channel aquatic conditions directly reflect upslope conditions given enough time. There exists a dynamic and direct cause and effect relationship (FEMAT 1993). Therefore, as upslope (management-related) problems & issues are addressed, in-channel aquatic conditions should improve and/or be protected. Not all sources of habitat or fisheries degredation, and hence remeady, exist upslope. However, building upon the past rehabilitation accomplishments in the Salmon River sub-basin, many of the restoration oppourtunites remain with controling road related sediment, reducing the risks of future catastrophic wildfire, and accelerating recovery of riparian vegetation.

Within the Salmon River subbasin, approximately 21 percent of the estimated sediment production from landslides is from roads, approximately 38 percent from harvest and fire, and about 41percent from undisturbed lands (this analysis). It is clear from this information that restoration work should focus primarily on **road-related activities** designed to reduce sediment impacts from eroding road prisms. Controlling sediment production by "erosion-proofing" roads (through decommissioning, upgrading, and closures) has the potential to provide the biggest "bang-for-the-restoration-buck" in terms of reducing sediment yield from management-related activities and lowering model-derived adverse cumulative watershed effects. Fuels concerns should also be addressed concurrently. Restoration oppourtunities, by activity type, for high priority watersheds are identified in **Table 2** and for all subbasin drainages in **Appendix A-13**.

Table 2. Highest *restoration* priority drainages and identified opportunities by project type.

Drainage	Roads	Fuels	Riparian
Knownothing Creek	High	high	moderate[1]
McNeal/Glasgow	very high	high	
North Russian	High	very high	moderate[1]
Kanaka/Olson	Moderate	high	moderate[1]
Cody/Jennings	High	moderate	
Sur Creek/Gargen	High	high	moderate[1]
Black Bear Creek	very high	very high	
Negro/Hotelling	very high	very high	moderate[1]
Portuguese/Grant	Moderate	low	
Big/Pollocks	very high	moderate	moderate[1]
Specimen Creek	Moderate	moderate	
Horn/Boyd	Moderate	moderate	

\[1] indicates riparian vegetation treatments to promote habitat connectivity only, re-vegetation treatments not reflected.

Where should restoration focus within priority watersheds?

With priority drainages and restoration treatments evaluated next step is to **rank and prioritize restoration opportunities within drainages**. Many project opportunities may be identified in road access and travel management plans and roads inventory/assessment investigations. Emphasis should be given to roads based on the magnitude of the risk they pose to the aquatic ecosystem. Decommissioning should proceed initially on roads in sensitive locations; progressing to those in less sensitive environments. In other words, decommission roads that run parallel to and near streams, within inner gorge areas, on toe zones of dormant slides, on active slides, or roads through weathered and dissected granitic lands first. These areas compose Riparian Reserves (USFS, 1995c) and are defined hydrologically as being adjacent to streams and geologically as being unstable areas. 'Toe zones' are steep areas of unconsolidated landslide material located at the downslope terminous of larger landslide features. During the1997 Flood, debris slides occurred at very high rates within toe zone areas (de la Fuente & Elder, 1998). High risk stream crossings, cross drains, and other fills should be prioritized on the basis of their potential impacts. In other words, fix the big consequences, most threatening stream crossings first.

NOTE: Prior to 2001, Forest transportation planning recommendations were accomplished in an interdisciplinary team setting that typically resulted in a document entitled **Access and Travel Management (ATM)** Plan. Beginning in 2001, this procedure is now called **Roads Analysis Process (RAP)**.

Some transportation planning option and prioritization recommendations (the "so what" of the two paragraphs above - extracted from *Assessment and Implementation Techniques for Controlling Road-Related Sediment Sources*, Pacific Watershed Associates, 1997) are referenced below.

Decommissioning -- Low priority roads include those which follow ridge lines, traverse large benches or low gradient upland slopes, and roads with few or no stream crossings. If these low impact roads are unneeded, they may be identified for closure. For example, the *Klamath National Forest Westside Roads Analysis* (1997) identifies many dead-end logging spur roads as candidates for decommissioning. Some of these became decommissioning candidate more because they were unneeded than because they were "high risk" to aquatic resources. Removal of these relatively low impact roads will do little to protect downstream aquatic habitat. Closure would be relatively easy and expensive, thus saving decommissioning funds for higher priority ("high risk") roads.

Based on potential threats to the aquatic ecosystem, the following roads qualify as high priority for decommissioning: roads built in riparian areas, roads with high potential risk of sediment production (such as those built on steep, unstable slopes or across highly erodible soils), roads built in areas where steep slopes and stream crossings are common, roads with high maintenance costs and requirements, and high sediment yield abandoned roads.

Upgrading -- Retained roads are expressly needed for management activities or as an essential component of the overall transportation network. They are typically, but not exclusively, located on stable terrain, where risk of fluvial erosion, stream crossing failure, storm damage, or landsliding is lowest. Each retained road is then upgraded as necessary, to make them "erosion proof" (non-sediment producing), and largely self-maintaining (or requiring low levels of maintenance). A variety of erosion-proofing techniques are available.

Fuels and Catastrophic Wildfire -- Strategic fuels planning can be divided into long-term and short-term objectives. **Long-term** objectives focus on re-introduction of fire to the ecosystem. Goals include returning the fire regime to conditions that existed prior to suppression activities, where wildfires were more frequent, of lower intensity with less severe effects, and with natural spatial distribution. Maintenance of this fire regime and fuels condition may require periodic underburning, depending in part, on levels of future wildfire suppression. Watersheds in this *desired future condition* present low risk to catastrophic, stand-replacing wildfire. Long-term objectives may be difficult to achieve across large areas (e.g., ~ half-million-acre subbasins).

Short-term objectives include the prevention of watershed-scale, stand-replacing catastrophic wildfire by the creating strategic fire breaks, treating where the "black meets the green," treating harvest-related activities fuels, silvicultural treatments (such as thinning), and targeting and treating high risk areas or *pockets* within watersheds. Treatment of these high risk "pockets" may be limited to strategic *isolation*. Ridgetop shaded fuel breaks and/or *defensible fuels profile zones* (DFPZs) or equivalent strategic treatments should be created and maintained. Silvicultural treatments (such as thinning & salvage tree removal) should be employed where appropriate. Shaded fuel breaks and/or DFPZs should also be created and maintained along emergency access routes and public/private interface areas. Strategic fire plans must prioritize the work.

Subsequent to completion of the review draft of this document on January 16, 2000, new developments worthy of note have occurred. One was the creation of the Salmon River Fire Safe Council, a community based group whose “primary mission is to plan, implement, and monitor the reinstatement of natural fire regimes … in a manner that protects life, property, improves forest health, and enhances the resources valued by its stakeholders.” The SRFSC has produced two documents to help guide this primary mission. One is entitled the “Salmon River Cooperative Fire Safe Plan, Phase I.” The second document is the “Prioritization Strategy” used to prioritize private property for fuels reduction projects. See Appendix G.

The second new development was the adoption of the National Fire Plan. The Forest Service and the Department of the Interior, in cooperation with other agencies and groups, are in the second year of implementing the National Fire Plan. Significant headway was made in FY 2001 to meet both the intent and specific direction from Congress. The National Fire Plan is a long-term investment that will help protect communities and natural resources, and most importantly, the lives of firefighters and the public. The National Fire Plan addresses five key points: Firefighting, Rehabilitation and Restoration, Hazardous Fuel Reduction, Community Assistance, and Accountability. The Cohesive Strategy document identifies four fuel priorities:

- wildland-urban interface
- readily accessible municipal watersheds
- threatened and endangered species habitat
- maintain existing low risk areas from developing into moderate or high-risk.

The National Fire Plan and the Cohesive Strategy both emphasize the importance of community involvement in implementing the Plan. The SRFSC represents community involvement in fire and fuel management for the subbasin.

Where should watershed protection and maintenance be targeted?

This assessment identifies geographic priorities for both restoration and *protection/maintenance*. We introduce this concept in order to: (1) clarify the need to define identifiable *target conditions* (objectives) for this restoration strategy proposal; and (b) illustrate the shift in activity emphasis once *target conditions* are identified or achieved.

Inclusion of the *protection and maintenance* category is principally intended for identification of drainages which exhibit low overall risk of accelerated sediment delivery from human activities and lower risk to catastrophic wildfire. In addition, these drainages have high aquatic conditions or contribute to those of downstream drainages. These drainages should serve as a focal area for activites or management which maintains how risk and high quality habitat conditions. In some cases this approach may mean minimal human intervention; in others, activities include recurrent maintence of roads and fuel conditions. By in large, however, little if any major investment in restoration activites is envisioned unless conditions change dramatically. In essence, these drainages have achieved target conditions and the management emphasis is to maintain them.

Although additional work is needed in development of the identification of which drainages in the Salmon River subbasin belong in the *protection and maintenance* category, **Table 3** illustrates the more obvious examples of drainages which exhibit the aforementioned characteristics (**Figure 12**). More than 30 percent of the Salmon River subbasin drainages could arguably be included the the *protection and maintenance* category. This restoration strategy proposes that, where applicable, these drainages be considered for priority recurrent maintenance investments.

Table 3. Drainages identified for protection and maintenance based upon low upslope risks and contribution to high quality aquatic habitat.

Drainage	Miles of Road	Fuels Risk
SF Salmon Headwaters	6.3	low
Conrad/Browns	0	moderate
Little S. Fork Salmon	0	low
Big Bend/Little Grizzly	0	moderate
Timber/French	6.8	moderate
Plummer Creek	0	low
NF Salmon Headwaters	0	low
RH Fork NF Salmon	0	low
Deer Pen/Atkins	0	low
Robinson/Rattlesnake	9.3	moderate
Upper LNF Salmon	2.3	low
Uncles Creek	0	low
Butler Creek	2.4	low
South Fork Wooley	0	low
Big Meadows/Hell Hole	0	low
North Fork Wooley	0	low
Bridge Creek	3.9	moderate
Wooley Ck Headwaters	0	low

What are target conditions and when are they achieved?

Achievement of target condition and subsequent change of focus of restoration activities to other watersheds does not mean to imply that these "secured" or "restored" watersheds are abandoned. High levels of maintenance activities may be necessary to ensure the security of these target condition watersheds. For example, newly improved and reconstructed roads must be maintained at high levels. Once established, shaded fuel breaks must be maintained. These watersheds must not be allowed to "back slide" out of target conditions. Monitoring must continue in these watersheds to confirm the maintenance of target conditions.

But what exactly are target condition and how are they measured? A complete restoration strategy includes not only watershed prioritization (where to do the work first) and project type prioritization (what to do first), but guidelines on when restoration is significantly complete (how much to do). In a given high priority watershed, major restoration is significantly complete when that watershed has achieved "target conditions" and most of the work and effort can then be shifted on another watershed.

Target condition (aquatic resources), as defined here, is not equivalent to pristine or wilderness-like. Neither is it intended to be inferred as synonomous as a return to pre-management conditions. Target conditions refer to managed landscapes (watersheds) and could be independent of land allocation or ownership. Target conditions may not be equivalent to *desired future condition (DFC),* but may represent an acceptable attainment (or percentage of) desired future condition. For example under DFC, we may want all identified roads to be outsloped in order to minimize disruption to the hydrologic regime. In a managed landscape with finite restoration resources, we may be satisfied that risks to watershed resources are acceptably low when 80% of those roads are outsloped and define this threshold as our *target condition.* DFCs are typically stated in generalities; target conditions are intended to be more specific and commonly measurable. Attainment of our management objectives whould be measured against defined *target conditions.* Watersheds achieving "target conditions" can be considered *secured* or *restored*.

Target condition is related to, but not synonomous with concepts associated with "Properly Functioning Condition" [PFC] (BLM 1993) and "Aquatic Conservation Strategy Objectives" [ACS] (USFS 1995c). Meeting target condition should positively affect attainment of PFC status and ACS objectives.

In order to facilitate development of a working application of this concept, we offer the following provisional definition of *target condition*(s) for the Salmon River subbasin:

- *compliance with administrative resource protection measures* - state and federal resource protection measures are regularly implemented and effective;

- *resource condition assessments complete* - this includes completion of road and watershed sediment source inventories and assessments;

- *cumulative watershed effects are reduced to an acceptable level* - one major way of accomplishing this would be by road decommissioning, upgrading, or more restrictive closures;

- *actions defined in planning documents are substantially complete* - this includes recommendations found in Ecosystem/Watershed Analyses, Roads Analysis Process, and strategic fuels reduction plans;

- *recognized guidelines and parameters for attainment of the Clean Water Action Plan, TMDLs, ESA terms and conditions and/or recovery objectives* – these my be specific or "vision" statements having to do with the extent and pattern of disturbance and habitat quality;

- *in-channel* indicators are positive.

When these *target condition* measurements are met:

- the emphasis of watershed efforts shifts from active restoration to protection and maintenance.

- work may remain to be done ! - especially in the areas of maintenance, completion of lower priority projects, and monitoring.

ACTION PLAN

The following action plan is formulated based on the best information available at this time (planning level information) and will require refinement and modification as more detailed information becomes available. The proposed schedule is contingent on available short-term and long-term funding. General cost estimates are shown in Table B-5 and Table B-6.

Three Year Objectives:

A. Complete 'Road Sediment Source Inventory and Risk Assessment' for all roads.
B. Complete Roads Analysis Process (RAP) for all of the subbasin. This process began for the entire Salmon River Ranger District in December 2001.
C. Develop comprehensive strategic fuels reduction plan for entire subbasin.
D. Complete project planning documents two years ahead of implementation (NEPA, ESA, Survey & Manage, project design, etc.) in order to maximize funding options.
E. Implement all high priority road projects in Upper South Fork Salmon watershed; initiate implementation of road projects in other high priority drainages.
F. Develop long-term effectiveness monitoring plan, watershed -scale and project-level.
G. Adopt, validate, and review provisions of this restoration strategy, including target conditions, and watershed prioritization.
H. Initiate fuels reduction projects in high priority drainages.
I. Conduct assigned implementation and effectiveness monitoring targets for subbasin activities.

Ten Year Objectives:

A. Review and revise this restoration strategy, strategic fuels plan, and monitoring plan to reflect new information and project implementation to date.
B. Complete road-related actions recommended in RAP and other road assessment documents for all high priority drainages.
C. Complete fuels-related actions recommended in plan for all priority areas.
D. Determine "state of the subbasin" in regards to restoration & maintenance activities as they apply to achieving target conditions. In other words, how many watersheds have achieved target conditions (been restored and transitioned to category 6).

ACTION PLAN

Recurrent/Ongoing Activities			
Cooperation & Coordination	**Education**	**Watershed Protection**	**Program Management**
SLUG – Develop annual cooperative work plan	Conduct community restoration program	Maintain public and private roads to reduce sedimentation and disruption of runoff flows	Market Restoration Efforts and Secure Funding Sources/ Maintain resouces for ongoing Stewardship and advocacy
Work with Klamath River Basin Task Force and Technical Work Group	Support Watershed Education Program/Involve area schools	Control spread of Noxious Weeds and invasive species	Encourage involvement by Research and Universities in furthering understanding of the Salmon River Subbasin
Continue cooperative planing efforts with Fires Safe Council	Increase awareness and support for eradication and control of noxious weeds	Reduce toxics, hazardous and solid waste sites in subbasin	Maintain and improve information resources within the Salmon Subbasin

Non-Recurrent Activities				
Time Period	**Inventory & Assessments**	**Project Planning**	**Project Implementation**	**Monitoring**
1999	Start Road Inventory: Lower South Fork (LSF) Salmon River Watershed	Complete NEPA and ESA Planning for ERFO Projects	Implement 97 ERFO Projects	Conduct BMPEP & Concurrent (CM) project-level monitoring/evalations
	Initiate Restoration Strategy for Salmon Subbasin	Complete NEPA & ESA Planning for Upper South Fork (USF) ATMP (Summerville)	Implement Steinacher Road Decommissioning	Monitor Implementation of Steinacher Decommissioning
	Complete Stream Inventories: 97 Flood Damaged Streams	Complete NEPA & ESA Planning for Crawford Road Decomm & Stormproofing	Complete Cherry Creek Road Stormproofing	Monitor Implementation of Cherry Creek Stormproofing
			Complete Design Phase For Upper South Fork T.S. Decommissioning	Adopt REO compatible, watershed-scale effectiveness monitoring
			Implement 10% Funded Stromproofing on Taylor	BMPEP & CM project-level monitoring/evaluations
2000	Start Road Inventory: North Fork (NSF) Salmon River Watershed	Submit funding proposals for 'high' priority road work identified in USF roads Summerville Project	Implement Steinacher Road Decommissioning	Review priorities for restoration activities
	Complete Road Inventory & Risk Assessment - LSF	Start S&M surveys, NEPA & ESA for Taylor Fuels project	Implement Upper South Fork T.S. Road Decommissioning	BMPEP & CM project-level monitoring/evaluation
	Start Road Inventory: Mainstem (MS) Salmon River Watershed		Complete 97 ERFO Projects including Decommissioning	Spring and Fall chinook, summer steelhead escapment counts
	Identify all potential road associated migration barriers to anadromous fish			Noxious Weed Monitoring
	Initiate Planning with County to correct all Migration barriers on County roads		Implement Crawford Road Decommissioning	
	Finalize Sediment Waste area disposal Site inventory for Salmon sub-basin		ID maintenance priorities For LSF including correcting stream/road diversion potential	

2001	Complete Road inventory & risk assess – North Fork & Mainstem Salmon	Review existing RAP (except LSF) to reflect new Information from road inventory/ assessment projects	Begin highest priority road work if funding available and planning documents are complete	BMPEP & CM project-level monitoring/evaluation
	Initiate Fish Barrier Inventory of FS & County Roads Salmon Subbasin	Project planning documents for projects identified above	Implement Steinacher Road Decommissioning	Spring and Fall chinook, summer steelhead escapment counts
	Noxious Weed Inventory	Submit funding proposals for 'highest' priority road work identified in other road assessments &/or RAP	Complete Design Phase For Smmerville Road Decommissioning & stormproofing	Noxious Weed Monitoring
		Begin implementation of provisional Fire Management Strategy.	Initiate validation of vegetation & fuels field conditions to be completed by 2004	
2002	Complete Road inventory & risk assess – USF Salmon	Initiate Planning for Fish Barrier Removal on FS & County Roads Salmon Subbasin	Implementation of Summerville Project to Decomm/Stormproof USF Roads	BMPEP & CM project- level monitoring/evaluation
	Complete Fish Barrier Inventory of FS & County Roads Salmon Subbasin	Complete Planning for Taylor Fuels Reduction Phase I; Initiate Phase II	Implement Crawford Road Stormproofing	Spring and Fall chinook, summer steelhead escapment counts
	Rock Pit Inventory and Asbestos Testing	Submit funding proposals for 'highest' priority road work identified in LSF RAP	Complete design for King Solomon Mine Rehab Project	Noxious Weed Monitoring
	Mine Tailing Assessment/ Management Plan	Complete Planning for King Solomon Mine Rehab	Start implementation of Taylor Fuels Rehab Project	
	Noxious Weed Inventory	Complete RAP for Salmon River RD/NEPA/ESA Planning for LSF Roads		
		Address Comments from TWG and Community in Salmon Subbasin Restoration Strategy		
		County Road Management Plan		
		Initiate Project Planning with Fire Safe Council on private And public lands		
2003 – 2008	Complete Provisional Fire Management Strategy for Salmon Subbasin	Submit funding proposals for '**high**' priority road work identified in other road assessments &/or RAP	Complete road work in '**highest**' priority watersheds; work identified & prioritized in RAP &/or road inventory/assessments	BMPEP & CM project- level monitoring/evaluation
	Inventory Riparian Reserve revegetation opportunities	Project planning documents for projects identified above – begin two years ahead of proposed implementation	Implement corrective Measures on Fish passage barriers at road crossings	REO compatible, watershed-scale effectiveness monitoring
			Iimplementation of provisional Fire Management Strategy.	Develop 5-year plan for restoration and monitoring

2009 – 2018		Submit funding proposals for '**moderate**' priority road work identified in road assessments &/or RAP	Complete road work in '**moderate**' priority watersheds; work identified & prioritized in RAP &/or road inventory/assessments	BMPEP & CM project- level monitoring/evaluation
		Project planning documents for projects identified above – begin two years ahead of proposed implementation		REO compatible, watershed-scale effectiveness monitoring
				Review/revise monitoring efforts
2019 – 2028		Submit funding proposals for '**lower**' priority road work identified in road assessments &/or RAP	Complete road work in '**lower**' priority watersheds; work identified & prioritized in ATMs &/or road inventory/assessments	BMPEP & CM at project- level monitoring/evaluation
		Project planning documents for projects identified above – begin two years ahead of proposed implementation		REO compatible, watershed-scale effectiveness monitoring
				BMPEP & CM at project- level monitoring/evaluation
				Review/revise monitoring efforts

Monitoring

The *Klamath Land and Resource Management Plan* and Watershed Analysis will provide the decision framework for a variety of planned ecosystem management actions within the Salmon River sub-basin. Specific watershed protection and rehabilitation actions will be guided by timeframes and geographic priorities recommended in this *Restoration Strategy.* Other land management actions will proceed on both public and private lands within the Salmon subbasin; additional natural disturbances such as flood, wildfire, and forest mortality will occur. In addition, conditions external to the subbasin will effect returns of anadromous fish populations to the Salmon River. The cumulative expression of these human and natural influences will ultimately drive the effectiveness of the proposed restoration strategy. For these reasons, a realistic appraisal of the questions pursued through monitoring need to be made.

<u>Why are we monitoring?</u>

Simply put, monitor is intended to provide essential feedback to managers on whether the goals and objectives of this strategy are being met. It is most effective when measurable objectives and outcomes are clearly established. Ultimately, results of monitoring should help to direct and improve the effectiveness of treatments and management actions (ie. Adaptive Management).

<u>What type of monitoring should be conducted?</u>

Monitoring the *implementation* and *effectiveness* of the proposed restoration strategy may yield the most value in the form of directing future management actions associated with watershed protection and rehabilitation. The goals of this approach would be to insure the elements of this strategy:

(1) discourage actions which retard recovery of watershed conditions, and;
(2) result in effective watershed restoration leading to specified outcomes in a timely manner.

Implementation monitoring addresses the question "are we implementing what we planned". This includes tracking the implementation of relevant standards and guidelines, compliance with the type and technical standards for restoration treatments, and attainment of temporal milestones of the action plan. *Effectiveness* monitoring should focus on "are the treatments or standards and guides meeting the intended objectives". For example, are the pertinent measures for protecting water quality actually minimizing pollutant delivery to streams or did road decommissioning restore natural hill slope drainage patterns? *Validation* monitoring addresses whether the hypotheses and judgments upon which treatments are based can be validated. This type of monitoring is valuable to the formulation of future restoration approaches and designs, however is beyond the scope of this strategy.

<u>What key questions should drive our monitoring?</u>

It may be better to do no monitoring than to do inadequate monitoring. Poor monitoring reduces the chance of obtaining resources for sound monitoring and further drains funds from contributing to the desired outcome. With that in mind, monitoring recommended as part of this strategy will be directed to addressing the three key questions listed below. These questions target the accountability of existing land management direction and components of this strategy. Affordable monitoring protocols exist to address questions #1 and #2 at annual or semi-annual intervals (eg., BMPEP; LRMP Monitoring Questionnaire; Strategy Action Plan). Question #3 is technically more complicated and should address upslope watershed condition measures, target condition thresholds, and measures for evaluating condition of beneficial uses, linked to the extent possible with cause-effect principles. Intervals for evaluating #3 may be on the order of 5-10 years.

#1 Are the environmental and administrative standards for land management actions within the Salmon River subbasin being met?

#2 Have the milestones, prioritized treatments and target conditions prescribed in this strategy been achieved as planned?

#3 How effective has this strategy been in reducing the risks of habitat degradation and recovery of anadromous fish producing habitat within the Salmon River subbasin?

<u>Other ongoing monitoring</u>

1. Temporal and Spatial Landslide Evaluation – 10 year interval

2. Fall Chinook Escapement – Annual
3. Spring Chinook Holding Census – Annual
4. Salmon River Flow Monitoring – Continuous
5. Water Temperature Monitoring – Continuous/Seasonal
6. Noxious Weed Eradication Effectiveness – Project level; Annual

Information Needs

"Before effective action can be taken to restore fish populations, project planners should have enough information to determine which factors are limiting the production of the species to be restored." (Klamath Plan, 1991; pg. 3-8)

Managers, scientists and local organizations have collected a large amount of physical and biological information on the Salmon River subbasin. While this information appears to provide a data-rich environment for planning purposes, care must be taken to understand and evaluate the scale and quality of data. Without an understanding of data limitations, incorrect conclusions will be drawn from conducted analyses.

Many of the data layers currently used on the Salmon River were generated for the Klamath National Forest Land Management Plan which was a coarse assessment of land management options for the entire Forest.

The following is a description of the more important data layers used in this document.

<u>Vegetation</u>: USFS Data layer - this layer was started in 1976, as part of the compartment inventory assessment program, which generated growth and yield models. This is tied to a timber type map generated by photo interpretation. This became the vegetation layer for the Land Management Plan. Since the 70s, some areas have been updated - especially timber management units. Many of the unmanaged burned areas have not been updated. Combined with preliminary classification errors, the accuracy level of the vegetation layer has been reduced to 50-60%. The vegetation layer was also used to derive fuel models and habitat management areas. Interpretation errors would be expected to further degrade data accuracy of the fuel models and habitat management areas. No formal accuracy assessment of the vegetation or fuels information has been conducted. The need for updating or re-creating this data layer is well recognized. The vegetation layer is currently the highest priority and the most important data gap.

<u>Roads: USFS Data layer</u> - Originally digitized from paper maps, the roads layer is highly accurate for system roads. The USFS (with SRRC assistance) is in the process of locating non-system roads and private roads within the subbasin. Current data resolution is 1:24,000.

<u>Geo13: USFS Data layer</u> - Derived from Bedrock Geology, Geomorphology, Inner Gorge, and Active Slides. This is a classification of geomorphic terranes into 13 types. Used as a base layer for the Klamath National Forest Land & Resource Management Plan, 1995. Attributes include active landslides, toe zones of

dormant landslides, dormant landslides, steep slopes and inner gorge areas. Accuracy is high relative to other areas. Ground truthing has been completed in many areas and is ongoing at the project level.

<u>Fire and Fuels</u>: USFS Data layer - the Salmon River has some of the most accurate historic fire information available anywhere. Fires over 40 acres have been mapped since 1911. Originally obtained from 1:126,720 Ranger District Fire Atlases. Polygons were ocularly transferred to 1:62,500 manuscripts. Current data resolution is 1:24,000.
Burn intensity layers were based on 1:15,840 color infrared aerial photography, which were determined from the appearance of the post-fire canopy and converted to general groupings. Current data resolution is 1:24,000.

As mentioned in the vegetation section above, the fuels model originated as a "cross walk" from the LMP Vegetation Layer. There has been no accuracy assessment of this information and most fire experts agree the accuracy level is low.

An important consideration to the Salmon's overall high fuel loading and risk of catastrophic fire return is the managed stand - plantations. The threat of (and to) these plantations has never been quantified. There is a great need for an overall Strategic Fire Plan.

30-meter Digital Elevation Model: USGS/USFS-GSC Data Layer. DEM-generated, 30-meter mesh. Moderately accurate at the 30 meter level.

<u>Property Ownership</u>: USFS Data layer - Includes Forest boundaries plus all private land boundaries within the KNF boundary. Built as a line coverage for display purposes only. Landlines are approximate. Cecilville and other areas were recently updated in 1998. Other updates will be ongoing. Land acquisition is going on in several locations in the wilderness areas at the present time. Current data resolution is 1:24,000.

<u>Fish Species Streams</u>: USFS Data layer - 1:126,720 manuscripts provided by forest/district fisheries biologists, ocular transfer to 1:24,000 stream data. Provides the known, suspected & historic range of both native & introduced fish species. Updated in 1994. Current data resolution is 1:24,000. More information is needed about the life history differences between Steelhead and Rainbow trout.

<u>Noxious Weeds</u>: Very little information is available about the level of infestation and location of non-native pest plant species. A comprehensive Noxious Weed Inventory is needed to help managers with the need for, and methods of an eradication strategy.

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