SQUAW/ELLIOTT/LAKE

1995 Watershed Analysis

Rogue River National Forest

Applegate Ranger District

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1995 WATERSHED ANALYSIS
SQUAW/ELLIOTT/LAKE WATERSHEDS

APPLEGATE RANGER DISTRICT
ROGUE RIVER NATIONAL FOREST

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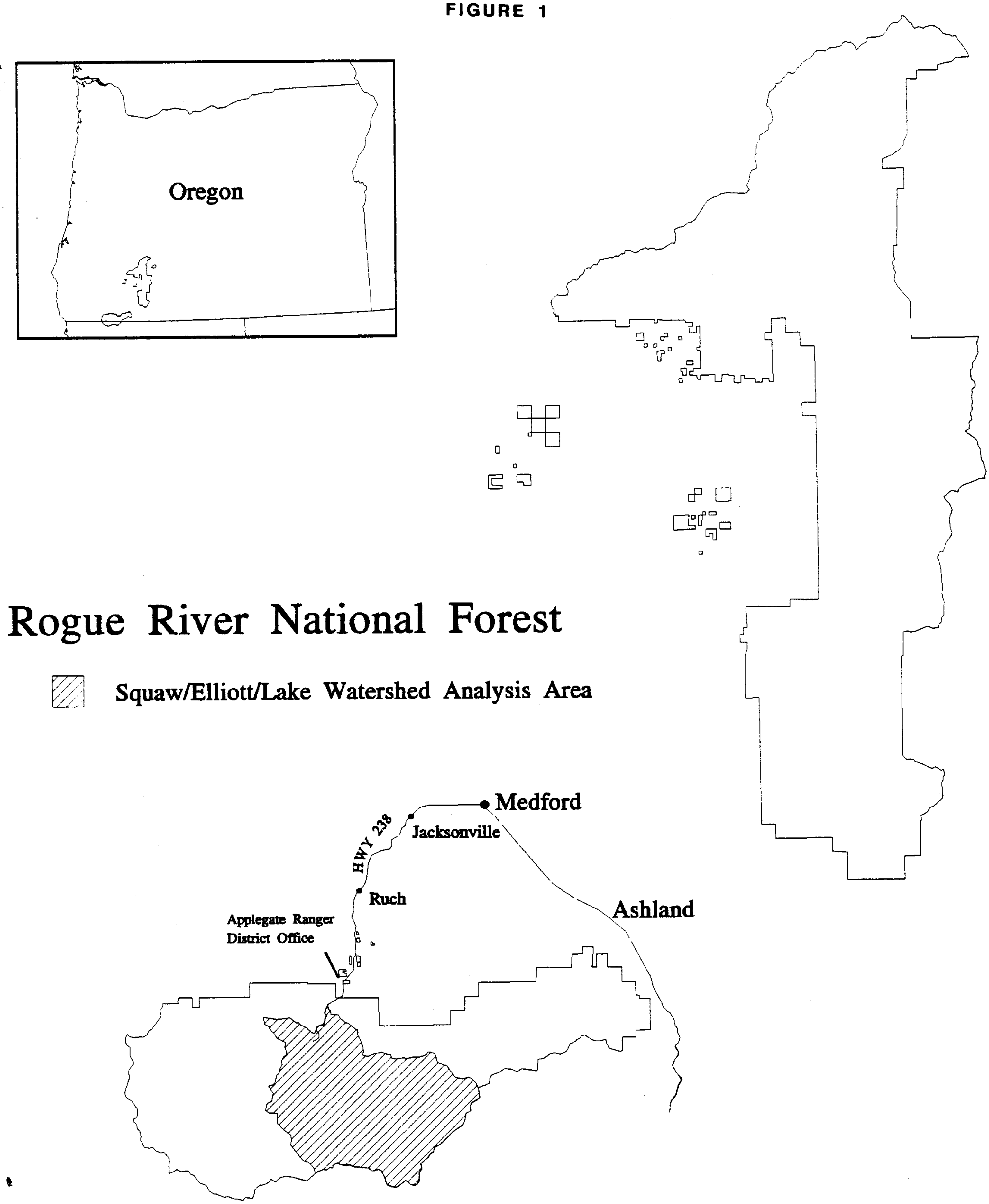


1995 WATERSHED ANALYSIS
SQUAW/ELLIOTT/LAKE WATERSHED ANALYSIS AREA

Applegate Ranger District
Rogue River National Forest

I. INTRODUCTION

A. ANALYSIS STRATEGY

1. Watershed Analysis

The Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl (ROD) incorporates the Aquatic Conservation Strategy, developed for restoring and maintaining the health of watersheds and the aquatic ecosystems contained within them, on all public lands. The Aquatic Conservation Strategy is a basis for Standards and Guidelines (contained within the ROD) which focus on the attainment of this strategy. Watershed Analysis is a key component for implementing the Aquatic Conservation Strategy. Through watershed analysis, opportunities will be identified for the restoration of aquatic habitat and ecosystem health.

Watershed analysis is an assessment of the health of an ecosystem at the watershed scale and plays an important role in providing for the protection of aquatic and riparian habitat. It identifies processes and functions occurring within a watershed that are key to maintaining healthy terrestrial and aquatic ecosystems, and assesses the effects of human activities on these processes and functions. This analysis focused on the compilation and analysis of data identifying processes and functions occurring within the Squaw/Elliott/Lake Watershed Analysis Area, and displays the effects of human activities. This Watershed Report will document the analysis completed by an Interdisciplinary Team. It will also identify gaps in data and information needed to make sound decisions and recommendations on future management activities in these watersheds.

2. Analysis Area Management Strategies

The Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl (ROD), (Northwest Forest Plan), (USDA/USDI, 1994) and the Rogue River National Forest, Land and Resource Management Plan (RRNF, LRMP) provide guidance for the management of lands within the Squaw/Elliott/Lake Watershed Analysis Area. Figure 2 displays a composite of land allocations of both plans. The process of reconciling the RRNF, LRMP with the Northwest Forest Plan is still in progress. The map displaying land allocations is a dynamic product and minor changes

Squaw/Elliott/Lake Watershed Analysis Area

Management Area Land Allocations

(ROD & RRNF LRMP)

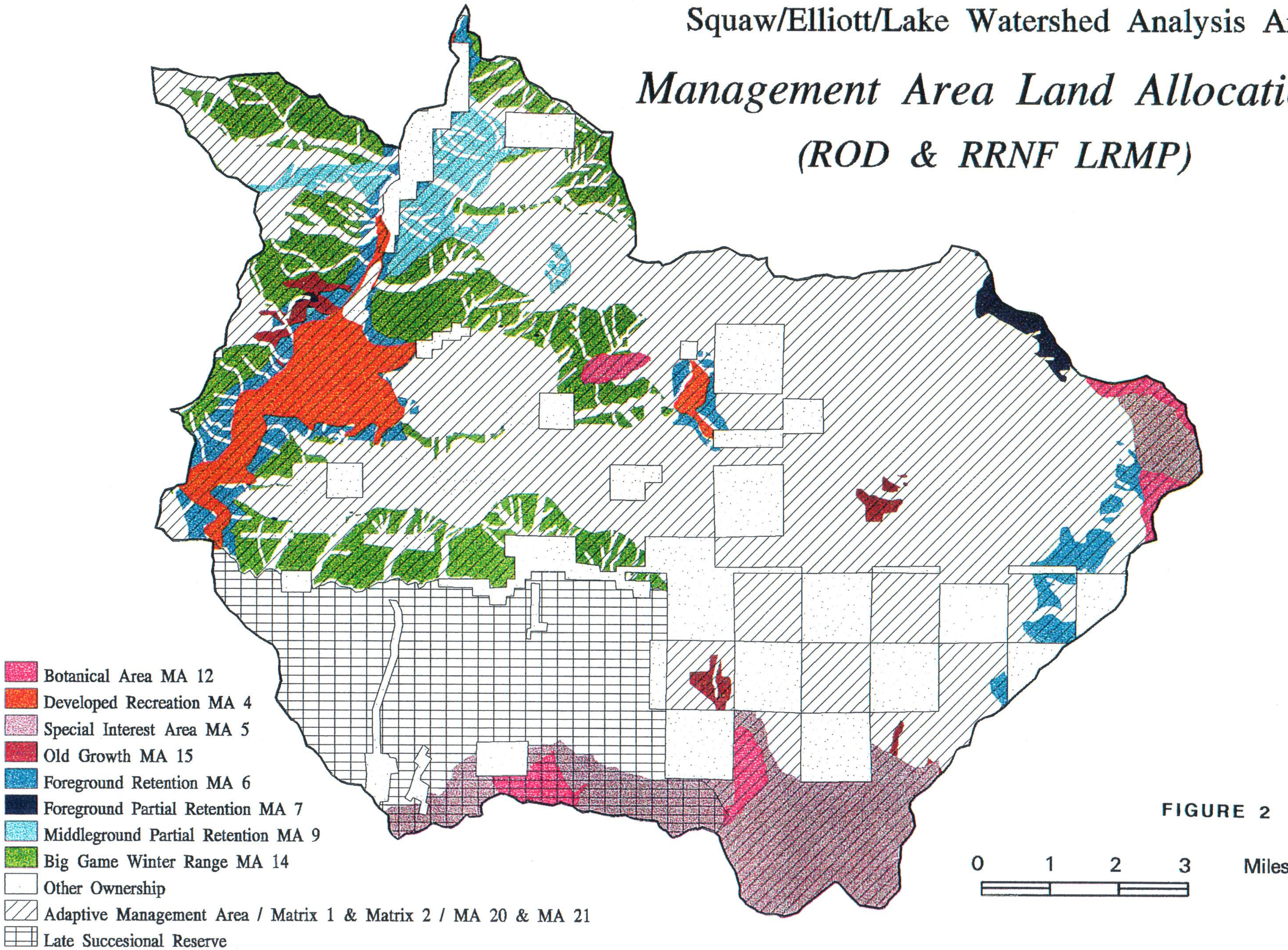


FIGURE 2

are expected as the Forest Plan Reconciliation Process is finalized and as ground verification of land allocations, such as Riparian Reserves, takes place.

a) ROD Land Allocations

Adaptive Management Area:

The majority of National Forest lands within the Squaw/Elliott/Lake Watershed Analysis Area are allocated by the (ROD) to **Adaptive Management Area**. Adaptive Management Areas (AMA) are designated to encourage the development and testing of technical and social approaches to resource management while achieving conservation objectives outlined by the ROD Standards and Guidelines. It is hoped that local, individualized approaches that rely on the ingenuity of resource managers and communities rather than traditionally derived and tightly prescriptive approaches can be pursued.

> **Technical Objectives of AMA:** "The Adaptive Management Areas have scientific and technical innovation and experimentation as objectives. The guiding principals is to allow freedom in forest management approaches to encourage innovation in achieving the goals of these standards and guidelines." (ROD, p. D-3)
>
> **Social Objectives of AMA:** "The primary social objective of Adaptive Management Areas is the provision of flexible experimentation with policies and management. These areas should provide opportunities for land managing and regulatory agencies, other government entities, nongovernmental organizations, local groups, landowners, communities, and citizens to work together to develop innovative management approaches."
>
> "Innovative approaches include social learning and adaptation, which depend upon local communities having sufficient political capacity, economic resources, and technical expertise to be full participants in ecosystem management." (ROD, p. D-4)

Late-Successional Reserve:

A portion of the Analysis Area is allocated by the ROD to **Late-Successional Reserve (LSR)**. LSRs have been set aside as areas to be managed to protect and enhance late-successional and old-growth forest ecosystems which serve as habitat for late-successional and old-growth related species. The Dutchman Peak/Oak Knoll LSR (#CA-354) functions within a network of LSRs designed as an interacting reserve system which maintain a certain level of connectivity of late-successional and old-growth forest ecosystems.

Riparian Reserves:

Riparian Reserves apply to National Forest and Bureau of Land Management lands and generally parallel the stream network. Unstable and potentially unstable lands, wetlands, and areas adjacent to lakes, ponds, and reservoirs are also designated as Riparian Reserves. Riparian

Reserve widths vary by stream type. Figure 11, Chapter II, Riparian Habitat, displays interim Riparian Reserves; Table A-19, Appendix A, Hydrology, displays Riparian Reserve widths by hydrological/geological feature.

Non-Key Watershed:

All watersheds within the Analysis Area are recognized by the ROD as non-key watersheds.

b) RRNF, LRMP Land Allocations

Within AMA, Rogue River National Forest, Land Resource Management Plan land allocations, recognized by the ROD are to be considered concurrently with AMA direction. These land allocations are: Developed Recreation (MA 4), Special Interest Area (MA 5), Visual Retention Strategies (MA 6, MA 7, and MA 9), Botanical Area (MA 12), Big Game Winter Range (MA 14), Old-Growth (MA 15), Timber Suited 1 (MA 20) and Timber Suited 2 (MA 21). Information specific to the goals, objectives, and Standards and Guidelines of these land allocations can be reviewed in the RRNF, LRMP. Within AMA, land allocations of existing Forest plans are to be considered during the planning and implementation of activities within AMAs. Current RRNF, LRMP land allocations and associated Standards and Guidelines may be modified in AMA plans based on site specific analysis. Coordination with the Regional Ecosystem Office is required (ROD, C-3).

Roadless Areas: Four Inventoried Roadless Areas (Rare II) occur within the Analysis Area; Little Grayback (7,534 acres), Kinney (4,223 acres), Condrey Mountain (9,387 acres), and a very small portion of Kangaroo (58 acres). Roadless Areas comprise an estimated 21,201 acres (29%) of the Watershed Analysis Area. Condrey Mountain Roadless area overlaps with Late-Successional Reserve (#CA-354). Roadless areas are not shown on Figure 2; maps of individual roadless areas can be viewed in Appendix C of the RRNF, LRMP.

3. How this Analysis Was Conducted

The Team, following the "eight steps" suggested by the original Federal Agency Guide for Pilot Watershed Analysis (pp. 8 and 15), identified the processes, functions, and issues key to this Watershed Analysis Area (WAA), and developed key questions that were used to guide this analysis. These questions are available for review in Appendix B.

a) Key Issues:

With the development of issues surrounding resources of the Squaw/Elliott/Lake Watershed Analysis Area a re-occurring theme became evident. How the conditions of vegetation relate to the health of individual components of the ecosystem provides a basis for much of the discussion contained in this Watershed Analysis Report. Vegetation provides a wide variety of plant and animal habitats, affects the ability/inability of fire spread, affects the flow of water through a watershed, provides streambank and slope stability, provides shade for streams, contributes organic matter and coarse woody debris to site productivity and aquatic habitat complexity, and provides commodities contributing to the economic health of a community. Many years of fire exclusion from a fire dependent ecosystem combined with a range of human activities has affected a large change in vegetative compositions, structures, and distribution than that which occurred pre-historically. Other re-occurring themes in many discussions are the affects of road development, fire exclusion, and the role of natural geologic and geomorphologic setting in the affected environment.

The following summarizes **Key Issues** associated with Squaw/Elliott/Lake Watershed Analysis Area:

Ecosystem Condition and Forest Health:

The vegetative component of the Squaw/Elliott/Lake ecosystem is generally in poor condition. Overstocked vegetative conditions brought about by years of fire suppression and compounded by 9 years of drought has severely lowered the ecosystems resistance to natural disturbance mechanisms. The **major natural disturbance mechanisms of concern for vegetative component of the ecosystem are: wildfire, insects, and disease.** The absence of fire in a once fire dependent ecosystem has changed the composition, structure, and distribution of vegetation types; the current vegetative conditions are said to be outside of the natural range of variation. In the lower elevations, oak savannahs historically maintained by frequent fire episodes are rapidly disappearing as a result of fire suppression and increased vegetation densities. The majority of shrublands and brushfields fall in the mature to over-mature age class, lacking the dynamics and diversity found in a younger age class of shrub and brushfield communities.

Where **insect and disease infestations cause high mortality in conifers**, there is a general decline in the ponderosa and sugar pine component and associated plant communities, a decline in the large tree component of conifer stands, and fire hazard is increased.

Fire has the greatest potential to affect the largest blocks of land in just a matter of days or in some cases hours. Because of the presence of high fire hazard combined with high values at risk, there is a high fire risk in lower elevations of the Watershed Analysis Area, especially in the area of Applegate Lake. If a large catastrophic fire occurred, the loss in value and benefits of resources would be great. As with any wildfire occurrence, the loss of human lives are always a potential. Recreational use concentrated around Applegate and Squaw Lakes has increased the potential for human-caused fires.

The changes in vegetative composition, structures, and distributions are accompanied by changes in the type, amount, and distribution of habitats provided as well as the species dependent on those habitat types. For example, years of timber harvesting and road development has reduced and/or degraded many acres of late-successional habitat within the Analysis Area. The analysis of certain indicator species (such as the northern spotted owl) shows there to be a deficit in optimal levels of late-successional habitat, especially for areas located outside of roadless areas. Decadent brushfields lack quality foraging habitat for big-game that was once provided. Rare plant species occurring in the lower elevations of the Analysis Area, now co-exist in higher fuel loads and the potential for higher fire intensities.

Aquatic systems in many areas of the Watershed Analysis Area have been impacted from timber harvesting and road building, resulting in degraded riparian zones, increased sediment produced to stream channels, and simplified aquatic habitat. Grazing has impacted wetlands, mainly those concentrated in the Upper Elliott and Upper Squaw subbasins.

Socio-Economic:

Adaptive Management Area (AMA): The Squaw/Elliott/Lake Watershed Analysis Area is located within Adaptive Management Area. Meeting the objectives of Adaptive Management Areas as determined by the ROD will be a unique challenge when planning and implementing activities within the AMA.

Developed Recreation: Recreational use of the Applegate Lake and Squaw Lakes areas has been on the rise and is expected to continue to increase. A recreation plan completed at the time Applegate Dam was constructed is no longer adequate considering the change in issues that has occurred over the last decade. Todays issues include fire risk management, Threatened, Endangered, and Sensitive species management, and changes in recreational use activities.

Fire Hazard and Risk: There is an increasing concern shared by many local residents that the Forest Service is not doing enough to resolve the concerns of increased fire hazard and risk. On the contrary, some local residents have a concern over methods used to reduce fire hazard and risk, as related to smoke management, escaped controlled fires, and maintaining an aesthetically pleasing landscape.

b) Data Sources:

The direction for completing this analysis was, to the extent possible, to use existing data. Except for a minor amount of field reconnaissance the team felt was important to the completion of this analysis, this direction was met.

The majority of vegetative data used for this analysis was obtained from Pacific Meridian Resources (PMR) and (GRS) satellite imagery. The accuracy of satellite imagery data is around 80 percent, with structure and canopy more accurate than the species data. Geographic Information System (GIS) was used as a tool for analyzing data for this Watershed Analysis. Map Overlay Statistical System (MOSS), R6 Maps, and ARC-Info GIS software systems were used.

4. Watershed Analysis Linked to Late-Successional Reserve (LSR) Assessment

Approximately 12,000 acres of Federal lands, located within the Squaw/Elliott/Lake Watershed Analysis Area are designated as Late-Successional Reserve. Before habitat manipulation activities can be designed and implemented within LSR, a management assessment is required. LSR Assessments focus on Late-Successional habitat and associated species while watershed analysis is a broader look at all processes and functions occurring within a watershed. LSR boundaries are not based on hydrologic boundaries but are based on species migration and dispersal needs and habitat connectivity. Therefore, the Squaw/Elliott/Lake Watershed Analysis Area boundary does not coincide with the LSR boundary, it overlaps (Figure 3). The LSR Assessment will also provide recommendations on strategies for the management of the LSR in meeting and obtaining ROD goals and objectives. The LSR Assessment is subject to review and approval by the Regional Ecosystem Office (REO).

5. Criteria for Watershed Analysis Updates and Revisions

Watershed Analysis is an ongoing, iterative process that will evolve as experience and knowledge of new techniques for completing this process grow. This report is a dynamic document that will be revised and updated as new information becomes available for the Analysis Area.

Updates of this document may include the following types of information: resource data collected at the project level, monitoring data, resource analysis from the LSR Assessment, and questions and answers pertaining to clarification of findings and recommendations contained in this report. Revisions of this document are warranted when new data and information collected indicates important changes in watershed conditions or trends.

The first foreseeable checkpoint for review of this Watershed Analysis is expected to occur following the completion and approval (by the REO) of the Late Successional-Reserve Assessment. If findings and recommendations made by this Watershed Analysis are found to be inconsistent with findings and recommendations of the LSR Assessment and/or the REO, a revision of this Watershed Analysis Report would likely occur.

Squaw/Elliott/Lake Watershed Analysis Area

Late Successional Reserves Adjacent to Analysis Area

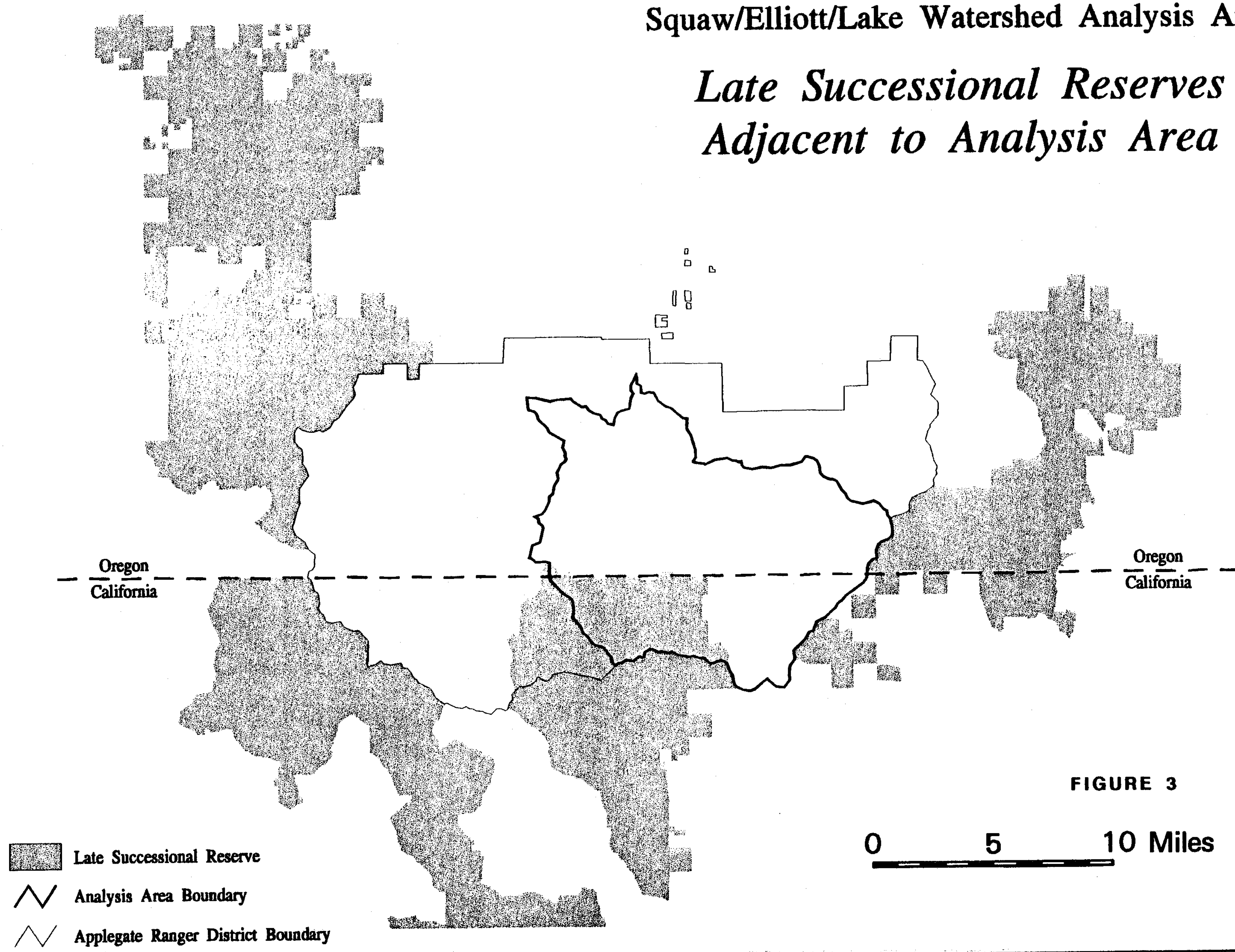


FIGURE 3

B. WATERSHED SETTING

1. Basin Overview

The 492,730 acre Applegate Watershed is one of seven subbasins within the 3,300,000 acre Rogue River Basin which flows into the Pacific Ocean. The Rogue River is located in the Klamath Mountain Physiographic Province and the Cascade Mountain area which includes the Western and High Cascade subprovinces. The Rogue River Basin is approximately 110 miles from east to west, with the main river about 210 miles in length from Crater Lake National Park to Gold Beach. The upper section of the river originates primarily in the steep topography of the Rogue-Umpqua Divide, west slope of the Cascade Mountains and upper elevations of the Siskiyou Mountains.

The Applegate River meets the Rogue River in the central valley segment of the Rogue River. The lower Rogue River below the confluence of the Applegate River is characterized as a gorge with steeper gradients than the central valley segment and tends to transport sediment and large wood to the estuary and ocean.

This portion of the River serves as a highway for all anadromous fish species to reach the interior Rogue River streams for spawning and rearing. Much of the freshwater lifecycle of fall Chinook, spring chinook, and summer steelhead is spent in the mainstem of the Rogue River. Coho salmon and winter steelhead are generally more dependent on tributary stream habitat and tend to stay in these habitats for one full year or more (Frick, 1994).

2. The Squaw/Elliott/Lake Watershed Analysis Area

The Squaw/Elliott/Lake Watershed Analysis Area is located in the Upper Applegate Watershed and drains an estimated 73,157 acres of the Applegate Watershed. The Analysis Area ranges in elevation from slightly over 1,600 feet at the confluence of Rock Creek and the Applegate River, to just over 7,400 feet atop Dutchmans Peak. Ownership distribution is broken into the following categories: approximately 60,596 acres (83%) National Forest lands, 1,520 acres (2%) Bureau of Land Management (BLM), 11,040 acres (15%) private land inholdings (Figure 4).

Squaw/Elliott/Lake Watershed Analysis Area

Ownership

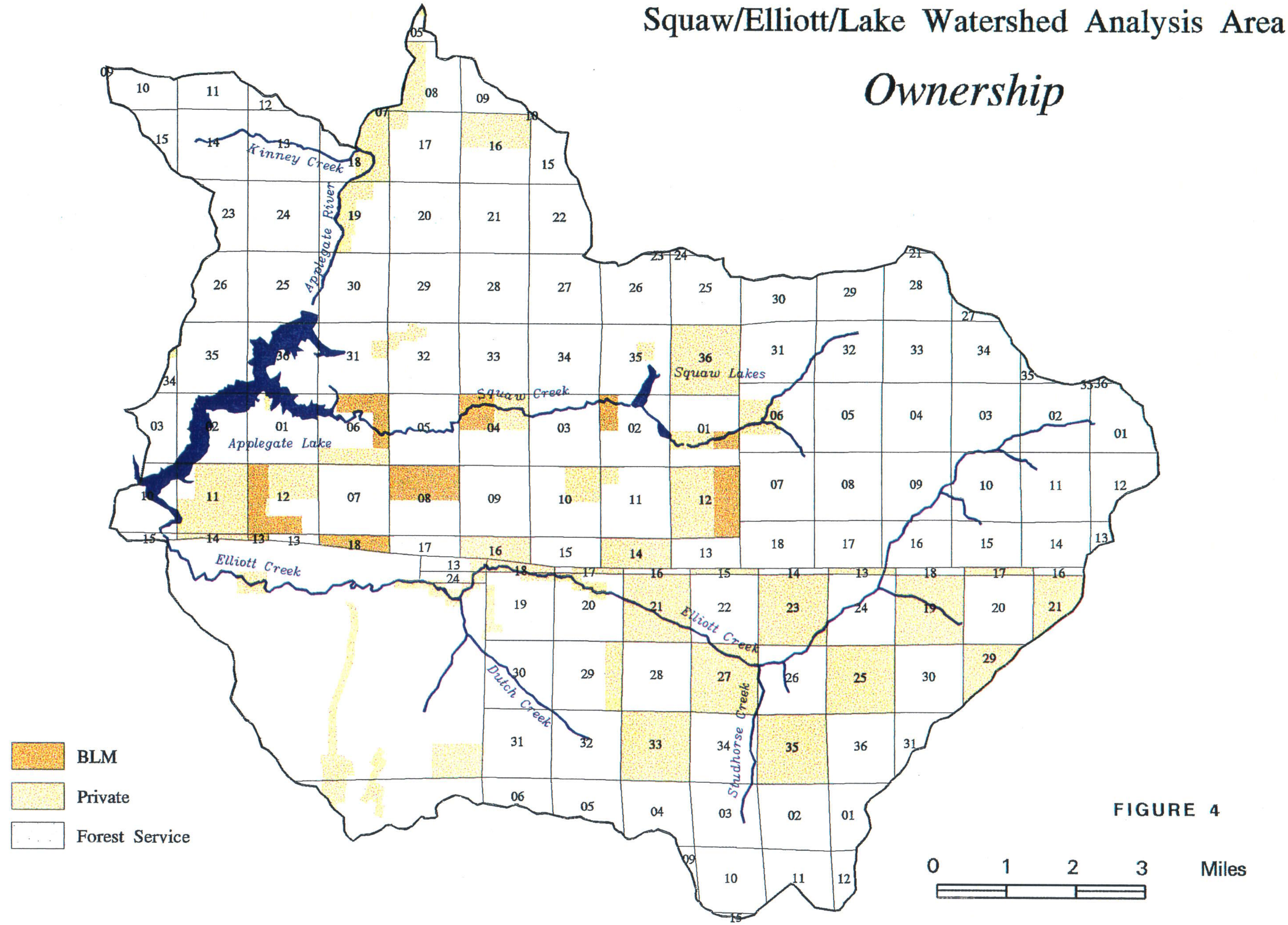


FIGURE 4

Squaw/Elliott/Lake Watershed Analysis Area

Subbasins

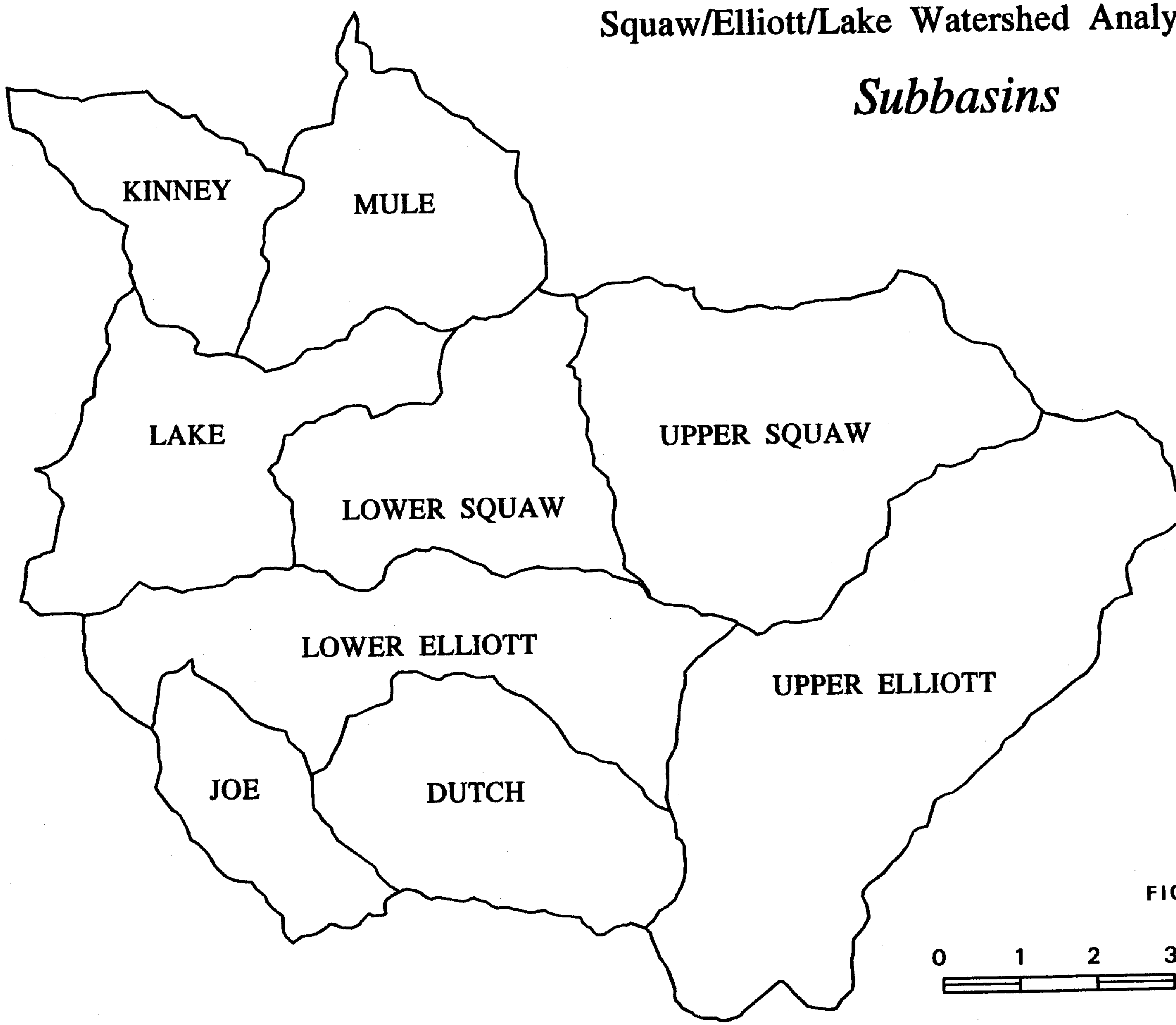


FIGURE 5

The Squaw/Elliott/Lake Watershed Analysis Area is comprised of the following subbasins; Upper Elliott Creek, Lower Elliott Creek, Dutch Creek, Joe Creek, Upper Squaw Creek, Lower Squaw Creek, Lake, Mule Creek, Kinney Creek (Figure 5) The following table lists the number of acres associated with each subbasin:

Table 1: Acres by Subbasin

Subbasin	Acres
Upper Elliott Creek	16,740
Lower Elliott Creek	9,114
Dutch Creek	6,875
Joe Creek	3,474
Upper Squaw Creek	11,828
Lower Squaw Creek	6,992
Lake	7,494
Kinney	4,280
Mule	6,360

3. Climate

a) Synoptic Weather Scale:

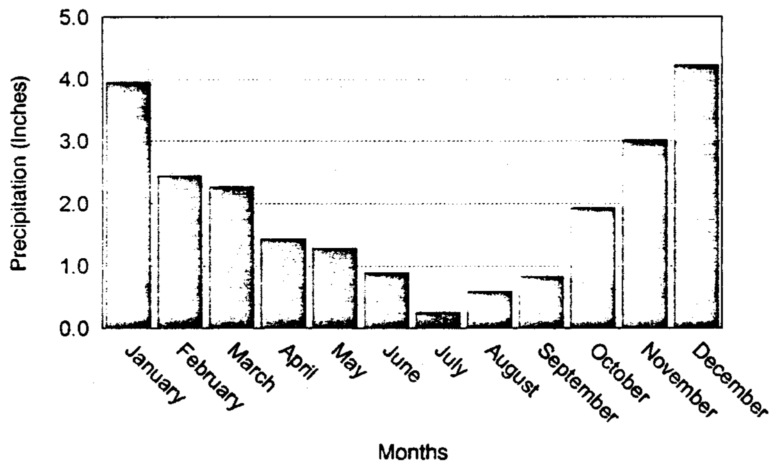
The summertime weather pattern is dominated by the Pacific high pressure ridge. The Pacific high pressure cell moves from its southern wintertime position and migrates into the northern Pacific during the summer months. Moisture and cold air mass movement and location are influenced by the position of the Pacific high pressure ridge. During the summer months many storms with moisture are diverted to the north of interior southwest Oregon due to the influence of the Pacific high pressure.

The global position of interior southwest Oregon results in exposure from cold storms of the north and warm tropical storms from the south. These cold air masses (low pressure areas) influence snow and rainfall potential during the cooler months. The upper air tropical moisture influxes, influence lightning activity during the summer months.

b) Interior Southwest Oregon:

The Squaw/Elliott/Lake Watershed Analysis Area experiences the Mediterranean climate typical of southwest Oregon. A prolonged cool wet period form November through May is followed by a hot dry season which normally extends from June through October. Winter precipitation is usually associated with large storm systems moving inland from the Pacific Ocean. Except for thunderstorms usually at higher elevations, rainless periods of several months are not uncommon during the summer (Figure 6). Annual precipitation is shown to range from 25 inches per year at lower elevations to 50 inches per year at the crest zone (Figure 7). Most precipitation occurs as snow above 5000 feet and as rain below 4000 feet. The transient snow zone is generally between 4000-5000 feet, during certain periods of winter and spring rain on snow events can occur. This condition creates a higher risk for mass wasting and surface erosion.

Figure 6: Mean Monthly Precipitation (Inches) at Buncom (NOAA Sta Index No. 1149)



As referenced in Atzet and Wheeler's document concerning the fire history of the Klamath Province (Atzet and Wheeler 1982) the unique topographic orientation of the Klamath Mountain Range (including the Siskiyou Mountain Range) influences the manner in which storms are received across the landscape; incoming storms are not uniformly received across the landscape. There is no recognizable pattern to the major drainages of the Siskiyou Mountains. Therefore, some drainages preferentially intercept the cold storms while others the warmer storms.

Interior southwest Oregon, eastern Siskiyous has the lowest annual precipitation and the highest annual summer temperatures for the west side of the Cascade Mountain range. Waring (1969) recognized climatic differences between the eastern and western Siskiyous and used the absence of Sadler oak to indicate the drier eastern climatic zone. The rain shadow from the Oregon coast to the Analysis Area is very pronounced. The influence of temperature and moisture is important for a site's vegetative potential contribution to the fire hazard.

Squaw/Elliott/Lake Watershed Analysis Area

Precipitation Zones

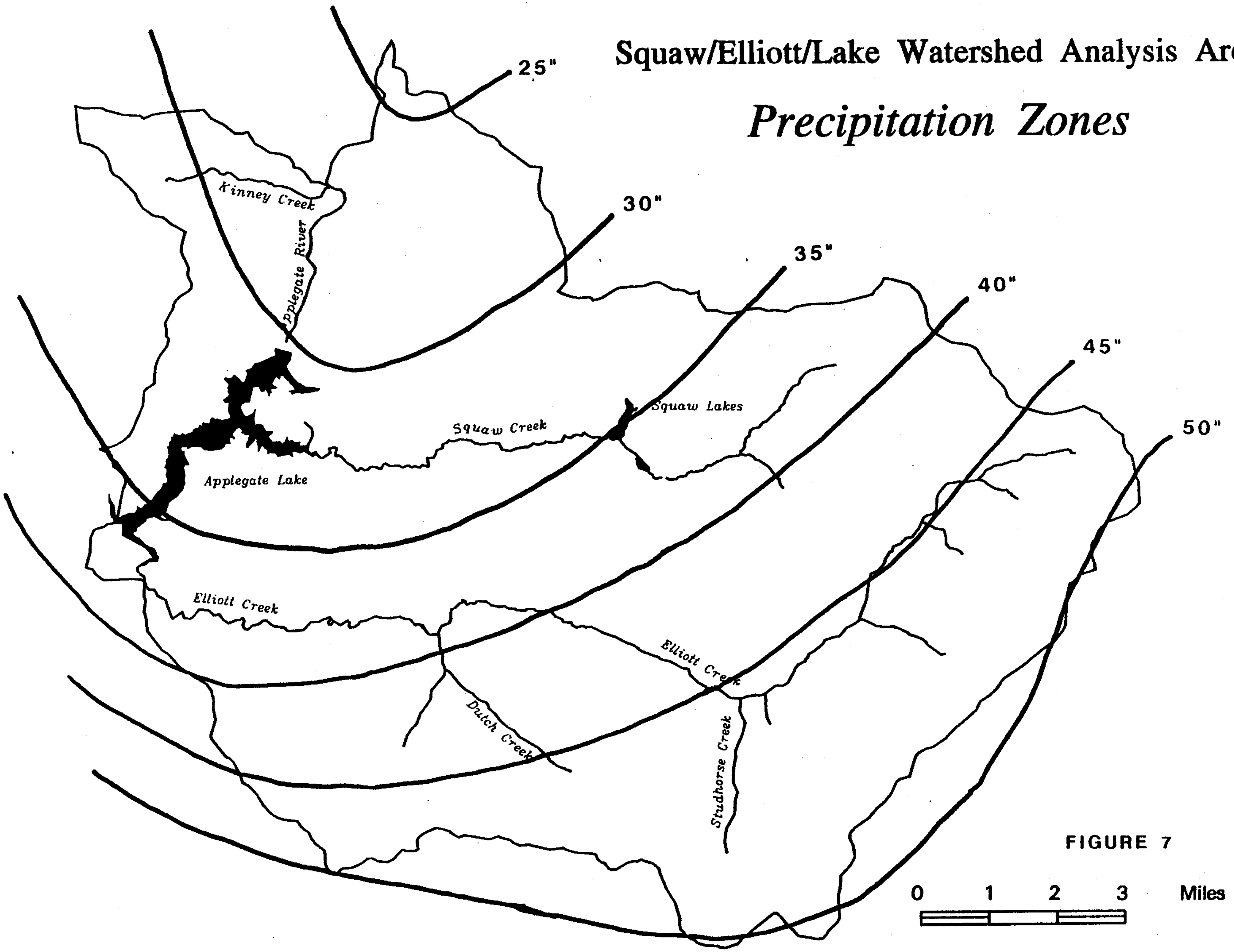


FIGURE 7

From the Squaw Peak remote automatic weather station (elevation 4,964) and the Star Ranger Station weather station (elevation 1,676) summer time temperatures can be closely estimated for the Squaw/Elliott/Lake Watershed Analysis Area.

Table 2: Summertime Temperatures

Squaw Peak	Average High Temperature	Maximum High Temperature
June	65	89
July	72	90
August	72	89
September	68	92

Star Ranger Station	Average High Temperature	Maximum High Temperature
June	80	107
July	87	107
August	90	107
September	86	108

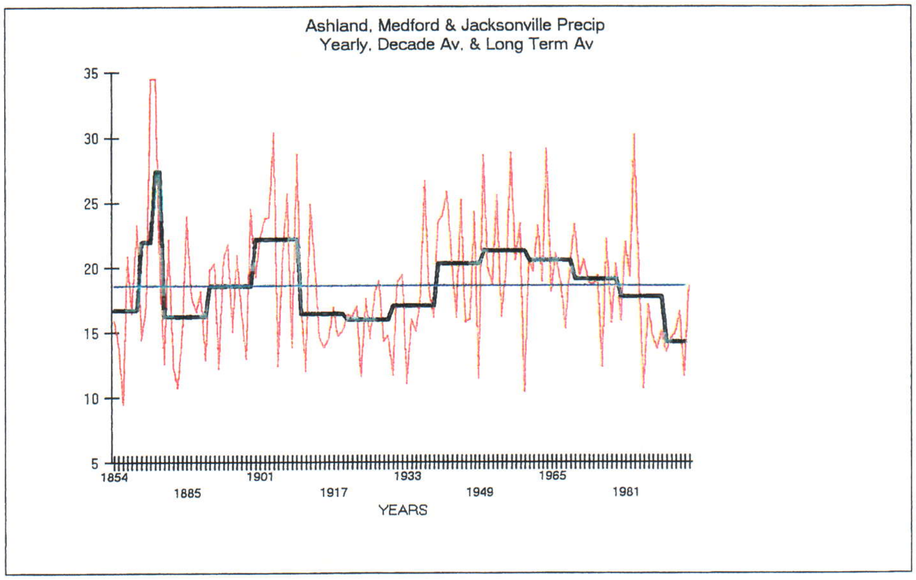
Relative humidities are often in the single digit during the latter part of the summer months. Particularly during September. Generally low-elevation, south aspects are hot and dry. On north aspects relative conditions are cool and moist. Elevation and aspect conditions influence micro-climate and vegetative response. Northern aspects stay in snow for longer periods of time than the more southerly facing aspects

While annual precipitation can vary widely year to year, the decadal average best indicates wet and drought periods. Precipitation information as derived by early records to present from Ashland, Jacksonville, and Medford were extrapolated to give a fairly good estimate of trends. While this area has experienced generally above average precipitation for several decades prior to the 1980s, there has been a steady decline over the past four decades. Southwestern Oregon has been in a low precipitation (drought) cycle since the mid 1980s (Figure 8).

Figure 8: 100 Year Precipitation Data

- Red Line: Annual Precipitation Records
- Blue Line: 100 Year Average Precipitation
- Black Line: Decadal Average Precipitation

Southern Rogue Valley Precipitation
Yearly, Decadal, and Long-term Average



Precipitation information as derived by early records to present from Ashland, Jacksonville and Medford.

4. Geology

The Squaw/Elliott/Lake Watershed Analysis Area is located in the Klamath Mountains Physiographic Province. This region represents a wide variety of ancient geologic environments that have been brought adjacent to one another through plate tectonic processes involving intense compression, faulting, uplift and intrusions. Formations range in age from about 130 to 250 million years old. The watershed contains three distinct geologic terranes, each with unique properties. The Condrey Mountain schist dominates the watershed and is noted for its highly productive, but also highly erodible and unstable soils.

The landscape has responded to broad regional uplift with high rates of erosion and mass wasting. Numerous geologic structures and process, as well as climatic forces, have strongly influenced watershed landforms. The result is steep, highly dissected slopes with extremely complex soil distribution. Slope instability and high erosion rates have locally been accelerated by human disturbances, predominately by roading and timber management. Copper mining was historically important at the Blue Ledge Mine. Placer gold mining occurs intermittently on Elliott Creek. Small scale, inactive gold mines are scattered throughout the watershed. Rock resources are limited to sites located outside of the Condrey schist.

5. Terrestrial Vegetation

The Squaw/Elliott/Lake Watershed Analysis Area is comprised of a diverse range of plant communities. Conifer forests cover much of the landscape with inclusions of hardwood forests, brushfields, and grasslands. Riparian areas and wetlands consisting of wet grass/forb meadows or alder glades are scattered throughout the area.

Forest vegetation can be divided into four main vegetation zones; the Interior Valley Vegetation Zone, the Mixed Evergreen Zone, the white fire zone, and the Shasta fir zone. Stands are distributed among early, mid, and late-successional stages. Site potentials within the Analysis Area is also highly variable ranging from poor sites with rocky droughty soils to areas of deep productive soils. Soils formed from mica schists have some of the highest site potentials found in the Analysis Area.

6. Terrestrial Wildlife

The diverse group of plant communities comprising the Analysis Area provides habitats for a large group of wildlife species. The species list compiled for the Applegate Adaptive Management Area (BLM, 1993) includes 12 amphibian species, 19 reptile species, more than 100 bird species, and greater than 60 mammal species. The Analysis Area is home to uncommon species (i.e. the northern goshawk), endimic species (i.e. Siskiyou Mountain salamander), Federally listed species (i.e. northern bald eagle and northern spotted owl).

Caves, bridges, and buildings provide nesting and roosting habitat for a variety of bat species. The Analysis Area is likely to be utilized by 12 bat species.

The Squaw/Elliott/Lake Watershed Analysis Area provides diverse habitats for neotropical migratory birds. Habitats utilized by neotropical migratory birds include grasslands, shrub lands, hardwood communities, conifer forests, wet meadows and alder glades, streamside riparian zones, lakes, and non-forested areas such as rock outcrops and cliffs. Several species of concern for the area include Little Willow Flycatcher, Band-tailed Pigeon, and Turkey Vulture. This is by no means a complete list of neotropical migratory birds occurring in the area.

Other sensitive wildlife species occurring in the area include the California mountain kingsnake, western pond turtle, and the Pacific fisher.

7. Hydrology

The major water producing basins within the Analysis Area are Elliott Creek which yields an average 78,000 acre-feet of runoff per year, and Squaw Creek which yields and average 40,000 acre-feet annually. This water yield and the lower yield from the Lake subbasin streams feed into the lower Applegate Reservoir, together with water produced from Middle Fork, Applegate, and Carberry Creeks. Water yield from Kinney and Mule Creek are unknown but are much lower than from the other subbasins since they are smaller in size and located in a zone of lower precipitation. The normal pattern of annual runoff is similar for all subbasins in that high winter elevations and at the highest meadows; the effects of this practice have only begun to fade after the past 80 years or so of fire suppression in the area.

The early 1800s saw the first penetration of Euro-American explorers to the interior. The Hudson's Bay Company and others attempted to "trap out" the streams of the region, however, it is unlikely they had much of an impact to streams of the Analysis Area, since this area was too remote for the fast-moving groups.

The first recorded prospecting in the uppermost Applegate River drainage occurred in 1852-53. Small placer-gold mines occurred along the Applegate River and Elliott Creek. Large-scale hydraulic mining beginning in the 1870's impacted a number of locations in the Analysis Area; lower Elliott Creek near the mouths of Joe and Dutch Creek ("Boggs Mine"), and Squaw Lakes Mining Company between French Gulch and Brushy Gulch. Hard-rock or load mining was extremely limited during the 19th century. In the early 1900's lode mining activity involved the low-grade copper ores of the middle sections of Elliott Creek (Blue Ledge Mine, New Bloomfield Mine) and Squaw Creek (Great Eastern); the Blue Ledge Mine being the most extensive development. The high price of gold after 1932, stimulated another round of placer and lode mining in the area.

Farming settlement occurring in the nineteenth century and later took place along the Applegate River from French Gulch and downstream and the lowermost Squaw Creek. These small operations involved raising livestock, growing hay or other forage, and tending small vegetable gardens and fruit orchards. During the second decade of the twentieth century livestock operations expanded in the area. Heavy grazing pressure and over grazing impacted the higher elevation meadows. Later during the depression, a reduction in numbers of livestock occurred.

Miners and settlers "high graded" the forests of the area of accessible, good quality sugar pine and ponderosa pine for settlements and mining developments. They also continued the aboriginal pattern of "light burning". Beginning in the 1930's and continuing on into the 70's and 80's, road development provided increased access into the Watershed Analysis Area. With increased access came increased recreational use and increased timber harvesting. In the 1970's and 80's intensive logging throughout the Analysis Area; clear-cutting and shelterwood harvest systems dominated, whereas earlier logging was accomplished primarily through selective harvesting. In the early 1970's, the land around Squaw Lakes became part of the National Forest, leading to a small scale recreational development at the site.

II. FINDINGS, DESIRED FUTURE CONDITIONS (DFC), & RECOMMENDATIONS

This section summarizes **findings**, identifies the **desired future condition** (DFC), and presents the **recommendations** for moving toward the desired future conditions identified for the Squaw/Elliott/Lake Watershed Analysis Area. This section is divided into three main areas; 1) Terrestrial Systems, 2) Aquatic Systems, and 3) Social and Economic. Recommendations discussed in this section apply only to Forest Service lands.

The issues developed during the analysis process are key to the integration of resources in this Analysis Area. The findings and desired future conditions found in this section display constant themes that blend the terrestrial, aquatic and social systems. Concerns for forest health as it relates to drought, insect attacks and diseases as well as managing for fire resistance, habitat restoration and terrain stability are the re-occurring themes that drive the recommendations. Management direction that is responsive to resource restoration or maintenance of the current condition is emphasized and is considered to be critical to the natural and social well-being of this ecosystem.

1. TERRESTRIAL SYSTEMS

A. GEOLOGY AND GEOMORPHOLOGY

Findings

The Analysis Area consists of steep, highly dissected mountainous terrain with **high rates of natural erosion and mass wasting**. Geologic history, rock types and structures have a dominant role in the current landscape. Relatively resistant metavolcanics in the northern portion occupies 22% of the Analysis Area. Extremely complex geology is found in the southeastern portion of the Analysis Area. **Condrey Mountain schist underlies 56% of the Analysis Area, and is noted for locally highly productive soils, weak bedrock and highly erodible, unstable slopes**. Approximately 19% of the Analysis Area has been classified as unstable, or potentially unstable. About 93% of this unstable terrain is located within the Condrey schist. Over 50% of the Interim Riparian Reserve acres are located on existing or potentially unstable slopes. Slightly over 50% of the soil types are considered to have high to moderate erosion potential.

Roading and associated timber management have accelerated erosion and instability, particularly within the black schist portion of the Condrey Mountain formation. Both the Upper and Lower subbasins of Elliott and Squaw Creeks contain high amounts of roads associated with riparian zones, unstable terrain and erodible soils. These two drainages contain over 20 miles of unsurfaced roads traversing highly erodible soils within riparian zones. Non-system roads on public lands and may locally be significant contributors to erosion and sedimentation. **Mine drainage from the inactive Blue Ledge Mine has a toxic effect on aquatic life in Joe Creek** (see Water Chemistry). The active soapstone mine on Elliott Creek has the potential to be patented. **There are no rock sources for restoration projects and road**

surfacing within the Condrey Mountain formation. This implies very high haul costs to areas in need of rehabilitation.

Desired Future Condition

Accelerated rates of mass wasting and erosion are reduced to natural background levels that minimize impacts to soil productivity and riparian habitat. Vegetation throughout the watershed has been managed such that vigorous, healthy stands are maintained. Roads, particularly those located in the Riparian Reserves, not necessary for future management and access are stabilized and decommissioned. Abandoned mines and quarries are rehabilitated and toxic discharge from the Blue Ledge Mine no longer occurs.

Recommendations

1. Complete Watershed Improvement Needs inventory to identify and prioritize restoration projects.

2. Complete Access and Travel Management plans to identify candidate roads for decommissioning.

3. Utilize Table A-2 to assist in priortization of watershed restoration projects associated with road accelerated erosion within the Riparian Reserves.

4. Inventory non-system roads (skid trails, private roads, landings) to attain a complete picture of roading impacts to watershed health. Use the Soil Porosity Analysis as a tool for identifying and priortizing areas for inventory.

5. Stabilize sites impacted by accelerated rates of erosion and slope movement.

6. Inventory and, where appropriate, rehabilitate abandoned mines.

7. Identify potentially responsible parties associated with toxic waters discharging from the Blue Ledge Mine that impacts water quality of Joe Creek. Request that the parties perform rehabilitation to prevent ongoing offsite impacts. If the parties are unable or unwilling to voluntarily perform restoration activities, pursue long term solutions by utilization of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) authority assigned to the Forest Service.

8. Ground disturbing activities should be planned with on-the-ground assistance of a qualified engineering geologist and/or soil scientist within unstable, potentially unstable, or highly erodible soils.

9. Emphasis for the vegetation management activities in unstable or potentially unstable terrain should be on maintenance of a healthy, vigorous forest stand with the intention of enhancing slope stability and minimizing erosion.

10. Restoration activities within the Interim Riparian Reserves boundaries should be analyzed by an interdisciplinary team. Depending upon the complexity of the project, the team should involve an engineering geologist, hydrologist, fisheries biologist, wildlife biologist, silviculturalist and project engineer.

11. Update long term rock resource management plans to assure that adequate rock materials are economically available for anticipated future needs.

B. SITE PRODUCTIVITY

Findings

Three factors defining site productivity in general terms are soil porosity, topsoil, and organic matter. The analysis of organic matter was not completed for this Watershed Analysis. See Geology for discussion of topsoil loss through erosion.

Soil porosity is greatly affected by ground-based logging equipment, such as tractors and skidders, which compact the soil under most conditions. Through aerial photo analysis the extent and area of soil compaction was evaluated. Table A-4 (Appendix A, Site Productivity) displays the number of acres within the Analysis Area impacted by skid trails. **The "moderate" and "high" categories exceed the Forest Service Regional standards of 20% for allowable soil disturbance (Forest Service Manual 2500-90-1, 8/1/90), indicating these sites are likely to have undergone a significant reduction in site productivity, which may affect at least one rotation of timber growth and yield.**

Compaction from skid trails does not occur uniformly across the landscape. **The concentration of skid trails is especially high in Upper Squaw, Upper Elliott and Joe subbasins; this is likely to have effects on streamflow regime, sediment production and slope stability (Geology and Hydrology).**

Although soil porosity analysis did not cover private lands comprising approximately 15% of the Analysis Area, **a cursory view of high elevation photo quads show that private lands have had as much or more disturbance from ground-based harvest systems as those areas found on Forest Service lands.**

Desired Future Condition

A better understanding of trends in site productivity for the Analysis Area is gained through research and monitoring of all factors contributing to site productivity. Areas where site productivity has been reduced as a result of soil compaction from skids trails and landings have been restored. Management activities are implemented in a manner to reduce areas impacted by soil compaction.

Recommendations

1. When planning and implementing harvest activities that will use high ground-pressure equipment the following should be considered:

- Design a permanent skidtrail system that will meet the needs of any future silvicultural prescriptions, and record for future entries.
- On units that have already been logged by tractors, an on-site evaluation should be made to determine which existing skidtrails are suitable for use, and record for future entries.
- Skid trail location must be avoided in draws, wet areas, steep slopes, and areas where surface water would be concentrated.
- Consultation with watershed specialists throughout the layout and administration phases.

2. The probability of restoring an abandoned road surface and cutbank to previous productivity levels is nearly impossible since topsoil, organic matter and porosity have been removed or reduced. Bringing these sites back to some level of productivity is still possible, yet how this is accomplished and to what degree should be completed based on the objectives of benefiting other resources as well such as watershed improvement, wildlife habitat, and range improvement.

3. The most common method of obliterating skid trails and road surfaces has been the use of the subsoiler. If used in the right conditions, this tool can reduce compaction. Unfortunately the lasting effects of this operation are not well understood, a monitoring project should be set up first to see how these soils respond to this restoration activity.

4. When planning and implementing the restoration of skid trail, landings and obliterating road surfaces using a subsoiler the following should be considered:

- Evaluate the site for water drainage problems. Design road dips, waterbars and other structures necessary to alleviate water concentration.
- The appropriate subsoiling equipment needed to meet restoration objectives.
- Monitor the end results of the project to determine if project objectives are being met.
- Sites with over 40 percent of the area in skid trails, could be considered for obliteration using the winged subsoiler.

See Monitoring and Research for recommendations on monitoring site productivitiy.

C. TERRESTRIAL VEGETATION

Findings

The exclusion of natural wildfire since the early 1900s has contributed to high vegetation densities causing extreme competition for moisture, nutrients and growing space. The combined effects of many years of fire exclusion and drought have contributed to levels of insect and disease activity that have had significant, large scale effects. **In the past decade mortality rates**

have dramatically increased. Both the large tree component of stands and the conifers growing near the valley floor at the lowest forested zone have experienced severe mortality. This zone is dominated by oaks and madrone, south slopes are occupied by grass and brushfields of Ceonothus and manzanita spp. In this lower zone, the white oaks have survived and exist at much higher densities than were historically maintained by the natural fire regime.

Vigorously growing vegetation is less susceptible to insect and disease attacks than poorly growing stagnated vegetation. Further discussion on the importance of late-successional habitats can be found in Terrestrial Wildlife, Appendix A.

The past nine years of drought has contributed considerably to conifer mortality, particularly in older stands of ponderosa and sugar pines. Stands stressed by competition and drought are highly susceptible for attack from insects and diseases. Douglas-fir and white fir, especially at low elevations, are experiencing high levels of mortality caused by bark beetles and woodborers. **Bark beetles and dwarf mistletoe have been the primary disturbance agents related to insects and diseases for the Analysis Area**. Other insects and diseases are present and can be attributed for some mortality. **As a result of these disturbance agents, the Forest is losing both the large tree and the pine component of stands within the Watershed Analysis Area, reducing biological diversity**.

Desired Future Condition

Landscapes are relatively resistant to large insect and disease infestations and resistant to large scale high severity stand replacing fires. Site productivity is restored and maintained at levels conducive to healthy vegetative growth and survival.

Recommendations

1. Manage vegetation according to recommendations in the *Applegate Adaptive Management Area Ecosystem Health Assessment*, Landscape and Stand Level Goals.

2. Specific recommendations in addition to the recommendations in the *AMA Ecosystem Health Assessment* include:

    a.) Reduce stand densities by thinning and prescribed burning in overstocked natural stands where ponderosa pine, sugar pine or black and white oak are desired;

    b.) Consider thinning and favor stocking for higher proportions of pines and hardwoods on low elevation, south facing slopes where Douglas-fir mortality is high due to activities of woodborers and bark beetles;

    c.) Thin plantations with ponderosa pine before trees reach an 8 inch average diameter. Evaluate the effects of removing mistletoe infected trees relative to wildlife values on a site-by-site basis;;

    d.) Thin around western white pines greater than 14" in diameter in dense natural stands at higher elevations;

e.) Identify root disease centers before thinning in Douglas-fir or white fir natural stands and plantations;

f.) Take opportunities to plant blister rust resistant sugar and western white pines, especially above the 4000' elevation;

g.) Analyze existing soil conditions when designing vegetation management projects. Design new projects to restore or maintain soil productivity characteristics.

3. Contact the staff of the Southwest Oregon Forest Insect and Disease Technical Center for additional information and assistance with watershed analysis and project level surveys and planning at (503) 858-6125 or DG: R06F10D19A.

D. BOTANICAL RESOURCES

Findings

The Squaw/Elliott/Lake Watershed Analysis Area contains many disjunct populations of plant species. **Five of the twelve Rogue River National Forest Botanical Areas are located within this Analysis Area. Fifty-one rare, twenty-two sensitive, eighteen review list and eleven watch list plant species are found within these watersheds**.

Approximately 25% of the Analysis Area has been surveyed for sensitive plant species, all within the past 5-7 years. Vascular plants from Table C-3 of the ROD have been surveyed, two species (*Cypripedium fasciculatum* and *Cypripedium montanum*) were found.

No management plans have been written for the five Botanical Areas in the Analysis Area. Three Botanical Areas are adjacent to proposed Botanical Areas on the Klamath National Forest.

Yellow Star Thistle is a major problem around Applegate Lake and the lower part of Squaw Creek road. This plant is spread by road maintenance equipment and vehicles as well as animals and people.

Desired Future Condition

Management plans for Botanical Areas are in place, rare species plant species have are inventoried, non-native plant species are controlled or eliminated.

Recommendations

1. Complete the management plans for the five Botanical Areas within the watershed.

2. Maintain communication with the Klamath National Forest concerning protection for rare plant species.

3. Inventory for ROD, Table C-3 species according to schedule, consider protection of these species during project planning and implementation.

4. Develop and implement a program to control the spread of noxious weeds on the Applegate Ranger District.

E. FIRE REGIME

Findings

Given the natural fire regime for interior southwest Oregon, the ecosystem we see today is outside the realm of its natural variability. **Overstocked, dense, multi-layered stands combined with high conifer mortality (increasing dead standing and down Coarse Woody Debris) is a large factor contributing to the high fire hazard and chance for stand replacing fires.** In addition, decadent old shrub fields (dead to live ratios of individual shrubs) are very flammable contributing to fire hazards. During forest wildfires the greater the amount of dead and down Coarse Woody Debris (CWD) or decadent vegetation within shrub communities, available during fire passage, the greater the intensity and residence time of fire passage.

The presence of high values associated with the land combined with high probability of occurrence for fire ignition is the basis of fire risk assessment. **The encroaching deveiopment of residential areas within forested lands (mostly off of National Forest lands) is contributing to an high fire risk within the rural/wildland interface area** due to the high values associated with human life and property. Increased access brought about by urbanization is increasing the threat of human-caused fires. **Where concentrations of residential or improvements exist (real value) on National Forest lands, there is an increase in fire risk. The chance for catastrophic loss of high values associated with the Analysis Area through high intensity or stand replacing fire events is a serious threat challenging land managers.**

Necessary Strategies

Protection from stand replacement and/or high intensity wildfire is necessary to reach the desired future condition for the Squaw/Elliott/Lake WAA. Several fire management strategies were assessed for how well they would meet protection and resource management objectives for the Analysis Area. The following table lists the management strategies and compares the relative degree to which they are desirable and implementable. **Individual strategies may not result in solving forest health or fire hazard problems. The diversity and complexity of the environmental conditions in this Analysis Area will require a combination of strategy methods as this table indicates**. See Appendix D, Fire Management, for a detailed explanation of Fire Management Strategies relative to the following table.

Table 3: Comparison of Fire Management Strategies.

Strategy* See Fire Appendix A for explanation	Current Level of Strategic Application (acres)	Relative Ability to Protect Multiple Resource Objectives	Relative Cost	Probability of Success
1. **Fire Suppression-Prevention** (No change from current)	95%	Low	Low	Low
2. **Shaded Fuelbreak System** (Medium success if meets minimum design criteria)	0%	Low	Medium	Low/Medium
3. **Fuels Modification Zones** (Modify vegetation to reduce fire hazard)	0%	Low	Medium	Low/Medium
4. **General Area Underburning** (Apply Rx fire throughout the WAA where applicable)	0%	Medium	High	Medium
5. **Density Management** (Harvest Thinning)	.005%	Low	Medium	Low
6. **Early Seral Treatment** (Target young high risk stands for treatment)	.0027%	Low	Medium	Low
7. **Combination of above strategies**		High	Medium/ High	High

Social/Political

Fire risk and fire hazard will continue to increase, at the expense of forest health, unless there are changes in policies, laws and social perceptions concerning fire and fuels management.

In many locations adjacent to National Forest land private land owners are logging conifers with little or no hazard reduction treatment of residual slash. Consequently fire hazards are increasing.

Regulations that control local air-quality standards limit the use of prescribe fire for the purpose of improving forest health and reducing fire hazards. The biggest issue in many rural communities is that any prescribed fire immediately generates smoke complaints. One place to start would be to revise local "nuisance smoke" ordinances, to allow more controlled burns and to reduce pressure to extinguish fires that should be allowed to burn under prescribed conditions.

Fear of damaging other private property and legal consequences over property damage from fires "escaping" from prescribed burns keeps forest managers from using prescribed fire as a management tool.

Additional funding will be necessary to adequately train, staff and retain personnel sufficient to the task of prescribed fire application on a landscape scale.

Forest restoration projects are inhibited by environmental regulations. Forest ecologists claim that a tangle of regulations hampers efforts to restore forest ecosystems. Since it is not possible to maximize all resource objectives and conflicting management objectives on every acre, tradeoffs will need to be identified and documented in the planning process. Acceptance by resource specialists and the public may not be achieved for every large scale prescribed burn.

Community and public education needs to take place concerning fuels management specific to improving forest health and fire hazard reduction. There are several conflicts contained in the standards and guidelines of the Northwest Forest Plan that contribute to this problem. As a result, some public have an expectation that all standards and guidelines can and must be met on all acres. There is a need to educate the public, resource specialists, and management as to the uniqueness of the environmental factors specific to this Analysis Area.

Prescribed Burning and Riparian Zones

The reintroduction of fire to certain locations in a fire dependent environment requires an understanding of fire effects to vegetation. The types and amounts of vegetation within riparian zones that exist today are partly a result of fire exclusion due to aggressive fire suppression. The ability to keep prescribed fire out of all riparian areas, given the numerous complex and highly dissected drainage's of the Siskiyou Mountains, while burning over large areas is near impossible. Through review of past burn projects, it has been observed that where springtime underburning has taken place, the existing natural vegetation within the riparian areas was not significantly altered or modified. This is primarily due to spring moisture conditions of these areas.

Prescribed Burning and Shaded Fuel Breaks

The use of the fuel breaks as control points for prescribed burning and to facilitate easier forest access should lower costs and be more effective with applied control measures when prescribed burning takes place.

Effects of Fire on Historic, Current, and Future Distribution of Wildlife Habitats

Stand densities and structures, the amount and size of Coarse Woody Debris (CWD), and vegetative species composition was different prior to organized fire suppression. The proportion of shade tolerant and shade intolerant vegetation has changed. Shade tolerant species have increased to the detriment of shade intolerant species. Fire intolerant vegetation species are increasing at the expense of fire tolerant species.

Snags, coarse woody debris, multi-layered canopies, prominent seral stages have all been changed over what would have prevailed during the pre-suppression era. Thus, habitat that may now appear today at the lower elevations of the interior valley zone and mixed conifer zone under current fire suppression (fire exclusion) strategies are much different than when natural fire regimes occurred years ago.

Understory burning reduces dead fuel loads and vertical fuel continuity within a treatment area. Although this reduces catastrophic fire potential for some time, the elimination of a multi-layered understory may result in sub-optimum owl habitat for a treatment area. However, in the long-term it may be necessary to have vegetation conditions of less density and volume at some strategic locations, rather than risking catastrophic losses of habitat that may be critical to the viability of late-successional species. (See Appendix A, Terrestrial Wildlife for a discussion on the importance of late-successional habitat.)

Desired Future Condition

Important values, such as the protection of life and property, watershed values, Late-Successional Reserve, and various wildlife habitats and species, are those that are intended to be protected from loss through large catastrophic wildfire. Within the Squaw/Elliott/Lake Watershed Analysis Area it is desired that vegetative landscapes are resistant (within a natural range of variation) to large-scale stand replacing fires.

Recommendations

Recommendations for fire management will be discussed under the following sub-headings: Vegetation Management, Presuppression, Snags and Fire Fighter Safety, Suppression, Fire Prevention.

Vegetation Management

1. **Take action to protect, restore, or stabilize these vegetative landscapes**. The following matrix displays the intersect of fire hazard and fire risk. The highest priority areas for management action are where high and moderate fire hazard intersect with moderate, high, and extreme fire risk.

Priority Areas For Action

Fire Hazard		Fire Risk: Mod	Fire Risk: High	Fire Risk: Ex
	Extreme (Enhanced)	X	X	X
	High	X	X	X
Fire Hazard	Mod	X	X	X
	Low	O	O	X

Each X depicts possible priority areas for action where there is a high likelihood that **VALUES** will be lost to fire. (Also refer to Figure 9 for a map displaying the distribution of fire hazard intersected with fire risk).

Squaw/Elliott/Lake Watershed Analysis Area

Fire Hazard / Fire Risk

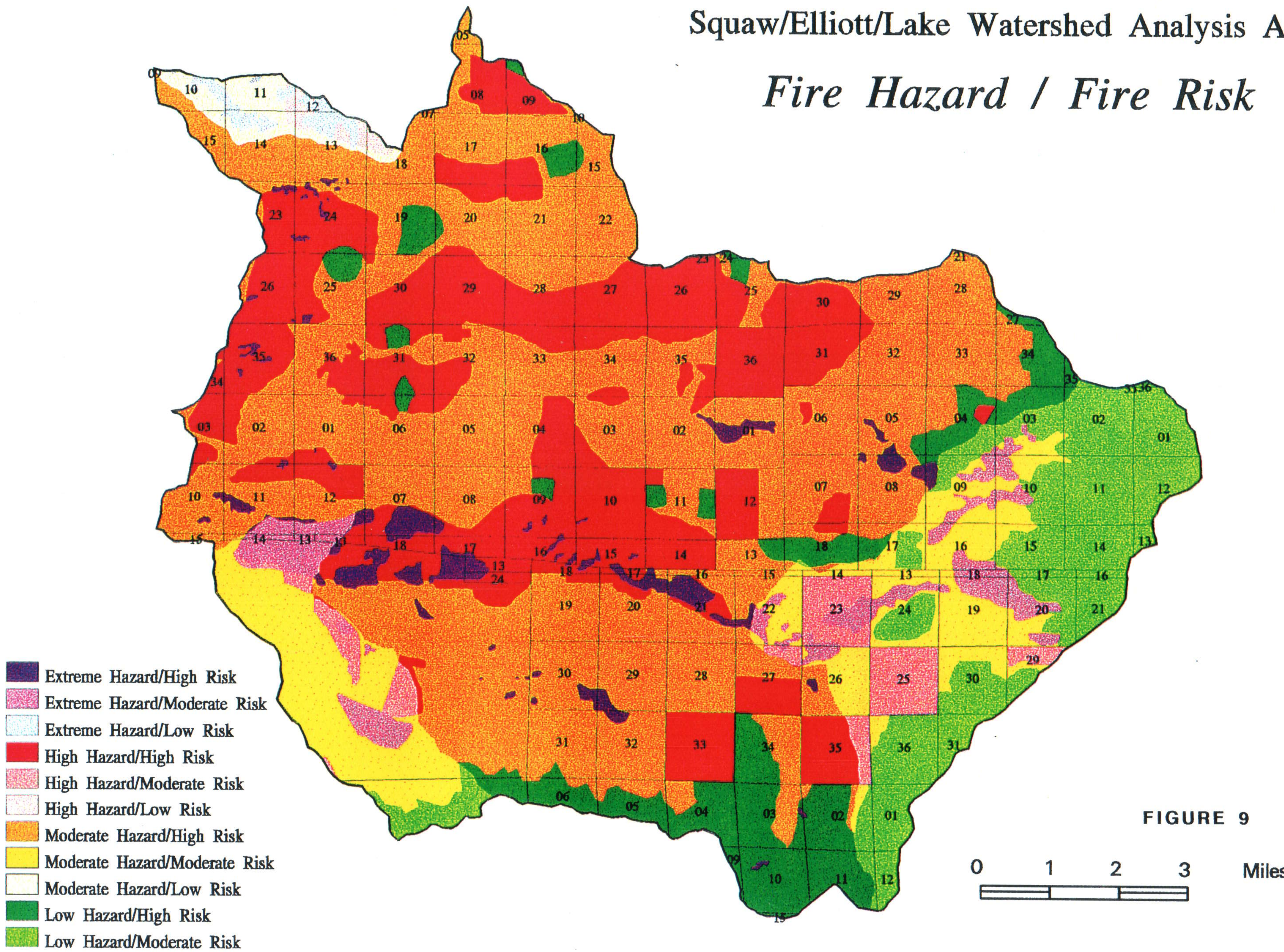


FIGURE 9

2. All vegetation management activities described are consistent with the recommendations within the Applegate AMA Forest Health Assessment of 1994. It recommends that projects mimic natural disturbance to meet landscape objectives. Tools to be considered include density management, prescribed fire, and manual manipulation of live and dead vegetation. Over the long term these types of management activities will help reduce fire hazard and improve forest health.

3. Integrate the analysis of habitat requirements, site productivity, Riparian Reserves and other ecological considerations with site specific fire hazard and fire risk analysis. This integration must take place when making final decisions considering vegetation management including the amount of Coarse Woody Debris and standing snags within a planning area.

4. Coarse Woody Debris (CWD) better known from a fire management perspective as "dead and down material," will be managed where fire hazard reduction is the objective of the management activity. Table 4 provides reasonable amounts (within the range of natural variation) of coarse woody debris while considering fire protection through hazard reduction. **The objective is to meet the intent of the Northwest Forest Plan standards and guidelines while achieving fire protection and hazard reduction**. The level of hazard reduction on a landscape basis is driven by the climate, topographic features, and the types of vegetation described previously.

   The following table illustrates the important statement from page B-2 of the ROD. "In some forest types subject to frequent low intensity fire, such as ponderosa pine, the late-successional and old growth stages are typically characterized by relatively open understories and relatively few large fallen trees (in comparison to more moist Douglas-fir/western hemlock types). Standards and guidelines designed to promote the desired conditions vary among physiographic provinces because forests also vary among provinces." Using the best existing information, the following table recommends the amount of CWD within vegetation zones based on aspect as influenced by the pre-fire suppression fire return interval. **Note**: The amount of CWD is measured by pieces of wood. Piece is defined as wood with a minimum of 16 inch diameter by 16 foot length.

Table 4: Recommended Amounts Within Forested Cover Types for Coarse Woody Debris Considering Fire Hazard Reduction

Vegetation Zones (a) (Series)	Desired Successional Phase	Fire Return Interval (b)	Pieces per acre of Woody Debris (Considering the Range of Variation Among Vegetation Zones)
Interior Valley Zone (ponderosa and driest Douglas-fir series)	Seral	8 to 10 years	0 to 3 pieces on south aspects; 2 to 5 pieces on north aspects. Class I or II decay rate
Mixed Conifer Zone (Douglas-fir and driest white fir series)	Mostly Seral	15 to 20 years	3 to 7 pieces on south aspects; 5 to 10 pieces on north aspects. Class I or II decay rate
White fir Zone	Mostly Climax	25 to 35 years	7 to 12 pieces south aspects: 10 to 16 pieces north aspects. Class I or II decay rate
Shasta fir Zone	Mostly Climax	40 years	10 to 20 pieces; Class I or II decay rate
Mountain Hemlock Zone	Mostly Climax	100 to 115 years	10 to 20 pieces Class I or II decay rate
Riparian Wetlands			120 lineal feet (minimum 16 inch diameter by 16 foot length).

(a) taken from Jerry F. Franklin and C. T. Dryness. Vegetation Of Oregon & Washington. - USDA Forest Service Research Paper PNW-80. 1969. **(b)** Fire return intervals are on a landscape basis. Intervals determined from personal discussion with Tom Atzet, Area Ecologist, 1994, concerning fire return interval for the forest/urban residence interface above Ashland, Oregon and the upper Applegate Valley eastern Siskiyous.

5. A risk assessment should be completed within the Squaw/Elliott/Lake Watershed Analysis Area that will identify important habitats in need of protection from high intensity wildfire. Such important habitat conditions and locations are the eagle nesting and LSR's. These areas should be a priority for management action with a range of treatments.

6. Where shaded fuel breaks are proposed to be constructed, spacing of conifers to be left on site within existing plantations should be 20 feet or greater. This spacing ensures that conifers remain in an open canopy condition for a longer period of time. Experience has shown with fuel break construction, when competing vegetation is eliminated conifers grow at a phenomenal rate. They soon occupy the site and go into canopy closure.

7. Prescribed burning to maintain viability of the ponderosa pine community.

8. The potential for fire risk and fire hazard should be analyzed where the management activity is expected to increase the dead and down or standing dead vegetation. Activities that increase dead and down or standing dead material over many acres within the Mixed Conifer and Interior Valley Vegetation is a concern. Analysis should take place before the management activity is implemented. Post activity fuels treatment plans will include detailed discussion of how the fuel treatment work will be completed; when the work will be completed, and the availability of funding.

Presuppression

1. The completion of a shaded fuel break system meeting minimum design criteria should take place as soon as possible(see Appendix B-Fire). The completion of these strategically located fuel breaks provides several tactical advantages. In addition to the benefits of fuel breaks for safe deployment or evacuation of fire fighters, the penetration of retardants through the opened forest canopy is enhanced and the likelihood of crown fires (fire carried through the tops of the taller, vegetation) is reduced.

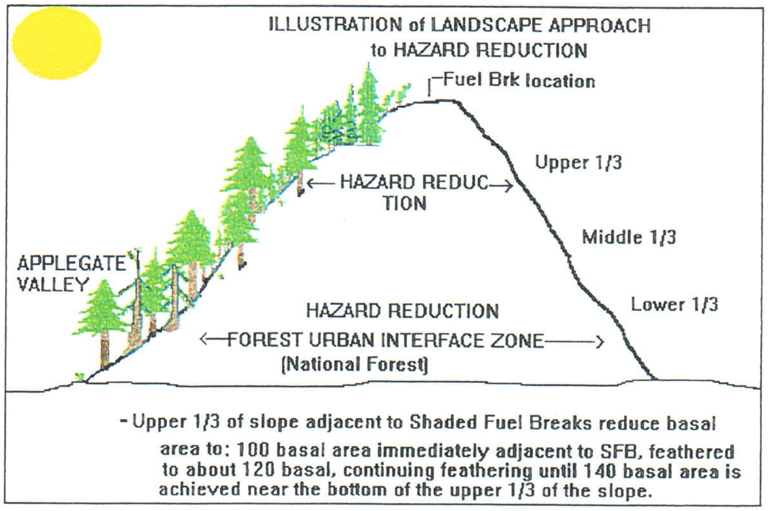
   - Coordinate completion of National Forest shaded fuel breaks with the shaded fuel break system that private land owners are starting and completing.

   - For shaded fuel breaks to be the most effective during a wildfire, the forest floor of the fuel break should not have more than 1.5 tons of CWD per acre. Generally, snags should not be within or adjacent to the fuel breaks. Overstory canopies should not be interlocking (closed). The density of the understory vegetation should be reduced sufficiently to prevent ground fire from igniting the overstory vegetation. The width of the fuel breaks must be designed with consideration for the density, height and character of the vegetation adjacent to the fuel breaks.

   - Maintain fuel breaks and vegetation density of flank areas with the use of manual hand maintenance, prescribed underburning, administrative timber sales, or a combination of these treatments.

   - The density and type of dead and down vegetation or live vegetation adjacent to the flanks of the fuel breaks needs to be modified or reduced. This may entail a "staged" sequence of density management, prescribed underburning, manual cutting and piling and pile burning or combination at any one selected site. The ratio of dead to live vegetation must be considered. Within this concept the age or viability of the vegetation often times determine its flammability. For example young shrubs are less flammable than mature shrubs which have a higher ratio of dead to live branches in their crowns.

Figure 10: Illustration of a Landscape Approach to Hazard Reduction



2. Analyze and provide for adequate presuppression and preattack facilities such as helispots, access and safety zones. Maintain initial attack helispots. Pre-determine tractor fireline locations in the event of a large wildfire that are acceptable considering hydrologic and soils conditions and identify on pre-attack maps (using criteria established under Riparian Reserve management recommendations).

3. Analyze for adequate suppression access response when completing access and travel management planning.

Snags and Fire Fighter Safety

Injuries and fatalities associated with snags while suppressing wildfires are only second to aviation accidents. Fire fighter safety while suppressing wildfires is of utmost importance. One of the greatest threats to fire fighter safety is working around burning snags, burned snags or fire weakened trees. Also the greater the number of snags burning in a wildfire, the more difficult the fire is to control. Snags thwart and frustrate aggressive fire suppression due to extreme risk to fire fighters and the amount of firebrands produced. These firebrands produced high in the tree canopies are lofted in convection columns and produce downwind spot fires when they land in flammable vegetation away from the originating fire.

1. Project analysis needs to include issues related to fire fighter safety where snags are to be maintained or created to meet other resource objectives.

2. The number of snags retained per acre must be orchestrated with hazard reduction and wildlife needs. For example, those areas where hazard and risk reduction are a primary management action and objective, snag numbers and their location will have to be considered. For areas within high fire risk and high fire hazard areas, snags within or adjacent to shaded fuel breaks or adjacent to private residential property should be reduced

or eliminated (depending on other resource objectives) since these are areas where fire fighters will likely be used in suppression of wildfires.

Suppression

1. Aggressive fire protection shall be the norm throughout the Squaw/Elliott/Lake Watershed Analysis Area.
2. Mutual aid agreements should be reviewed and updated periodically by the various cooperative agencies. Updates and reviews should entail looking at the most efficient manner to help prevent or reduce destruction of life and property, watershed, habitat, and fisheries values due to wildfire.

Fire Prevention

Wildland fire prevention involves informing, educating, and regulating of human behavior or activities that influence the various types of potential ignition sources within flammable vegetation. As agency downsizing continues, the need to maintain a proactive fire prevention program will become a challenge. Particularly since the majority of National Forest human-caused fires are concentrated around Applegate Lake and Squaw Lake.

1. Cooperative fire prevention with the, Oregon Department of Forestry and Jackson County fire agencies can help partially maintain a proactive effort in preventing human-caused fires. Public use access restrictions must continue to be an option during certain fire danger criteria. The initiation of public neighborhood fire prevention meetings discussing defensible space, fire apparatus access, home construction materials (flammability) design, etc., should take place periodically.

2. The Forest Service should consider taking the lead in organizing Coordinated Resource Management Plans (CRMPs) for sub-basins of the WAA critical to protecting resources from wildfire.

3. Continue to provide technical advice in urban residence/wildland fire planning to local land use planning agencies.

4. Before recreation opportunities are implemented, evaluation needs to be completed of the potential for the recreational endeavor increasing fire risk and agencies ability to mitigate increased access..

5. Establish a community education program concerning fuels management specific to improving forest health and fire hazard reduction. Work to educate the public, resource specialists and agency management as to the uniqueness of the environmental factors specific to this Analysis Area.

F. TERRESTRIAL WILDLIFE

Findings

Wildlife Habitats

Late-successional habitats are uncommon, representing only 13% of the Analysis Area. Extensive timber harvesting, especially regeneration treatments, within many subbasins is primarily responsible for removal of late-successional forests. Dutch subbasin, which has had only limited timber harvest, is representative of what may have been present in the absence of timber harvest. Late-successional habitats comprise 28% of Dutch subbasin. Mule, Lake, and Kinney subbasins contain the least amounts of late-successional habitats, 285 acres, 418 acres, and 455 acres, respectively. These three watersheds are not capable of supporting large amounts of late-successional habitats.

The amount of late successional forest habitat affects the presence, abundance, and distribution of late-successional dependent wildlife species.

Within all subbasins of this Analysis Area, mature habitats comprise the largest group of forest habitats, ranging from a low of 53% within Upper Elliott subbasin, to a high of 79% of Lake subbasin. **Mature habitats do not have the characteristics of and do not function as late-successional habitats** for terrestrial species. Commonly missing in mature habitats are a well developed snag and down tree habitat, and a multi-story canopy.

Early successional forest habitats are most common in Mule (32%), Upper Squaw (33%), and Upper Elliott (34%) subbasins. For the latter two subbasins, timber harvest is primarily responsible for these percentages of early succession forest habitats.

Hardwood forests are uncommon within the Analysis Area, but where present, provide important habitats for many wildlife species. These forests provide essential habitat for resident and neotropical migratory bird species. Other habitats present include non-vegetated areas, grass/herbs, and shrub lands.

The pine forests, oak savannahs, and early succession brushfields in the Analysis Area are wildlife habitats in poor condition. The poor condition of these habitats relates to changes in plant species composition, and reduction in their distribution across the landscape. Grass/herbaceous plant communities also were more widely distributed in the past, but have been encroached upon by shrubs and trees. The exclusion of large scale wildfire is a primary factor for the poor condition of these habitats.

Snags provide an important habitat type within the Analysis Area. Snag habitat is important along ridge tops, within forest stands and within riparian habitats. **Snag habitat is in good condition at the landscape level, with snag density high in low elevation areas where drought and insect related mortality has killed many trees, but is poor in nearly every past timber harvest unit.**

Permanently flowing streams(class 1, 2 and 3) and their riparian zones account for approximately 96 miles of riparian habitat. Intermittent streams (class 4) account for an additional 285 miles of riparian habitat. Intermittent streams provide riparian habitat during the times of year when they flow water, and they also provide connecting habitats within and with adjacent watersheds.

Late-successional forest habitats are common along riparian zones in upper Elliott, upper Squaw, Lake, and Dutch subbasins. Early succession habitats along riparian zones are most common in lower Squaw and lower Elliott subbasins. Along riparian zones, non-conifer habitats such as montane hardwood forests are most common in upper Elliott, Mule, Kinney and lower Squaw subbasins.

Wetlands are uncommon in the Analysis Area and consist of wet meadows, alder glades and wet conifer forests. Upper Elliott subbasin has the highest concentration of wetlands (600 acres) followed by upper Squaw with 115 acres of wetlands. Alder and forest wetlands are generally in good to excellent ecological condition, but wet meadows are generally in fair or poor ecological condition. **Many years of intensive livestock grazing has impacted many of the wet meadows in the Analysis Area. Some wetlands continue to receive heavy livestock use.**

Road density averages 2.5 miles of roads per square mile. **Road density is highest within upper Squaw (3.8 miles), upper Elliott (3.5 miles), and Joe (3.2 miles) subbasins. Road decommissioning within specific locations, i.e., Big Game Winter Range and Riparian Reserves, can improve the quality of wildlife habitats.**

Wildlife Species

Northern Spotted Owl (Threatened Species):

The Applegate/Oak Knoll Late-Successional Reserve (RC-354) is partially located within the Analysis Area.

Twenty-eight spotted owl pair activity centers are located in the Analysis Area. Sixteen (57%) pair activity centers are below U.S. Fish & Wildlife Service (FWS) guidelines for incidental take because of lack of suitable habitat within their home ranges. Ten of the 28 activity centers are within the Applegate/Oak Knoll Late-Successional Reserve. One owl pair activity center is considered to be in a "take" situation.

Habitat analysis indicates that the Applegate/Oak Knoll LSR is in good condition based on habitat amounts and the number of owl pairs within the LSR. The status (reproductive history and the amounts of suitable habitat within the home range) of each owl pair within the LSR has not been determined.

Reproductive success for all spotted owl pairs within the Analysis Area averages 0.56 young/year. **Reproductive success is 1.73 young/year for spotted owl pairs that meet or exceed FWS guidelines for habitat amounts within their home range. Conversely, reproductive success is 0.51 young/year for pairs that do not meet FWS guidelines for**

habitat amounts. The spotted owls with the best reproductive success are located within the Applegate/Oak Knoll Late-Successional Reserve.

Spotted owl dispersal habitat is generally in good condition within the Analysis Area. Seventeen quarter-townships are within the Analysis Area and except for quarter-township #31 they all meet 50-11-40 guidelines. The Analysis Area provides dispersal habitat between several adjacent Late-Successional Reserves. These include the Mt. Ashland/Oak Knoll LSR, a BLM LSR, and an LSR on the Siskiyou National Forest. Private lands contribute to supporting the spotted owl population within the Analysis Area.

Peregrine Falcon (Endangered Species):

A peregrine falcon home range overlaps the Analysis Area. The nest site is immediately adjacent to the Analysis Area. **Reproductive success at the site has been poor, with only one young fledged in the past four years.**

Bald Eagle (Threatened Species):

An active bald eagle nest is located within the Analysis Area and a Bald Eagle Management Area (BEMA) has been established for the site. The bald eagle pair are year-round residents of the BEMA.

Snags and large pines within and adjacent to the BEMA are important components of bald eagle habitat. **The Applegate BEMA has a reproductive rate of 1.5 young/year which exceeds the State average of 0.97 young/year.**

A BEMA wildfire management plan was started in 1993, but not completed.

Existing recreation activities at Applegate Lake and adjacent areas do not appear to affect bald eagle use within the BEMA. The present boat speed of 10 mph is a major factor that minimizes recreation/bald eagle conflicts. **There is no long-range recreation management plan for the Applegate Lake recreation complex. Recreation use is growing yearly and is expected to continue to grow. Without a carefully developed recreation plan, it is likely that recreation/bald eagle conflicts will arise.**

A livestock driveway is immediately adjacent to the bald eagle nest and human use of the portion of the driveway adjacent to the nest tree does negatively affect bald eagle nesting. The livestock driveway is closed to recreation use, but recreationist occasionally continue to use the area.

Great Gray Owl: (Sensitive Species, R-5; ROD Survey and Manage species):

Suitable habitat for great gray owl is found within the Analysis Area. **No known nest sites have been located within the Analysis Area, but are suspected for several locations**. Potential habitat for the great gray owl is located at the higher elevations of the Analysis Area. **Habitat conditions for great gray owls are excellent for upper Elliott and upper Squaw subbasins, but rated lower in other subbasins.**

Surveys for this species have been conducted in portions of the Analysis Area, but most of the potential habitat has not been surveyed to established protocol standards.

Siskiyou Mountains Salamander (Sensitive species-USFS; ROD Survey and Manage species; California-Threatened species):

This salamander species is endemic to the Applegate and the Oak Knoll Ranger Districts. The Analysis Area is the center of distribution for Siskiyou Mountains salamander. GIS analysis shows approximately 40,000 acres of potential Siskiyou salamander habitat within the Analysis Area.

Surveys for Siskiyou Mountains salamander can only be conducted during very specific environmental conditions. The limited survey periods could affect the timing of proposed projects.

Past impacts to this species occurred from timber harvest and timber harvest activities such as tractor logging, from road construction, and from rock pit developments.

Northern Goshawk: (FWS Candidate Species)

Six nest sites are found in the Analysis Area. However, three of the nest sites may actually be alternate nests of the same goshawk pair.

Surveys for goshawks have not been conducted within the Analysis Area. Habitat analysis has not been conducted for Goshawks in the Analysis Area.

Neotropical Migratory Birds:

Neotropical migrant birds utilize all major habitats in the Analysis Area. **Neotropical migratory bird habitats are in good condition within the Analysis Area, except for four habitat types of concern: ponderosa pine communities, oak woodlands, grasslands, and riparian/wetland habitats**. Opportunities exist to enhance these habitat types through various management activities, i.e., road decommissions and silvicultural treatments.

The little willow flycatcher, band-tailed pigeon, and turkey vulture are three neotropical migratory bird species of concern that are found within the Analysis Area. **The little willow flycatcher utilizes willow/alder glades for nesting habitat and livestock grazing could affect this species**. The band-tailed pigeon nests within the Analysis Area and large flocks stop-over within the Analysis Area for extended periods during the fall migration. Blue elderberry and madrone fruit are important food sources during these stop-overs. **The entire Analysis Area is utilized by the turkey vulture, however, large snags on dominant ridges within the Analysis Area are key components of this species habitat.**

Neotropical migratory bird monitoring projects are occurring within and adjacent to the Analysis Area. Immediately adjacent to the Analysis Area is a MAPS station (Monitoring Avian Productivity and Survivorship) which is part of a long-term, international study aimed at learning more about population trends of neotropical migratory birds.

California Mountain Kingsnake (Sensitive species, R-6):

The California mountain kingsnake is a low elevation species commonly found along riparian zones and within oak and oak/pine plant communities. This species is also closely associated with talus/rock outcrops. Surveys are not adequate for locating this species and no adequate survey protocol is available. Protection of their suitable habitat and the habitat of their prey species is the most effective technique in maintaining populations.

Western Pond Turtle (Candidate Species; Sensitive species, R-6):

The pond turtle is associated with aquatic and adjacent upland habitats. This species is found in several locations within the Analysis Area. **The distribution and populations of pond turtles have been reduced from historical levels because of human water use patterns and riparian management practices**. Livestock grazing within and adjacent to aquatic and nesting habitats of occupied sites could affect pond turtles.

Other impacts to pond turtles within the Analysis Area occur from (a) motor vehicles crushing pond turtles crossing Upper Applegate Road; these turtles are attempting to travel to nesting sites; and (b) predation of young turtles by two introduced species, the bullfrog and large mouth bass.

Pond turtle populations show a disproportionately high number mature individuals. Over the long-term this could negatively affect survival of this species. Surveys for pond turtles must be conducted during the correct environmental conditions.

Furbearers (American marten: Sensitive, R-6; Status of others to be added):

This group of species includes the American marten, California wolverine, and Pacific fisher. Sightings of these species in the Analysis Area have not been confirmed, however, the Pacific fisher has been confirmed within adjacent areas. Habitat for furbearers is found throughout the mid to high elevations of the Analysis Area.

Bats :

Habitats include mines, caves, rock outcrops, snags. **Species diversity is considered to be extremely high**. The Analysis Area is thought to be at the extreme end of the range for several species.

Telemetry studies of several species indicates strong associations with large snags along ridges that extend above the forest canopy. These studies also show a fidelity to a particular snag.

A particular snag is often used as a maternity roost for the entire local population of a bat species. Loss of these snags would eliminate this species from the local area.

Black-Tail Deer:

Black-tail deer utilize the entire Analysis Area during the summer. During the winter, the range is restricted to low elevation areas generally below 4,000 feet. Winter range is typically the limiting factor in black-tail deer populations.

Winter range habitat analysis has not been conducted, so the current forage/cover ratio are not known. From field observations of the winter range, forage areas appear to be a limiting factor. Optimal thermal cover within winter range may also be limiting.

Water developments within the summer range may enhance the black-tail deer population by making more habitat accessible.

Road decommissioning within black-tail deer winter range will enhance winter range habitat conditions.

Desired Future Condition

- Late successional habitats are well represented within all subbasins given the natural range of variability and resource management objectives.

- Patches of late-successional habitats are available to support species that utilize smaller patches than those used by spotted owls.

- Within the appropriate range, Oregon white oak savannahs and ponderosa pine/oak savannahs are well distributed and in a healthy condition (i.e., species composition, age/class distribution, and distribution across the landscape).

- Within their range, hardwood forests are well distributed and in a healthy condition (i.e., species composition, age/class distribution, and distribution across the landscape).

- Shrub lands demonstrate a more appropriate age/class distribution with more brushfields in younger age classes. These younger age classes have well developed grass/herb communities.

- Riparian habitats are in excellent ecological health. A healthy riparian habitat is different for each riparian type. For streamside riparian zones, it includes appropriate plant species composition, consist primarily of late-successional forests, but also have scattered areas of early serial vegetation, i.e., grass/herb, and willow/alder/maple. For wetlands, ecological health may include appropriate species composition and vegetation cover.

- Open road densities are reduced to appropriate levels depending on the area.

- Connecting habitats exist between low and high elevation habitats, along riparian habitats, and with adjacent watersheds.

- Special habitats are in excellent condition throughout the Analysis Area. Special habitats include snags, down logs, rock outcrops, caves and mines

- Where opportunities exist, manage clusters of **spotted owl** home ranges to provide adequate amounts of suitable habitat. Co-manage owl clusters and habitat with BLM and private companies. Through adaptive management, learn more about providing for spotted owl needs while managing for resource extraction.

- **Spotted owl** dispersal habitat is maintained within the Analysis Area that will connect with all adjacent Late-Successional Reserves.

- **Bald eagles** continue to occupy Applegate Lake and have access to their present home range, i.e., Applegate River and Squaw Lakes.

Recommendations

1. Maintain the present 10 mph boat speed on Applegate Lake.;

2. Develop a long range recreation plan for Applegate Lake to minimize conflicts with bald eagles.

3. Relocate the portion of livestock driveway within the bald eagle nest stand.

4. Use R-5 guidelines for habitat management within the home range of northern goshawks.

5. Consider nesting habitat when designing projects around pond turtle management zones.

6. Place signs along Upper Applegate Road at Applegate Lake to notify drivers of pond turtles crossing the road.

7. Use Access and Travel Management Planning for roads within black-tail deer range, particularly winter range.

8. Improve forage habitat conditions within black-tail deer winter range. Prescribed fire within brushfields will improve deer forage habitat.

9. Develop water sources within black-tail deer summer range.

10. Emphasize management of ponderosa pine and Oregon white oak communities to improve their health and distribution within the Analysis Area.

11. Shaded fuel breaks and fuels modification projects should be evaluated by a wildlife biologist to minimize negative effects to wildlife habitats and wildlife species. Habitats of concern include snags, down logs and brushfields.

2. AQUATIC SYSTEMS

A. STREAM FLOW REGIME

Findings

Historic low flows within the Analysis Area have not been significantly altered by human processes, with the exception of the Applegate River below Applegate Reservoir and the possible exception of Squaw Creek immediately above Applegate Reservoir and above the Squaw Lakes. Summer flows in the Applegate River immediately below Applegate Reservoir have been augmented over historic flows by that impoundment. Effects of water withdrawals from Squaw Creek and maintenance of water levels in Squaw Lakes may be impacting fish habitat within Squaw Creek from about two miles above Squaw Lakes to its mouth at Applegate Lake but this has not been verified. Flows in Elliott, Dutch, Joe, Kinney, and Mule Creeks are not affected by human activities such as irrigation withdrawals.

High flows of main stem streams (e. g. Lower Squaw and Lower Elliott Creeks) do not appear to have been affected by management activities, except that Applegate Reservoir is regulated for flood control so that downstream high or peak flows in the Applegate River will not attain historic events. Historic peak flows of these large streams are usually defined by unusual rain-on-snow events. Observable and possibly channel-altering increases in high flows have likely occurred in smaller tributary basins where there has been substantial roading and regeneration harvesting. These tributaries are mainly found in the Upper Elliott, Lower Elliott, Upper Squaw, Lower Squaw and Joe Creek Subbasins.

Desired Future Condition

All fish bearing streams maintain sufficient flows to preserve desired habitat conditions including summer stream temperatures and physical habitat structures such as pools (see the DFC in *Fish Population and Aquatic Habitat*). Peak flows in the smaller headwater streams gradually decrease to historic levels in Elliott and Squaw Creek subbasins.

Recommendations

Monitor summer stream flows and temperatures in Squaw Creek for several years, including wet and dry runoff years, to determine what, if any, effects water uses are having on fish habitat and populations. If there are impacts to fish habitat and populations, investigate recovery opportunities.

Reduce road densities in Upper Elliott, Upper Squaw and Joe Creek subbasins.

Discourage regeneration harvest treatments in Lower Elliott, Upper Squaw and Joe Creek subbasins until the area with forested stands under 30 years old is about 15 percent or less.

B. WATER QUALITY

Sediment

Findings

There is evidence that sedimentation and/or embeddedness are moderate to high in all subbasins, except for Dutch Creek and Mule Creek. Embeddedness is primarily observed in lower gradient streams (< 2 percent). These are particularly concerns in the Upper and Lower Squaw, Upper and Lower Elliott, and Joe Creek Subbasins which are in the mica schist Condrey Mountain Formation. While not as severe a problem, sediment in the Kinney Creek Subbasin affects the upper anadromous fish portion of the Applegate River. The human processes most responsible for sedimentation are roading and timber harvest operations (yarding, landings, etc.). Roads are the primary contributors of sediment to aquatic systems and the magnitude of input is directly related to overall road density, road proximity to riparian areas, and the inherent erodibility and mass wasting potential of roaded areas. High road densities are found in Upper Elliott, Upper Squaw and Joe Creek Subbasins. Riparian Reserves adjacent to fish-bearing streams that have been most directly altered and affected by roads are found in the Lower Elliott, Upper Squaw and Lower Squaw Subbasins. Sedimentation from mining and grazing are secondary but the effects of their contribution on aquatic values in this Analysis Area is not known.

Desired Future Condition

The sediment yields are reduced to where stream aggradation and embeddedness do not significantly affect fish habitat and populations. It is desired that channels with gradients under 2 percent will have less than 35 percent embeddedness.

It is desirable that restoration efforts be applied to private lands using the above prioritization scheme, even though Riparian Reserves and ground cover goals apply only to public lands.

Recommendations

Apply the watershed restoration component of the aquatic conservation strategy that emphasizes sediment control to Upper Squaw, Lower Squaw, Upper Elliott, Lower Elliott, Joe, and the lower portions of Dutch Creek Subbasins. These are heavily roaded subbasins (i.e. moderate-high road densities except for Dutch Creek) and/or have significant roading within Riparian Reserves and/or are within the highly erosive mica schist of the Condrey Mountain Formation. Kinney Creek Subbasin is a high priority for watershed restoration largely due to roading adjacent to Kinney Creek; while it is not as highly erosive as the mica schist formations, restoration efforts are warranted due to the fact that this area affects the anadromous portion of the Applegate River. Lake Subbasin is generally a lower priority for restoration, while most of Mule and Dutch Creek have not been roaded or otherwise affected by human processes.

Restoration of landings and skid roads within Riparian Reserves are important restoration opportunities. It is recommended that use and/or retention of skid roads and landings within Riparian Reserves be rare and that they be restored to natural conditions. This is extremely important in areas with mica schist soils.

A Watershed Improvement Needs (WIN) inventory has been initiated as part of this watershed analysis. This is a dynamic process wherein specific restoration opportunities will be inventoried and tracked through the implementation stage. With that in mind, and based on above observations on sediment sources, a watershed restoration prioritization scheme is recommended follows:

Very High Priority - Removal or stabilization of roads and yarding impacts (skid trails, landings, etc.) that are within Riparian Reserves on soils with high erosion potential; where applicable, replacement of existing culverts, bridges, and other stream crossings of fish-bearing (Class 1 and 2) streams to accommodate at least the 100-year flood including associated bedload and debris;

High Priority - Roads and yarding impacts (skid trails, landings, etc.) that are within Riparian Reserves on soils with moderate erosion potential; and roads and yarding impacts outside of Riparian Reserves on soils with high erosion potential; where applicable, replacement of existing culverts, bridges, and other stream crossings of Class 3 streams to accommodate at least the 100-year flood including associated bedload and debris;

Moderate Priority - Roads and yarding impacts (skid trails, landings, etc.) that are within Riparian Reserves on soils with low erosion potential; and roads and yarding impacts outside of Riparian Reserves on soils with moderate erosion potential; and harvest units, grazed sites, or other disturbed sites with high erosion potential whose area-wide effective ground cover (aside from roads and yarding) is less than 85 percent; where applicable, replacement of existing culverts, bridges, and other stream crossings of Class 4 streams to accommodate at least the 100-year flood including associated bedload and debris;

Low Priority - Roads and yarding impacts (skid trails, landings, etc.) outside of Riparian Reserves on soils with low erosion potential; and harvest units, grazed sites, or other disturbed sites with low-moderate erosion potential whose area-wide effective ground cover (aside from roads and yarding) is less than 70 percent on moderate erosion potential sites and 60 percent on low erosion potential sites;

Where it is not practical to obliterate and restore native vegetation to roads that are within Riparian Reserves it is emphasized that these areas are the most crucial sites for stabilization of sediment sources. The most common restoration measures are likely to be road surfacing, improvement of drainage systems and proper culvert sizing. The highest priority are roads in the Riparian Reserves adjacent to Elliott Creek, Upper and Lower Squaw Creek and their fish-bearing tributaries.

Figure A-6 (Appendix A, Geology and Geomorphology) displays soil erosion potential for the Analysis Area. It is based on groupings of data from the Forest soil resource inventory (SRI) into three broad erosion classes - high, moderate, and low. This map should be used with other resource data (e.g. the GIS road layer) to identify general areas to focus restoration efforts. It should also be used to help prioritize specific restoration opportunities that are already being identified in the WIN inventory.

Water Temperature

Findings

Temperature data is generally lacking in this Analysis Area but from 1993 data (a drought year) it is believed **temperatures in the Applegate River within the Analysis Area below the Reservoir are being maintained in the "good" (<61 degrees F) to "good-fair" (61-64 degrees F) range**; temperatures enter the "fair-poor" (65-68 degrees F) and (eventually) the "poor" (>68 degrees F) range downstream of the Analysis Area but this is largely attributed to irrigation withdrawals along the river.

The effects of water use on streamflows and **temperatures in Squaw Creek** are not fully understood (see Flow Regime Findings and Recommendations). Preliminary data suggests that high summer temperatures **may enter the "poor" range (>68 degrees F)** on Lower Squaw Creek between Squaw Lakes and Applegate Reservoir. This likely occurs during July and August of most years. The two miles of Squaw Creek above Squaw Lakes also experiences water withdrawals but the impacts of this on streamflow and water temperatures is unknown.

Data for **Elliott Creek** shows that **water temperatures enter the "fair-good" (61-64 degree F) range** during July and August. This is likely greater than historic levels but not considered excessive. The temperature increases are attributed to recent timber harvest and roading within riparian areas since water use is almost non-existent in the Elliott Creek Subbasin.

Mule Creek is dry by June in most years and summer flows in Kinney Creek are a mere trickle so that stream temperatures here are not significant.

Desired Future Condition

Summer stream temperatures attain historic levels in all perennial (class 1-3) streams where it does not currently exist. It is recognized that this may not be fully attained in Elliott Creek due to the large component of "Riparian Reserve" in private ownership there. Also, existing beneficial uses may not permit flows substantial enough to maintain desired summer temperatures in Squaw Creek above and below the Squaw Lakes. And temperatures in the Applegate River below Applegate Reservoir will likely continue to be influenced by the need to control reservoir releases for various downstream beneficial uses, including fishery needs; data suggests that these (summertime) temperatures will fluctuate within the "good" and "good-fair" range for anadromous and other cold water fish.

Recommendations

In order to expedite recovery of stream temperatures to approach historic levels it is recommended that silvicultural activities be encouraged within Riparian Reserves where this will hasten the progression of conifer stands which currently have early or mid successional characteristics to those with large conifer late successional characteristics. The subbasins with the highest potential and priority for this are Upper and Lower Squaw, Upper and Lower Elliott, Joe, and Lake Creeks. This is discussed in more depth under "Riparian Reserves." As discussed under Flow Regime Findings and Recommendations, if reduced streamflows are contributing to high temperatures in Squaw Creek, then investigate recovery opportunities there.

Water Chemistry

Findings

There are excessive amounts of copper, zinc and iron and very high specific conductivity in the three miles Joe Creek below the inflow of drainage from the Blue Ledge Mine. Fish and other aquatic organisms have been extirpated from this section of the stream.

Desired Future Condition

The return to pre-mining concentrations of toxic metals and specific conductivity in the waters of Joe Creek below the inflow from the Blue Ledge Mine.

Recommendations

Explore the technical and economic feasibility of restoration of Joe Creek. Determine the impacts of toxic elements in Joe Creek on down-stream values for Elliott Creek.

C. RIPARIAN HABITATS

Riparian Reserves

Findings

The amount of Riparian Reserves with late-successional forest characteristics has declined in all subbasins, primarily due to timber harvest and roading. Dutch, Mule, and Kinney Creeks have been least impacted by harvesting and roading activities. The minor decline of late-successional forest conditions in the Dutch Creek riparian area is almost entirely due to logging. The decline in Mule and Kinney Creeks is attributed to the permanent conversion of private forest land to agricultural uses adjacent to the Applegate River and to logging along certain portions of Kinney Creek. The actual decline in late-successional conditions in all three subbasins is low. (The Applegate River was used as a boundary between Kinney and Mule Creek Subbasins for analysis reasons so that the decline in late-successional conditions does not actually affect Kinney and Mule Creeks.)

Roads within Riparian Reserves affect the quality of riparian habitat. **Within the Analysis Area, nearly 28 miles of roads are located within the Riparian Reserves of class 1 and class 2 streams and an additional eight miles of road are located within the Riparian Reserves of class 3 streams**. These numbers indicate that roads are located within 36% of the riparian zones associated with class 1, 2 and 3 streams; thus, **one-third of the most productive riparian habitats in the Analysis Area are impacted by roads**.

All other subbasins have had substantial decreases in late-successional forest within riparian areas. The decline of late-successional forest in riparian areas from historic to current levels are: Upper Elliott-25%, Lower Elliott-56%, Joe Creek-58%, Upper Squaw-39%, Lower Squaw-51%, and Lake-28%. These declines are primarily due to timber harvesting and associated roading. A smaller amount is attributed to residential/agricultural development along Squaw Creek and in French Gulch, and mining activities along lower Elliott Creek.

Impacts to riparian areas from grazing is primarily confined to wetlands and adjacent to riparian areas. This is generally found at the higher elevations.

Approximately 77% of the 800 acres of wetlands within the Analysis Area is in the Upper Elliott Subbasin. Approximately 15% is in the Upper Squaw Subbasin. The remaining wetlands are scattered throughout the other seven subbasins. The hydrologic conditions of the high elevation wetlands and channels, as a result of grazing, have not been fully documented. Range analysis and cursory observation of wetlands in the Elliott Range Allotment indicate that cattle impacts are scattered and localized. Dense alder patches and steep slopes make many wetlands inaccessible to cattle. These wetlands and channels are in good condition.

Accessible springs, seep areas, and stream sides have been compacted and are devoid of vegetation where cattle have concentrated. Current revisions of Allotment Management Plans are addressing these situations.

Desired Future Condition

Riparian Reserves whose climax vegetation structure includes conifers are maintained in a range of stand conditions possessing late-successional characteristics from those with open park-like conditions where fire is a frequent occurrence to the dense multi-layered stands where fire is less frequent.

Riparian Reserves whose climax vegetative structure does not include conifers, but which historically were montane hardwood or non-forest type (grass, herbaceous, shrub, or barren), should be allowed to revert to and be maintained in those conditions.

Riparian Reserves will support a diversity of native plants, provide canopy closure that maintains stream temperatures, provide connecting habitat, support healthy populations of wildlife species, serve as effective filters of sediment from upslope sources, and provide stable streambanks which contribute to high quality aquatic habitat.

Recommendations

It is recommended that those subbasins whose Riparian Reserves were most impacted by past logging and/or which are in the mica schist receive the highest priority for restoration to late successional characteristics. These include Upper and Lower Elliott, Upper and Lower Squaw, Lake and Joe Creek Subbasins. With the exception portions of Kinney Creek, the Dutch, Mule and Kinney subbasins are low priorities for restoration in Riparian Reserves. Recommended actions which will maintain, improve, or hasten attainment of the DFC are detailed in Section C of the Standards and Guidelines (S&Gs) in Attachment A to the Record of Decision pertaining to the Northwest Forest Plan. These S&Gs address specific constraints to timber management, roads, grazing etc. on public lands. Some of the more important S&Gs pertaining to the Squaw/Elliott/Lake Watershed Analysis Area are highlighted as follows:

1. Where possible, obliterate existing roads within Riparian Reserves and reroute them to less sensitive areas; replant these road corridors to native tree species. Candidate roads may be identified through the access and travel management planning process; some are currently being identified and added to the SO Engineering watershed improvement needs (WIN) inventory. The watershed restoration prioritization scheme previously described to reduce sediment should be used to prioritize road obliteration. While it is recognized that many roads within Riparian Reserves will not be removed (e.g. main roads adjacent to Elliott and Squaw Creeks), these should receive high priority for stabilization to control sediment (see Aquatic Habitat - Water Quality - Sediment - Recommendations);

2. Where they have not yet recovered, obliterate and plant conifers in skid trails and landings located within Riparian Reserves;

3. Identify specific grazing impacts to riparian areas, especially wetlands and streambanks, in the Beaver Silver, Elliott Creek and Upper Big Applegate Allotment Management Plans (AMP). Then institute corrective measures;

4. Plant conifers within Riparian Reserves where they were historically established but are now absent or understocked;

5. Encourage density management and pine management in Riparian Reserves where this will hasten re-establishment of historic late forest successional characteristics.

6. Utilize prescribed fire as a tool to attain DFC in Riparian Reserves so long as Aquatic Conservation Strategy objectives and LRMP S&Gs are met.

7. Allow the salvage of logs from Riparian Reserves only for those that are in excess of that needed to meet present and future coarse woody debris needs.

Interim Riparian Reserves have been identified for the Analysis Area. This includes those associated with streams, lakes, ponds, reservoirs, wetlands, and geologically unstable areas. Except for larger fish-bearing perennials, most of the streamside Riparian Reserves have not been field verified. Wetlands Riparian Reserves have been identified using the USFWS National Wetlands Inventory; while not yet field verified, it was found in the Little Applegate Watershed Analysis that this inventory is quite accurate. Finally, unstable and potentially unstable areas have been identified. Four types of information were separately entered into the data base: unstable terrain identified in the 1990 LRMP FEIS, earthflows, debris slides, and Land Hazard Zonation Class 1; The Landslide Hazard Zonations were verified as part of past timber sale planning. Riparian Reserves can be identified in GIS separately for streams, water bodies, wetlands, and geologic features; Figure 11 is a composite Interim Riparian Reserve Map of all those features. This map represents both field verified and non-field verified Riparian Reserve locations. As areas are reviewed during site specific, project level analysis, this map is likely to change. Changes will be representative of field presence or absence of hydrological or geological features.

It is recommended that the Riparian Reserve widths outlined in the ROD be followed until site-specific analysis occurs at the project level. Only upon site-specific project level review should any Riparian Reserve boundary be changed, finalized and entered in GIS. Any changes in Riparian Reserves from the Interim locations must consider all riparian and terrestrial values associated with these areas (Northwest Forest Plan). As such, **any changes should be determined by an interdisciplinary team which should include a fishery biologist, wildlife biologist, geologist, hydrologist, and silviculturist.** This team may be expanded to include other disciplines such as when visual and recreational values warrant.

The following criteria should be used when considering site-specific changes to Interim Riparian Reserves:

(1) Needs of specific species listed in the Northwest Forest Plan and FEMAT Report;

(2) Spotted owl dispersal needs;

(3) Connectivity through matrix/AMA lands (corridors of suitable width);

(4) Area-wide or watershed-wide abundance or deficiencies of snags, large green trees, and late successional habitat;

(5) Verification of fish-bearing verses nonfish-bearing streams;

(6) Inherent potential erodibility of the landscape;

(7) Amount of effective ground cover within the Riparian Reserve;

(8) Verification of landscape stability or mass wasting potential;

(9) Verification of wetland boundaries;

(10) Locations of natural slope breaks (inner gorges) and such manmade features as roads relative to the Interim Riparian Reserve boundary;

(11) Potential plant community.

Squaw/Elliott/Lake Watershed Analysis Area

Interim Riparian Reserves for Public Lands

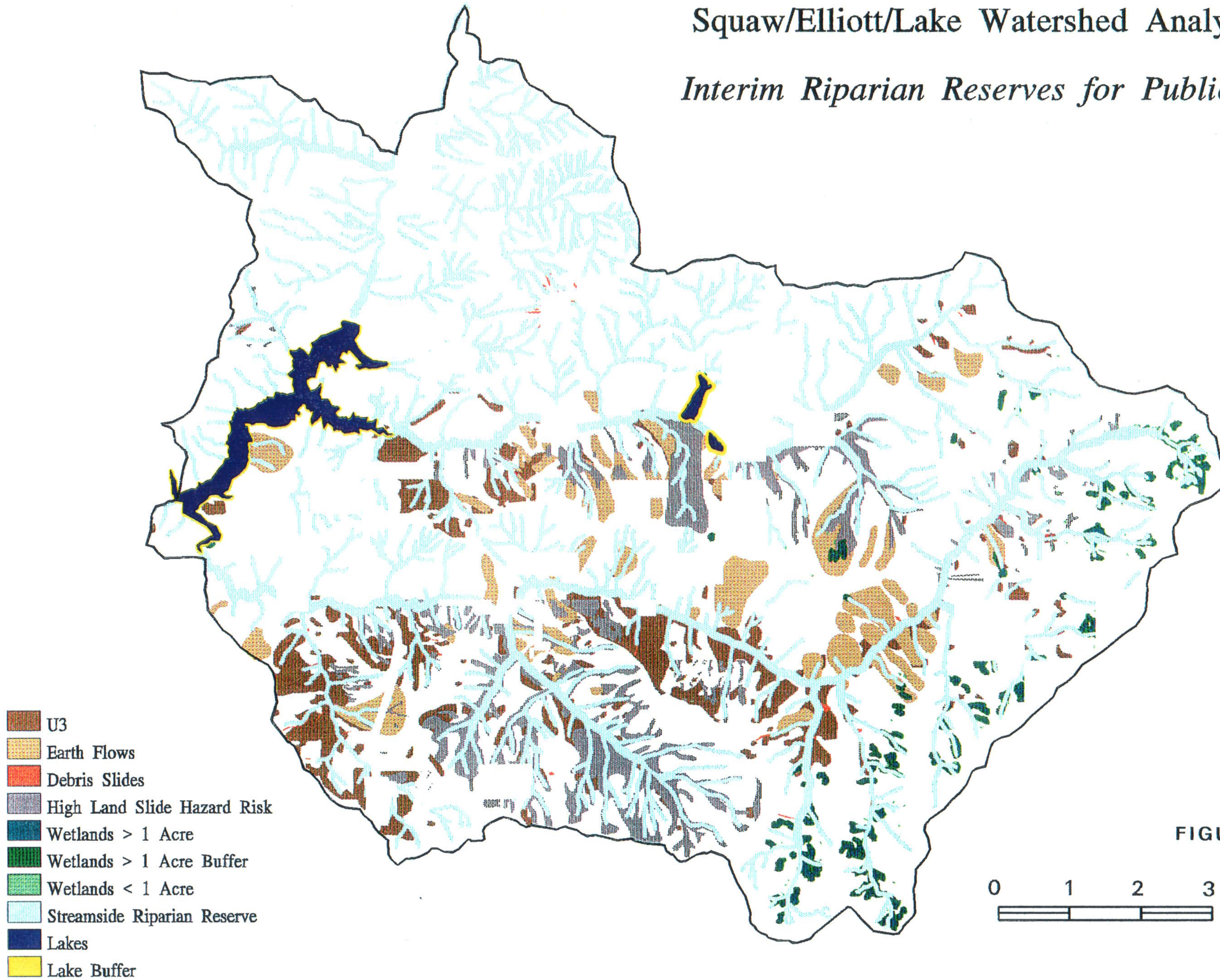


FIGURE 11

D. OVERALL WATERSHED CONDITION

Findings

A watershed condition rating is given for the nine subbasins in the Analysis Area. This rating is based on the current degree of accumulated human activity and current channel and fish habitat conditions.

A "poor" rating is given to the Upper and Lower Elliott, Upper and Lower Squaw and Joe Creek Subbasins. These basins have a high probability of incurring additional risks to fish habitat and populations based on existing conditions and the potential affects of new projects.

Lake, Kinney and Mule Creeks subbasins are rated "fair", although Mule Creek could be rated "good" up-stream of the Applegate River. Dutch Creek is rated "good".

Desired Future Condition

All subbasins in the Analysis Area are maintained in a "good" overall rating, watershed condition.

Recommendations

All subbasins in the Analysis Area should not be allowed to decline from their current condition. The recovery of all Subbasins that are currently in less than a "good" condition should be facilitated by:

1. Reducing road densities in Upper Elliott, Upper Squaw and Joe Creeks by approximately 40%. Apply restoration measures that reduce sedimentation and runoff and may include measures that result in road closures or total obliteration. Site specific restoration measures should be determined in concert with a WIN inventory;

2. Road densities in Lower Elliott, Lower Squaw and Kinney Creek Subbasins should not be increased. Some increase in road density in Dutch, Mule and Lake Subbasins may be acceptable, to be determined by project level analysis;

3. The highest priority for watershed restoration in Riparian Reserves are those subbasins currently in the "poor" watershed condition;

4. The highest priority for road improvement activities are roads that cannot be obliterated and are in Riparian Reserves adjacent to fish-bearing streams. Roads within Riparian Reserves adjacent to class 3 and 4 streams are the next priority;

5. Encourage the use of skyline, zig-zag (multi-span), aerial or other low impact yarding systems for timber harvest projects in all subbasins;

Prohibit regeneration harvest treatments in Lower Elliott, Joe and Upper Squaw Subbasins until the percent of these drainages in forest stands under 30 years of age is 15 percent or less. Discourage new regeneration harvest treatments in the Upper Elliott Subbasin.

E. FISH SPECIES DISTRIBUTION AND AQUATIC HABITAT

Fish Populations and Aquatic Habitats

Findings

Anadromous and resident fish populations are important indicators of water quality, hillslope processes and floodplain forest health. Approximately three lakes and 37 miles of streams exist in the Analysis Area; 3.1 miles of the 37 miles contain anadromous fish populations. Historic and current fish distribution is displayed on the following two maps (Figure 12 and 13). Actual fish distribution miles in the Analysis Area are listed for each stream in Table A-24: Historic and Current Miles of Fish Habitat (Appendix A).

Figure 12
Historic Salmonid and Trout Distribution
Squaw/Elliott/Lake Watershed Analysis Area

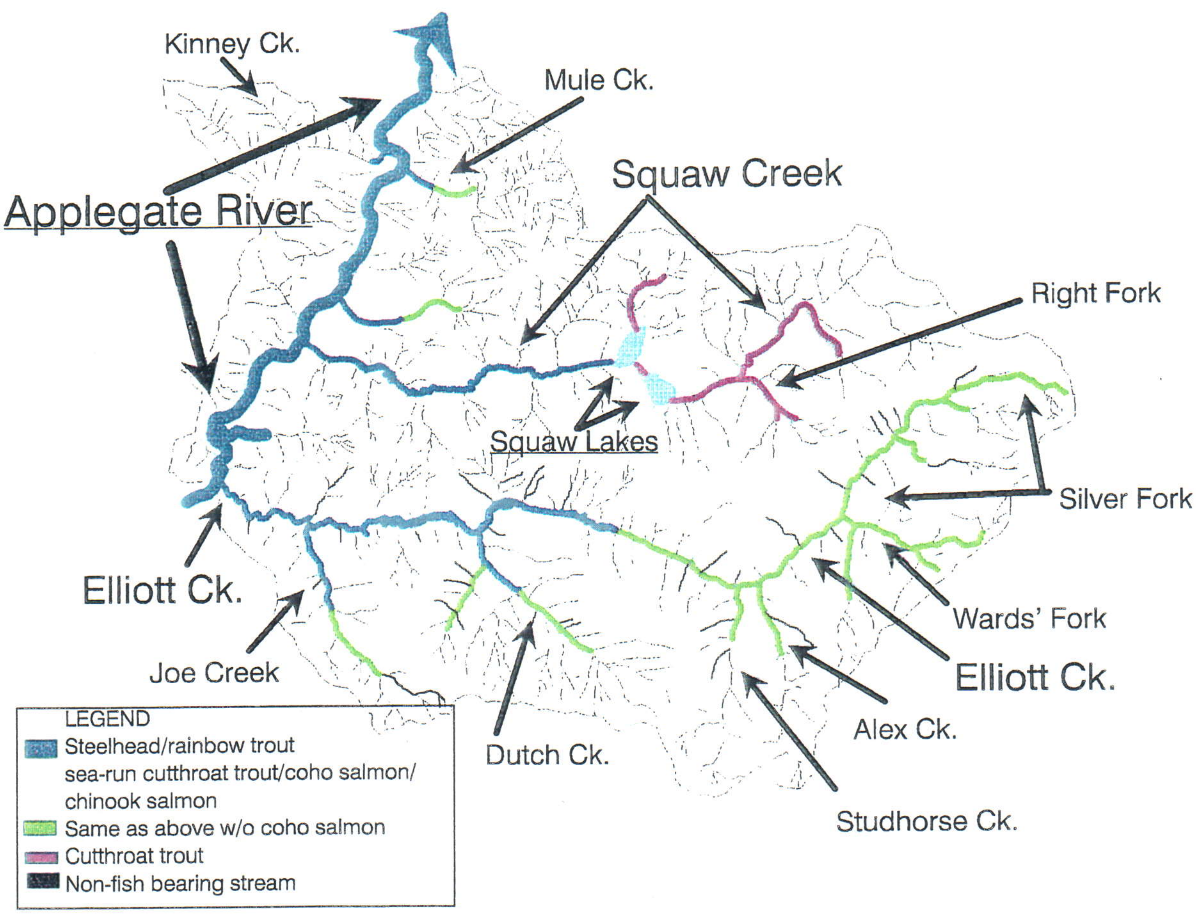
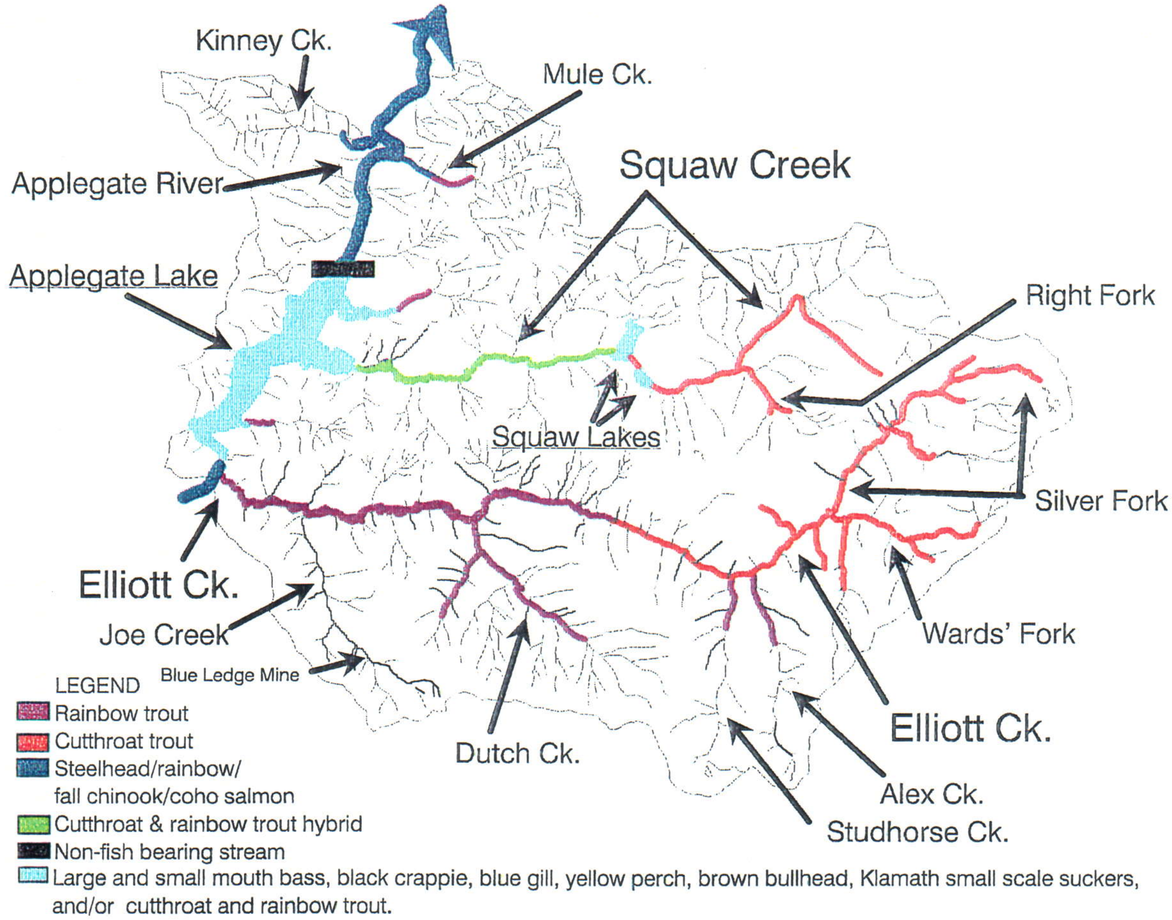


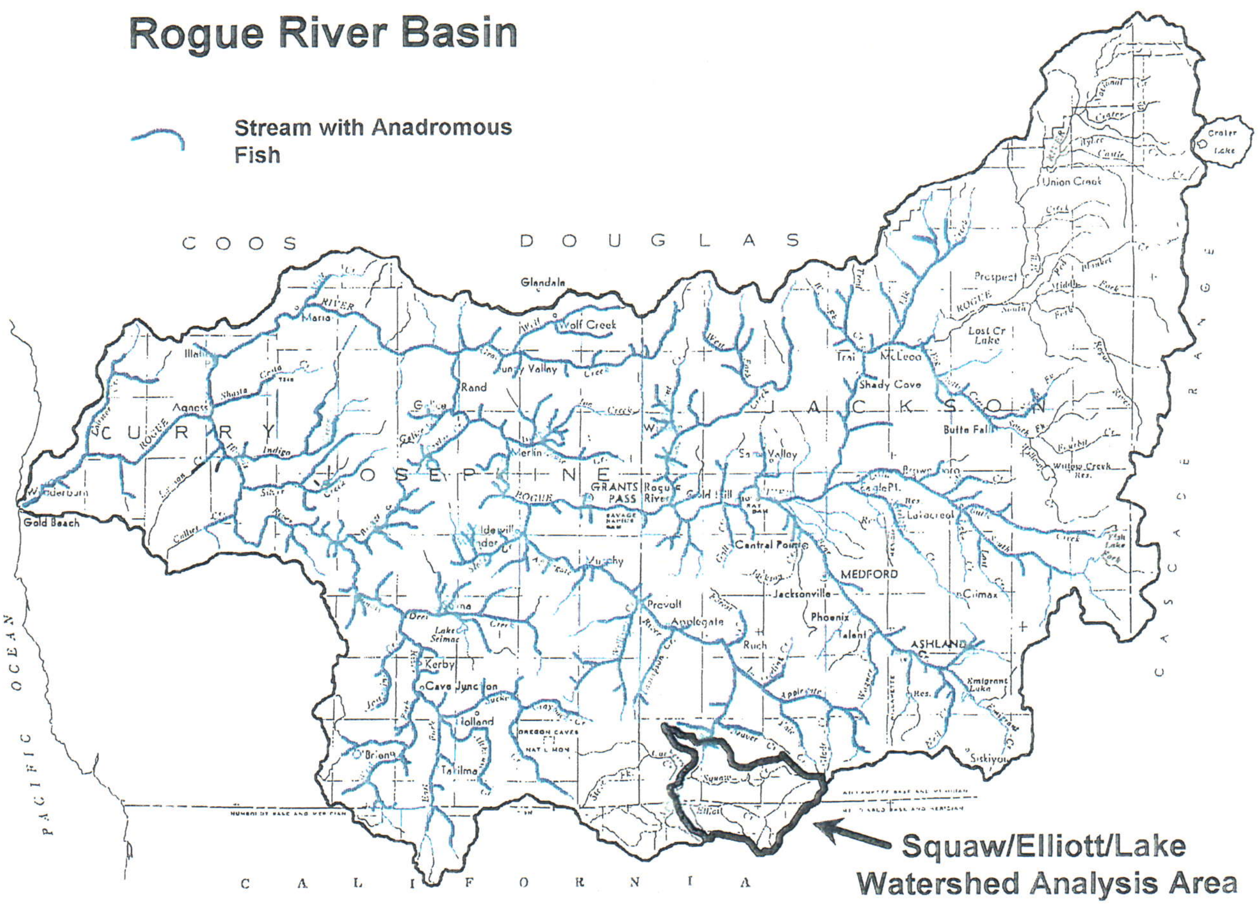
Figure 13
Current Salmonid and Trout Distribution
Squaw/Elliott/Lake Watershed Analysis Area



Anadromous Fish

Anadromous fish populations in the Analysis Area are principally steelhead trout (*Oncorhynchus mykiss*), coho salmon *(O. kisutch)*, and fall chinook (*O. tshawytscha*).

Figure 14
Anadromous Fish Distribution in the Rogue River Basin



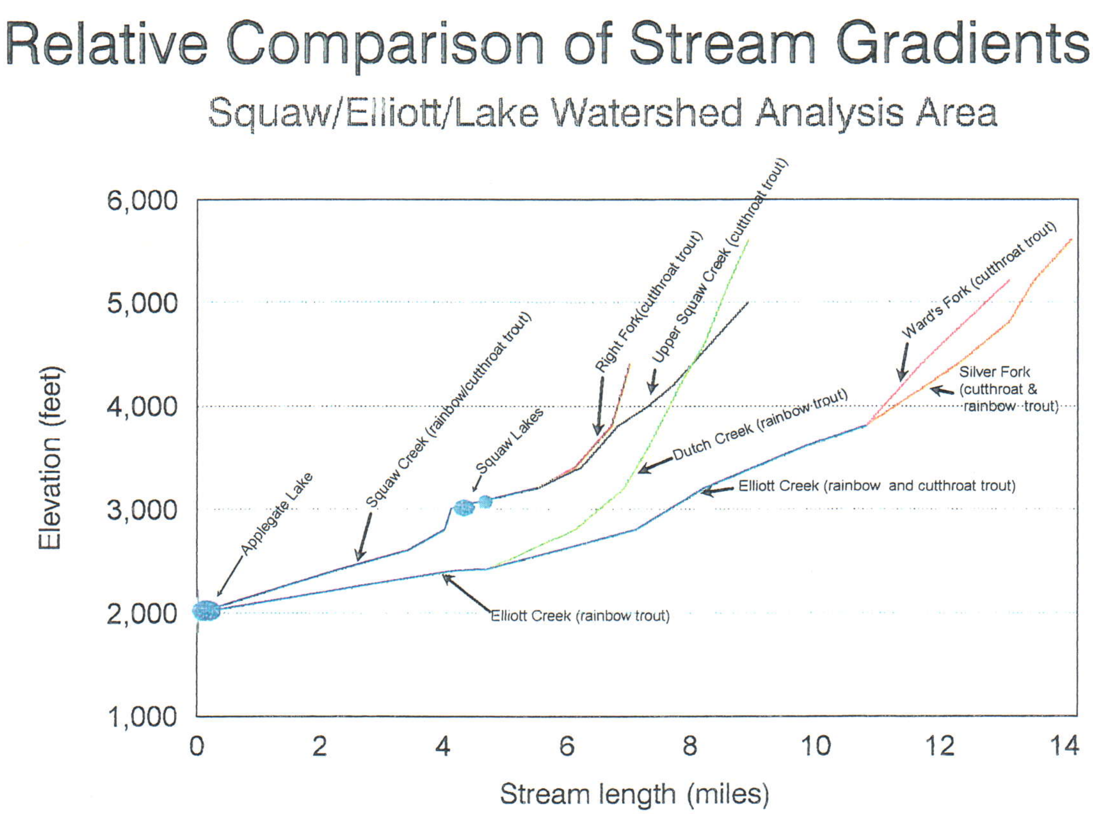
Note: Squaw/Elliott/Lake Watershed Analysis Area is about 73,157 acres of the 3,300,000 acres in the Rogue River Basin. About 3.1 miles of anadromous fish streams are present in the Analysis Area; Rogue River basin contains about 1,400 miles of anadromous fish streams.

These fish have historically flourished in the Analysis Area. Applegate Dam, a flood control project, has blocked about 50 miles of potential anadromous habitat since 1980. Below the dam, 3.1 miles of anadromous habitat exist in the Analysis Area Anadromous streams in the Analysis Area are Mule Creek and an Applegate River segment. Mule Creek contains a moderate population of steelhead and rainbow trout and the Applegate River segment contains a good population of steelhead trout, fall chinook and a moderate population of coho salmon. Kinney Creek has potential anadromous habitat, but a barrier near the mouth prevents the migration of anadromous fish upstream. Klamath Mountain Province steelhead trout and more recently Southern Oregon/Northern California coho salmon have been proposed for listing as threatened under the Endangered Species Act.

Resident Fish

The Analysis Area contains two large resident salmonid streams, Squaw and Elliott Creeks. These resident streams represent approximately 37 miles of habitat. A moderate population of rainbow (*O. mykiss*) and cutthroat (*O. clarki*) and rainbow/cutthroat trout hybrids exists in Squaw and Elliott Creeks (see Current Salmonid and Trout Distribution, Figure 13). Two stream types dominate the Analysis Area: alluviated canyons and colluvial and bedrock canyons. Gradient varies from 3 percent located in the lower stream reaches to 19 percent in the headwaters. Elevation ranges from 2,000 feet at Applegate Lake to 5,700 at Silver Fork of Elliott Creek (see Figure 15).

Figure 15



Elliott Creek is being considered for Wild Trout designation by the California Department of Fish and Game (CDFG) from Studhorse Creek confluence upstream to the Oregon border, including Ward's Fork. Wild Trout designated streams are given a closer scrutiny by the CDFG in regards to management activities, e.g., timber harvest, streamside alterations, and fishing regulations. It is unlikely that Elliott Creek will be designated as a Wild Trout stream. This stream does not contain plentiful large trout (18 inches - 22 inches in length) required for the designation. Elliott Creek has the potential to meet these criteria but is presently not functioning as a healthy trout stream.

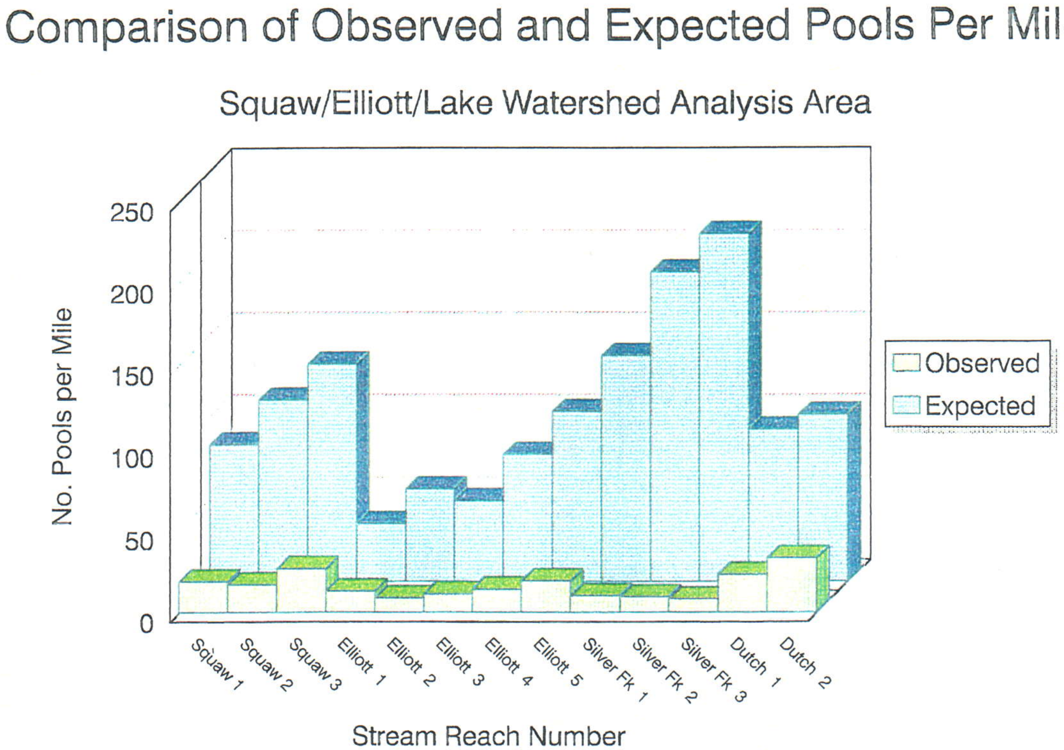
Elliott and Squaw Creeks are lacking large adult fish class (>8 inches in length) (FS fish survey, 1995 and California Fish and Game fish survey, 1992); due to habitat simplification from human activities. These human activities have created fish barriers/obstacles (Applegate Dam, mining activities, and culverts) and simplified aquatic habitat due to commercial timber harvest and road construction within riparian zones, instream wood removal, channel straightening, rural residential development and flood control measures.

Pools per mile

Pools per mile are below the expected range of conditions (see Figure 16 and Appendix A, Table A-23) to habitat degradation (Squaw, Elliott, Silver Fork, Joe Creeks, and lower two miles of Dutch Creek. Low number of pools were recorded where coarse wood has been reduced or eliminated. There is considerable literature documenting the importance of pools to salmonid fish production. Present pool frequency is also related to fine and coarse sediment influencing stream morphology, straightening of channels, removal of large conifer wood pieces in the channel and removal of a mature riparian component for future large wood recruitment.

The pools in the watershed analysis are short step pools or pocket pools. Some of the pools may not have been accounted for during the stream survey. As instructed in the Region 6 stream survey Forest Service manual, any pool with a length less than the stream width was not reported. This exclusion of "pocket pools and step pools" may cause the total pool percentage to be slightly underestimated. See Figure 16 for a chart displaying a comparison of observed and expected pools per mile.

Figure 16



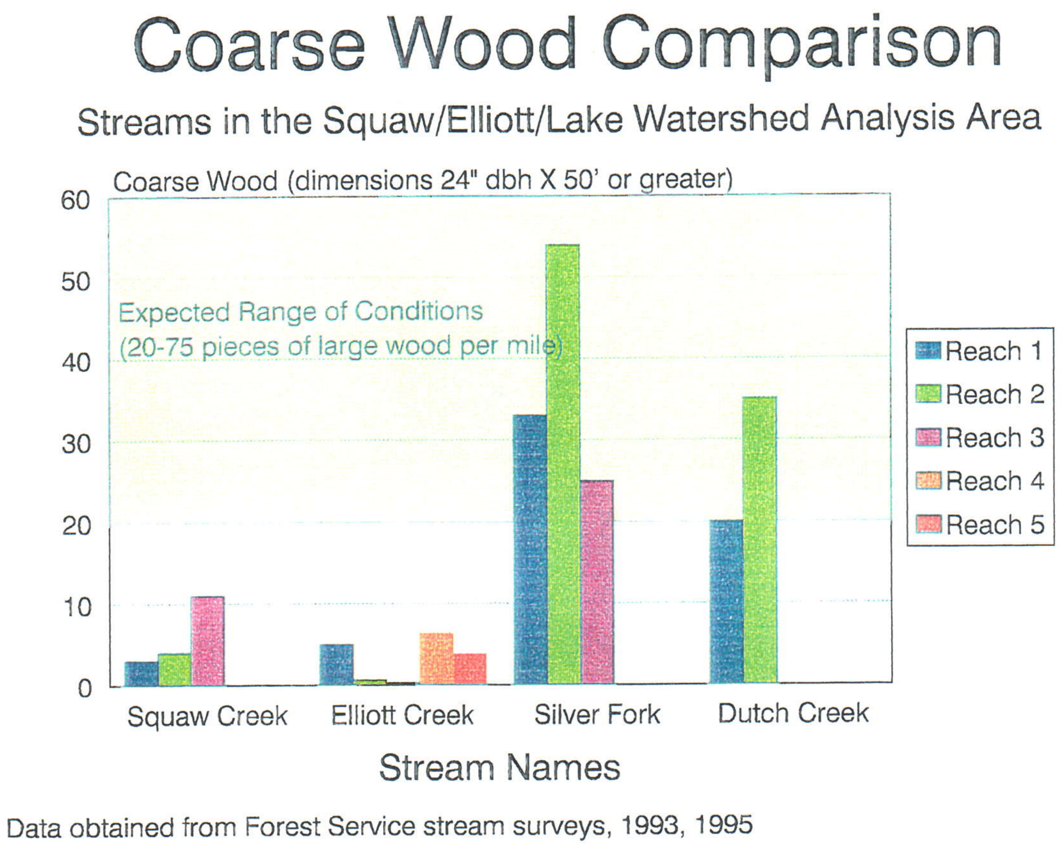
Expected range of pools per mile based on pool frequency of 3 bankful widths (2-4% slope - Rosgen B stream type) and 2.5 bankful widths (>4% slope - Rosgen A stream type).

See Appendix A, (Table A-23, Historic and Current Conditions for Aquatic Processes and Functions) for numeric pools per mile data.

Coarse Woody Debris

Coarse woody debris in the canyon stream types of the Analysis Area has a range of 2 to 37 pieces of wood per mile (see Appendix A, Table A-23 for historic and current conditions). Dutch and Silver Fork Creeks have a high amount of wood per mile due to their location in an unroaded area; limited management activities occur here. Past timber management activities and stream clean out have removed wood from Squaw and Elliott Creeks and their tributaries. See Figure 17 for a chart displaying a comparison of coarse wood by stream segment/reach.

Figure 17



See Appendix A, (Table A-23, Historic and Current Conditions for Aquatic Processes and Functions) for numeric wood per mile data.

Spawning Gravels

Human activities accelerating erosion in the mica schist soils of the Condrey Mountain Terrain have contributed to embeddedness of spawning gravels in lower Elliott Creek and Squaw Creek below Squaw Lakes (see geology for more discussion on erosion and sediment produced). Both streams have the potential of rearing large rainbow and cutthroat trout with conservation measures. This is evidenced by trout populations in isolated unmanaged canyon stream segments of Elliott and upper Squaw Creeks, e.g., Silver Fork, Dutch Creek and Right Fork of Squaw Creek.

Lakes

The Analysis Area contains three important fisheries lakes - Applegate and Upper and Lower Squaw Lakes. These lakes contain a two-tier fisheries (cold and warmwater fish populations); providing a popular destination for recreation. Applegate Lake contains coldwater (salmonids) - rainbow and some cutthroat trout and warmwater fish species - large mouth and small mouth bass, black crappie, blue gill, yellow perch, brown bullhead, and Klamath small scale suckers. Surplus fish from the collection facility below the Applegate Dam and Lost Creek Hatchery are placed in Applegate Lake to supplement the fisheries. Squaw Lakes contain coldwater (salmonid) cutthroat trout and warmwater fish species - large mouth bass, bluegill, black crappie and yellow perch.

Applegate and Squaw Lakes are lacking complex habitat in the shoal areas where warm and cold water fish forage. Habitat is lacking due to lake fluctuation; making it difficult for vegetation, e.g., willows to establish. Fish enhancement (brush rows and willow planting) in Squaw Arm of Applegate Lake has been ongoing since 1990. Partners include: Oregon Department of Fish and Wildlife, various private citizens, partners, and the Forest Service.

Numerous fish introductions by private individuals and the Oregon Department of Fish and Wildlife have occurred with warm and coldwater fish species in all three lakes. Nonnative salmonid fish from Squaw Lakes and Applegate Lake can affect native stocks by mixing with wild spawning stocks in streams in the Analysis Area. The effects of these introductions on native trout in streams is unknown.

Desired Future Conditions

Viable anadromous and resident salmonid fish populations with individuals of all life stages maintained throughout their habitat. Large adult trout where habitat is suitable.

Aquatic habitat restored and protected for all anadromous and resident fish. Spatial and temporal connectivity is restored and protected within and between watersheds.

Riparian zones are in proper functioning ecological condition (discussed in more detail under Riparian Zones, DFC).

Average between 40 to 100 pieces per mile in the stream channel (see Applegate Assessment, 1995) of large wood material (greater than or equal to 24 inches at the smaller end and 50 feet or two times the bankful width in length as described in Region Six Level II stream survey protocol). This will vary by channel morphology and vegetative conditions. This condition will not be achieved for 100-300 years unless wood pieces are placed. Wood structures may not be appropriate until the sediment regime (Condrey mountain schist) has been corrected in the upland portion of the watersheds.

In short-term, attain summer seven day average of the maximum daily stream temperatures less than 65 degrees F. throughout the basin. In long-term, maximum daily temperatures are reduced to approximately historic levels, 56 to 62 degrees F (see water quality for additional information on water temperatures).

Elliott Creek will meet criteria required by the California Department of Fish and Game for Wild Trout Status.

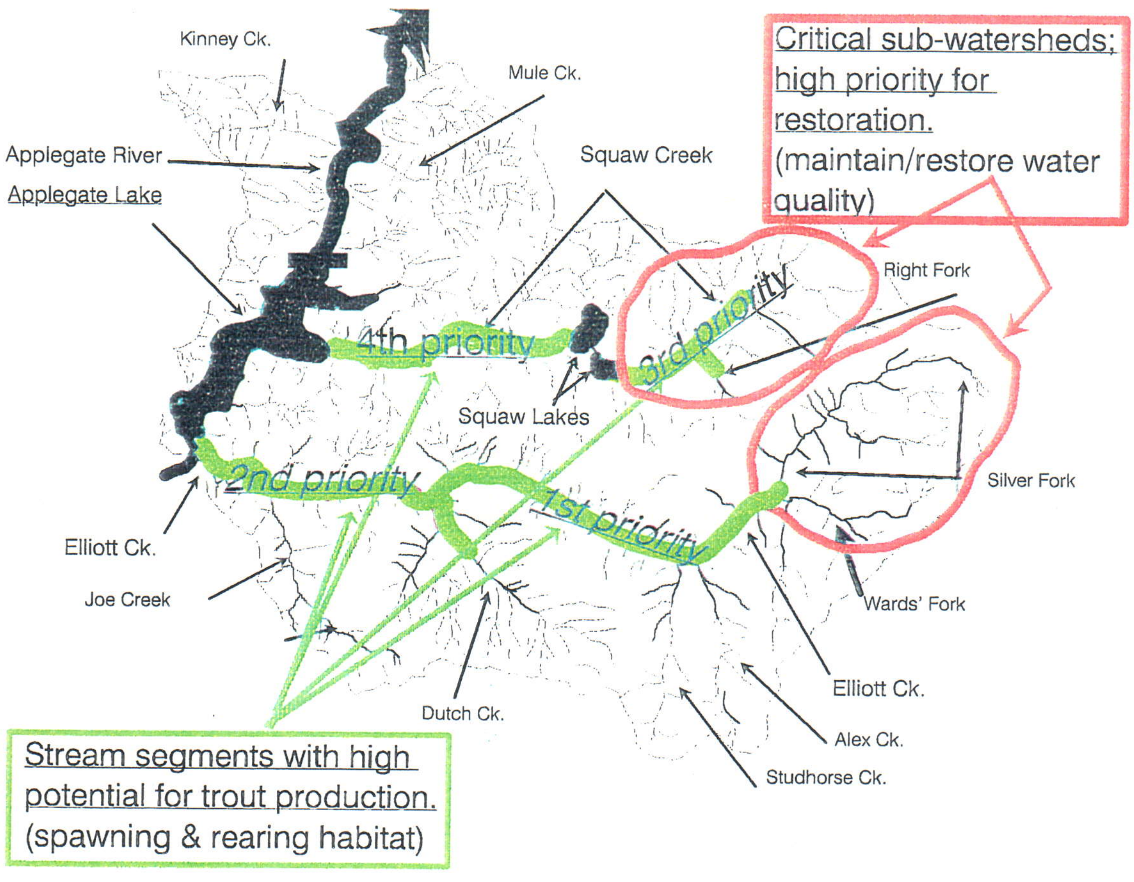
Channels with gradients of less than 2 percent will have less than 35 percent embeddedness.

Culverts allow for 100-year events and facilitate fish passage for all age-species and age classes.

Recommendations

Figure 18 displays priority areas for restoration in the Analysis Area. It is based on field observation and inventory. This map should be used with other resource data (e.g. GIS soil erosion potential, and GIS road layer) to identify general areas to focus restoration efforts. It should also be used to help prioritize specific restoration opportunities that are already being identified in the WIN inventory.

Figure 18
Watershed Restoration - Fish Species and Habitat
Squaw/Elliott/Lake Watershed Analysis Area



A Watershed Improvement Needs (WIN) inventory has been initiated as part of this watershed analysis. This is a dynamic process wherein specific restoration opportunities will be inventoried and tracked through the implementation stage.

(salmonid) cutthroat trout and warmwater fish species - large mouth bass, bluegill, black crappie and yellow perch.

Applegate and Squaw Lakes are lacking complex habitat in the shoal areas where warm and cold water fish forage. Habitat is lacking due to lake fluctuation; making it difficult for vegetation, e.g., willows to establish. Fish enhancement (brush rows and willow planting) in Squaw Arm of Applegate Lake has been ongoing since 1990. Partners include: Oregon Department of Fish and Wildlife, various private citizens, partners, and the Forest Service.

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Desired Future Conditions

Viable anadromous and resident salmonid fish populations with individuals of all life stages maintained throughout their habitat. Large adult trout where habitat is suitable.

Aquatic habitat restored and protected for all anadromous and resident fish. Spatial and temporal connectivity is restored and protected within and between watersheds.

Riparian zones are in proper functioning ecological condition (discussed in more detail under Riparian Zones, DFC).

Average between 40 to 100 pieces per mile in the stream channel (see Applegate Assessment, 1995) of large wood material (greater than or equal to 24 inches at the smaller end and 50 feet or two times the bankful width in length as described in Region Six Level II stream survey protocol). This will vary by channel morphology and vegetative conditions. This condition will not be achieved for 100-300 years unless wood pieces are placed. Wood structures may not be appropriate until the sediment regime (Condrey mountain schist) has been corrected in the upland portion of the watersheds.

In short-term, attain summer seven day average of the maximum daily stream temperatures less than 65 degrees F. throughout the basin. In long-term, maximum daily temperatures are reduced to approximately historic levels, 56 to 62 degrees F (see water quality for additional information on water temperatures).

Elliott Creek will meet criteria required by the California Department of Fish and Game for Wild Trout Status.

Channels with gradients of less than 2 percent will have less than 35 percent embeddedness.

Culverts allow for 100-year events and facilitate fish passage for all age-species and age classes.

.A watershed restoration prioritization scheme is recommended below (see map above for priority site locations). This scheme proposes a "top down" strategy whereby upper watershed function is restored first throughout the Analysis Area where appropriate.

It is recommended that restoration be accomplished in critical watersheds that are the most intact systems. These critical watersheds - Silver and Wards Forks, and upper Squaw Creek - supply high quality cool water. Inventory and prescribe restoration measure for roads in hyperzohic zones and unstable sideslopes.

First Priority - Conduct riparian silviculture within Squaw and Elliott Creeks watersheds to create a mature diverse riparian forest. Create a mature riparian conifer component which is the dominant overstory, providing stream shade, bank stability, and future large wood recruitment.

Reduce stream substrate embeddedness by minimizing erosion. Identify and repair roads accelerating sediment delivery to *fish-bearing* streams. Analyze roads adjacent to stream courses in riparian reserves. Correct road drainage to reduce sediment delivery to aquatic habitats. Replace culverts in streams identified as insufficient to carry 100-year flood events. Highest priority is in sub-watersheds identified as critical for production of high quality water, e.g., Silver Fork, Ward's Fork, Dutch Creek, and upper Squaw Creek. See Hydrology and Geology section for further sediment restoration recommendations.

Second Priority - Restore and/or diversify fish habitat and floodplain connectivity. Place large wood into streams to maintain pool habitat, fish cover, bank stability. The high priorities for restoration are upper Elliott Creek, lower Elliott Creek, lower Dutch Creek, upper Squaw Creek, lower Right Fork of Squaw Creek and lower Squaw Creek. These stream segments have potential to produce large trout. Recreate, where appropriate, and maintain side channel habitat adjacent to low gradient (<2%/Rosgen C type) main stem channels of Squaw and Elliott Creeks and Applegate River. Replace existing stream crossings where fish passage for all fish species and age classes is limited - at all flow conditions

Other Recommendations - Recommend a catch and release or limited take fishing only, ensuring a mature trout component while drawing more trout enthusiasts to Squaw and Elliott Creeks.

Continue creating habitat complexity in Applegate Lake by adding structures; brush rows and willow planting. Increasing the complexity in these areas would increase fish production and the number of older and larger fish. Willows will stabilize shoreline where prolific growth occurs. Review recreation and fish objectives for Squaw Lakes fish population; stocking vs. natural production.

Explore feasibility of anadromous fish passage over Applegate Dam and in Kinney Creek .

3. SOCIAL AND ECONOMIC

A. ADAPTIVE MANAGEMENT AREA (AMA)

Findings, Desired Future Conditions and Recommendations:

Continue in learning new approaches (both technical and social) in managing the AMA to meet the objectives as outlined in the ROD for the Applegate AMA. Monitor successes as well as failures and apply what is learned by adapting management approaches.

B. RECREATION

Findings

The Applegate Lake Complex and the Squaw Lakes Recreation Area are the major developed recreation sites in the Analysis Area. These areas combined draw up to 150,000 people annually. **Tent camping facilities at Applegate Lake do not accommodate RV type camping.** With a 10 mph speed limit, Applegate Lake lends itself to family oriented dayuse activities such as swimming, fishing, and picnicking. The Squaw Lakes Recreation Area provides a semi-primitive camping experience in a non-motorized setting. Recreational facilities at the developed sites have been inventoried for compliance with the Americans With Disabilities Act (ADA) requirements. **An analysis of the inventory has not been completed to provide a list of improvements needed to comply with ADA.**

Dispersed Recreation in the area consists of camping, mountain biking, hiking, hunting and fishing. **Mountain biking and other dispersed uses have been increasing and will likely continue to increase for the next few years. Existing facilities may be inadequate to accommodate this predicted increase.**

Desired Future Condition

Recreational facilities in the Analysis Area are adequate to accommodate the increasing number of users and the variety of uses while maintaining the character and integrity of the resources.

Recommendations

1. Complete a long-range recreation management plan for the Applegate Lake Recreation Complex.

2. Complete an assessment and subsequent proposal of needs to ensure compliance with the Americans With Disabilities Act in developed recreation sites.

Improve recreation facilities to accommodate modern recreational vehicles (electrical and water hook-ups, waste disposal sites, etc.).

Continue law enforcement coverage in developed and dispersed recreation areas to minimize vandalism and public harassment. Evaluate law enforcement needs considering current uses and expected future trends.

C. ACCESS AND TRAVEL MANAGEMENT

Findings

Several issues arise in the Squaw/Elliott/Lake Watershed Analysis Area that are associated with Access and Travel Management.

1) Increased Access leads to increased fire risk,

2) Coordination of multiple user recreation opportunities is needed,

3) Integration of recreational uses and wildlife needs,

4) The affects of high road densities on sediment production and slope stability, wildlife habitat, aquatic and riparian habitats and to a smaller extent flow regime.

Desired Future Condition

Forest Access and Travel Management (A&TM) plan amends the LRMP based and long-term transportation needs.

Recommendations

1. Utilize the Rogue River National Forest Access and Travel Management Process Guide to facilitate both interim and long-term transportation planning. In planning long-term transportation needs the following is considered:

- Road densities are reduced in areas where road densities are high especially in riparian areas, and sensitive and unstable soils (Geology and Geomorphology and Riparian Habitats);
- Adequate fire suppression response times are maintained;
- Interim steps are taken on a watershed basis to facilitate the closure and restoration of roads not currently being used until long-term forest wide plans are completed and implemented;
- Provide recreation access and travel in a manner that can be managed to protect resources and is compatible with wildlife and fire management objectives.

D. GRAZING

Findings

The Squaw/Elliott/Lake Watershed Analysis Area encompasses three separate grazing allotments with only portions of the total allotments within the Analysis Area boundary. Changes in the permitted numbers of livestock and in the seasons of use could occur over the next three years due to the updating of Allotment Management Plans.

There is an ongoing problem with the trespass of cattle from grazing allotments located south of the Siskiyou Crest on the Klamath National Forest.

High elevation wetlands and meadows are being impacted by heavy utilization from grazing.

Desired Future Condition

Allotment Management Plans regulate livestock grazing to minimize impacts from overgrazing and damage in riparian areas. Riparian Reserves within cattle allotments are in compliance with the Aquatic Conservation Strategy.

Recommendations

1. Complete the Allotment Management Plans for cattle allotments within the Analysis Area.

2. Improve communication between the Rogue River and Klamath National Forests to resolve the trespass issue.

3. Develop a plan to protect riparian and meadow resources at high elevations while continuing to allow grazing in the area.

4. Remove livestock structures from riparian reserves.

III. MONITORING AND RESEARCH

Geology and Geomorphology Monitoring Recommendations

- Perform monitoring to assess the ability of the Aquatic Conservation Strategy and the Rogue River National Forest Land and Resource Management Plan standards and guidelines to provide the anticipated level of protection to Interim Riparian Reserves.

- Determine if vegetation management in selected portions of Riparian Reserves can be performed to enhance slope stability conditions by promoting healthy forest stands.

- Monitor the effectiveness of watershed restoration projects.

Site Productivity Monitoring Recommendations

- Develop a sampling strategy for determining trends in site productivity by measuring depth of duff and litter and the extent and degree of soil compaction.

Terrestrial Wildlife Monitoring Recommendations

- Monitor spotted owl sites yearly to determine reproductive success. This will help monitor long term reproductive potential of the species within the analysis area.
- Conduct an analysis of habitat and spotted owl populations within all critical habitat units within or adjacent to the analysis area.
- Conduct yearly reproductive monitoring of the Applegate Lake bald eagles.
- Improve forage roosts for bald eagles on FS lands along the Applegate River.
- Conduct surveys of potential great gray owl habitat to locate nest sites.
- Conduct surveys for goshawks within potential habitat to locate nest sites.
- Conduct habitat surveys prior to conducting projects that may affect suitable kingsnake habitat. Manage the habitat of this species, because surveys are not adequate to determine presence or absence of this species.
- Conduct an analysis of black-tail deer winter range.

Aquatic Monitoring Recommendations

The following monitoring recommendations are made in order to provide information to fill gaps in our understanding of watershed processes and conditions within the analysis area:

- Quantify summer/fall streamflows in Squaw Creek at its entry point to Squaw Lake and at its entry point into Applegate Reservoir in order to determine impacts of current water uses to instream beneficial uses (fish);

- Monitor sediment impacts to fish habitat in all Class 1 and 2 streams in the analysis area. This may address deposition and/or embededness;
- Collect baseline summer temperature data on Upper Elliott (including Silver Fork), Lower Elliott, Upper and Lower Squaw, and Dutch Creeks.
- Monitor fish and macroinvertebrates in Elliott Creek to verify whether concentrations of dissolved metals from Joe Creek have adverse effects there.
- At a minimum, monitor shading of Class 1 and 2 (fish) and Class 3 (non fish-bearing perennial) streams using the solar pathfinder or comparable method.

Other Information Needs:
Complete a watershed improvement needs (WIN) inventory to help facilitate and prioritize restoration opportunities. (It is noted that an initial WIN inventory is being completed with this watershed analysis)

Fish Habitat Monitoring Recommendations

- Conduct monitoring on fish distribution and age class in all streams of the analysis area not currently inventoried.
- Monitor and reinventory aquatic/riparian habitats, stream temperatures, water quality (see Monitoring: water quality) and fish populations at regular intervals in mainstream of Squaw and Elliott Creeks and tributaries, e.g., Joe Creek, Dutch Creek, Silver Fork and Ward's Fork of Elliott Creek and Right Fork and Upper Squaw Creek.
- Establish permanent monitoring monuments to determine changes in channel morphology in Squaw and Elliott Creeks and tributaries.
- Collect baseline data on macroinvertebrate populations to determine the biotic integrity of stream habitat and trends on Squaw, Elliott, Joe, Dutch, Silver Fork Creeks,.
- Conduct water quality testing, lake surveys and fish population census on Applegate and Squaw Lakes.
- Adult size cutthroat trout were not found in upper Elliott Creek during a 1992 fish population study by the California Department of Fish and Game. Further data should be collected to resolve their absence.
- Monitor effects of nonnative salmonids spawning with populations of native trout in the tributaries.
- Monitor water withdrawal effect (fluctuation of water level) on local fish population in Applegate and Squaw Lakes.
- Monitor irrigation dams for possible fish barriers and irrigation canals for sedimentation sources.
- Monitor effects of warmwater fish e.g. gas on salmonid and pond turtle populations in the lakes.

APPENDICES

APPENDIX A: BASIS FOR FINDINGS, DESIRED FUTURE CONDITIONS, AND RECOMMENDATIONS

APPENDIX B: ISSUES & KEY QUESTIONS

APPENDIX C: GEOLOGY AND GEOMORPHOLOGY

APPENDIX D: FIRE MANAGEMENT

APPENDIX E: ACCESS AND TRAVEL MANAGEMENT

APPENDIX F: HISTORIC HUMAN PROCESSES INFLUENCING CURRENT WATERSHED CONDITIONS

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APPENDIX A

BASIS FOR FINDINGS, DESIRED FUTURE CONDITIONS, AND RECOMMENDATIONS

APPENDIX A

BASIS FOR FINDINGS, DESIRED FUTURE CONDITIONS, AND RECOMMENDATIONS

1. TERRESTRIAL SYSTEMS

2. AQUATIC SYSTEMS

3. SOCIO-ECONOMIC

Appendix A Tables

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APPENDIX A

BASIS FOR FINDINGS, DESIRED FUTURE CONDITIONS, AND RECOMMENDATIONS

1. TERRESTRIAL SYSTEMS

A. GEOLOGY and GEOMORPHOLOGY

The Squaw/Elliott/Lake Watershed Analysis Area contains some of the most geologically complex and oldest terrane in western North America. The region has transformed over hundreds of million of years due to the extremely dynamic geological forces that have forged this province. These forces have brought widely diverse rock types adjacent to one another, representing a myriad of geologic environments and processes. The complex geologic setting and history has a strong influence on how the rock types and structures modify the landscape. The geologic materials and structures have themselves been subject to weathering, mass wasting and erosion processes controlled by past and present climatic conditions. Therefore, the landforms in the Analysis Area we see today are the result of continual interactions between climate and regional geology over eons of time.

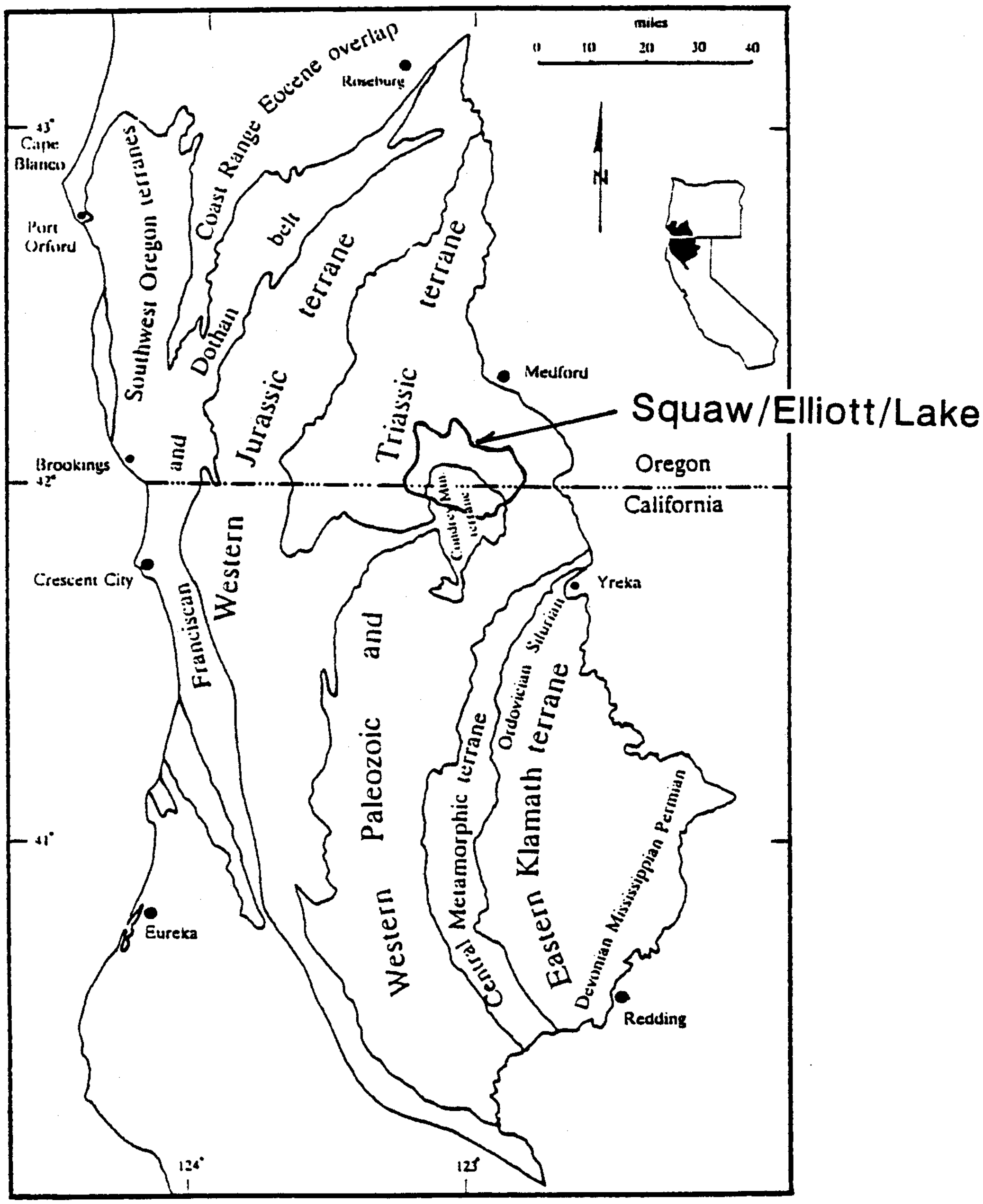
There is still much to be learned about the geology of this area. Indeed, a significant amount of information regarding geologic evolution of the region has only begun to become unraveled over the last two to three decades with the advancement of plate tectonic models. For the interested reader, the references cited give more detailed descriptions of geologic history of the area. In particular, the fourth edition of *Geology Of Oregon* gives a good summary of the regional geology. That source was borrowed from extensively for the geologic synopsis and diagrams given here.

1. Regional Geologic Setting

Figure A-1 shows that the Squaw/Elliott/Lake Watershed Analysis Area is situated along the eastern margin of the Klamath Mountains physiographic province. The figure also reveals how the province is subdivided into individual belts of different lithology that have been accreted or sutured to the southwest Oregon and northwest California coastlines. The belts represent progressively younger (from east to west) slices of the Earth's crust that were carried along the eastern margin of the Pacific plate and then collided with the western edge of the North American plate.

These northeast trending belts are composed of rocks signifying open oceanic or coastal geologic environments which are separated from each other by major thrust fault boundaries. Figure A-2 is a schematic representation of how the major tectonic terranes have been juxtaposed against

Klamath Mountains Province

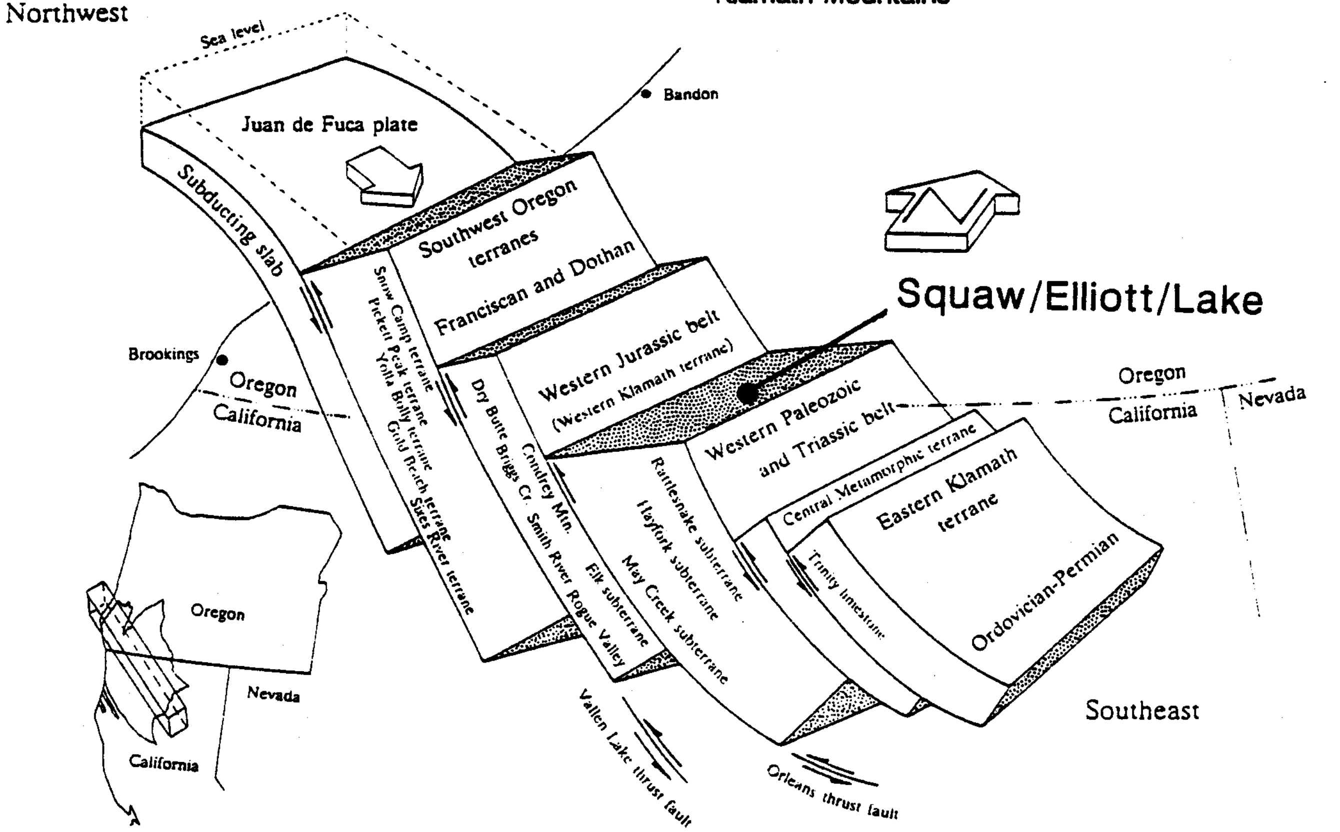


Distribution of terranes in southwest Oregon and northern California (after Irwin, 1985)

From: GEOLOGY OF OREGON 4th ed.

FIGURE A-1

Major tectonic terranes of the Oregon and California Klamath Mountains



From: GEOLOGY OF OREGON 4th ed.

FIGURE A-2

one another. Each belt was subject to intense compression, folding, faulting, shearing and metamorphism as they became fused to the North American plate. The Squaw/Elliott/Lake Watershed Analysis Area is located within the Western Paleozoic and Triassic Belt, with rocks ranging in age from approximately 250 to 130 million years old. The Klamath Mountain Province has been intruded by granitic rocks during several different episodes, some 140-155 million years ago. Nearly one hundred degrees of clockwise rotation and associated extension of the Pacific Northwest region had ceased by approximately 130 million years ago.

2. Squaw/Elliott/Lake Geologic Setting

Figure A-3 shows that the Squaw/Elliott/Lake Watershed Analysis Area is composed of three very different geologic terranes. Each terrane contains geologic formations that have similarities in terms of age, origin and structural history. The Analysis Area is dominated in the central and southern regions by the Condrey Mountain terrane. The western and northern margins are composed of the Hay Fork terrane. The southeastern portion of the Analysis Area is composed of the Rattlesnake Creek terrane. The Hay Fork and Rattlesnake Creek formations derive their names from type localities in northern California. These subterrane are collectively known as the Applegate Group and are a part of the Western Paleozoic and Triassic belt.

The Hay Fork terrane is a thick sequence of shallow marine sediments (sand, mud, lime), volcanic flows and ash that have undergone low levels of metamorphism. These formations represent an ancient, near-shore island arc. This would have been a geologic environment similar to the current chain of volcanic islands at present day Japan.

The Rattlesnake Creek terrane is a complex assemblage of rocks originating in the oceanic crust and upper mantle regions. The major rock types include amphibolite (predominately highly metamorphosed sediments), granodiorite (light colored, intrusive igneous rock of intermediate composition), gabbro and peridotite (dark colored, intrusive igneous rocks rich in iron), and serpentine (metamorphosed/altered peridotite).

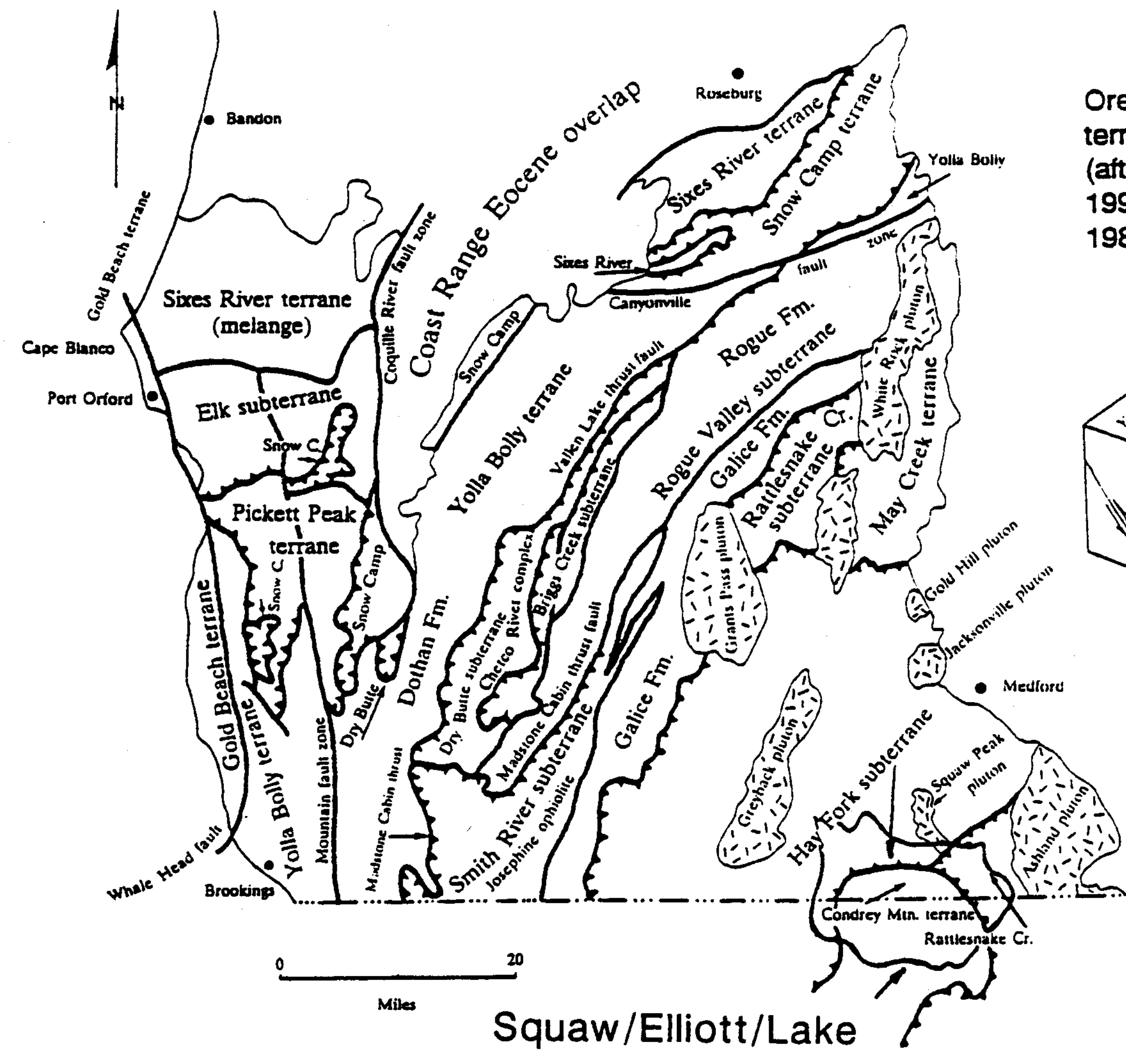
Figure A-3 shows that the Condrey Mountain terrane occupies a dominant portion of the Analysis Area. This formation of shallow marine sediments and volcanic ash has been metamorphosed into two types of schist. The green schist are thought to represent the volcanic ash, while the black schist represent organic-rich muds and silts. This region is structurally significant to the Analysis Area because of uplift and doming of Condrey Mountain some 8-20 million years ago, as seen in Figure A-4. This doming affected a large region of southern Oregon and northern California. The presence of the Condrey Mountain Formation is also significant in that it contains some of the most unstable and highly erodible slopes in the region.

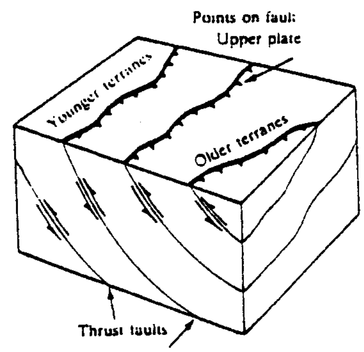
Granitic intrusions are found in both the Hay Fork and Rattlesnake Creek terranes. The southern extension of the Squaw Peak granodiorite pluton is located in the northeastern portion of the Analysis Area.

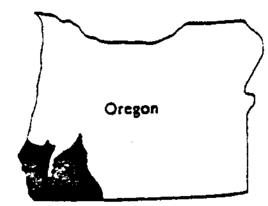
Figure A-5 shows the distribution of various geologic rock types found within each of the three geologic terranes. This simplified geologic map is a composite map produced by numerous

Klamath Mountains

Oregon Klamath Mountain terranes and major faults (after Pessagno and Blome, 1990; Harper and Wright, 1984; Blake, et al., 1985)

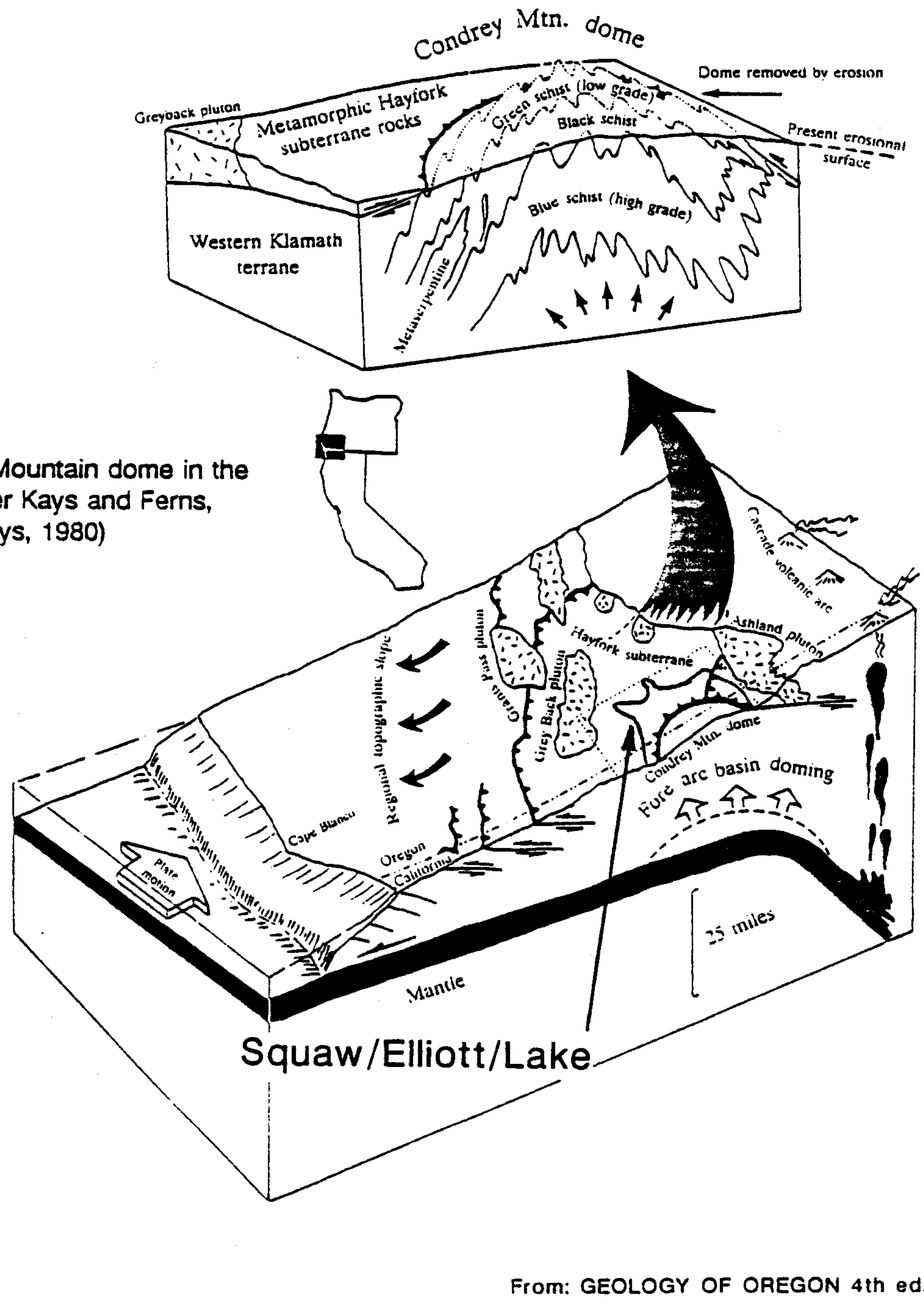






From: GEOLOGY OF OREGON 4th

FIGURE A-3



Tertiary uplift and the Condrey Mountain dome in the Oregon Klamath Mountains (after Kays and Ferns, 1980; Donato, Coleman, and Kays, 1980)

From: GEOLOGY OF OREGON 4th ed.

FIGURE A-4

geologists. Major rock types include black schists of Condrey Mountain (32%), green schists of Condrey Mountain (19%), metavolcanics and metasediments (22%), amphibolites (12%), granitics (4%), and ultramafics (peridotite and serpentine) (4%).

3. Stages of Landscape Erosion

The Klamath province has long been recognized for having a landscape with concordant mountain peaks. That is, the province displays a widespread region with relatively even mountain summit elevations. This is thought to represent the relics of an ancestral stage of landscape erosion known as old age. Old age is marked by subdued landscape relief and was likely characterized by broad flood plains, with a few large meandering rivers separated by rolling hills.

Subsequent to the creation of this broad plain, the entire region was uplifted causing renewed erosive energy and dissection of slopes. This youthfull stage of erosion was characterized by a few widely spaced streams, and broad, flat-topped interstream divides. During this early erosional stage there was a progressive increase in local relief, with steep and irregular landforms being created.

The landscape we see today is in the mature stage of erosion. The results of regional uplift are seen as modification of the terrain by creation of numerous, closely spaced streams, extensive tributaries and disappearance of the initial level surfaces. The land is completely dissected and reduced to slopes, sharp, narrow divides and the greatest degree of ruggedness possible. As much as three to five miles of uplift and associated erosion of the landscape is suspected of having occurred in this region.

4. Landscapes of Squaw/Elliott/Lake

Appendix C contains a description and map of the nine landscape subdivisions that were delineated for this analysis. The intent of the lanscape units is to provide a method in which to group the terrain into regions of similar geomorphic processes, landforms, geology, soils and climate. The landscape units can be considered as large management response units and the basis for integrating resource strategies.

5. Geologic Controls on the Landscape

As geologic formations were incorporated onto the west coast of North America, numerous geologic structures and rock types influence the Analysis Area landscape we see today. These structures include faults, folds, domes and igneous intrusions. Related to these features are the small scale textures associated with rock bodies, most importantly jointing and fracturing of the rock.

Faults

Fault zones are associated with fractured, sheared and pulverized rock resulting from differential movement of geologic formations. Such crushing of the rock creates weak zones which are more readily impacted by erosion and mass wasting processes.

The most significant faulting in the Analysis Area has both regional and local implications. This extensive faulting process separates the Hay Fork and Rattlesnake Creek terranes from the Condrey Mountain terrane by a geologic structure known as a thrust fault. This thrust fault resulted from horizontal compression associated with major plate tectonic motion whereby the younger Condrey Mountain rocks were shoved underneath older rocks of the Hay Fork and Rattlesnake Creek terranes. Associated doming and subsequent extensive erosion exposed the underlying Condrey rocks, Figure A-4. The contact between the Condrey Mountain and surrounding geologic terrane is along an eroded exposure of the thrust fault boundary.

A major (nearly 20 miles long) northeast trending fault separates the Hay Fork and Rattlesnake Creek terranes. It controls the alignment of upper Squaw Creek and created the weak zone at Squaw Creek Gap. Another important, east-west trending fault nearly bisects the Analysis Area. This fault controls the alignment of French Gulch, French Gulch Divide, Mulligan Gulch and the lower reaches of Slick Taw Gulch.

Faults also play a part in controlling the distribution of groundwater in portions of the Analysis Area. Faults can either act as transmission zones or barriers to the migration of subsurface water, depending upon the permeability of the fault zone. Yellowjacket, Chappel and Kilgore Springs are examples of fault controlled groundwater. The abundant springs located in the headwater of Tamarack Creek are associated with fault boundaries between serpentine and amphibolite bedrock. Alignment of springs in the headwaters of Silver Fork basin are likely fault controlled, however direct evidence is masked by glacial deposits.

Faults often separate different rock types from each other. This is particularly true for serpentine bodies in the Rattlesnake Creek terrane. There are marked differences in the associated soils, resistance to mass wasting and erosion, and active slope forming processes between the rock bodies.

Doming

The region centered around Condrey Mountain developed into a structural dome during a period extending from about 20 million to 8 million years ago. Doming as initiated in response to compressive stresses brought about by the convergence of tectonic plates. This is depicted in Figure A-4. Evidence suggests that doming caused regional uplift of as much as four miles. This period of doming is considered the cause of the broad regional uplift and associated erosion of the Klamath Province.

The central location of the dome to the Squaw/Elliott/Lake Watershed Analysis Area has a marked impact. Uplift initiated the landscape erosion cycle previously discussed. Compared to the surrounding formations, rocks and soils of the Condrey Mountain are extremely unstable and highly erodible.

Joints and Fractures

Joints and fractures in bedrock are breakage in a rock body that do not have offset movement directly associated with them. They are formed in rock in response to stresses including compression, tension, folding, faulting, intrusion and doming. Rocks in the Rattlesnake Creek terrane were at one point deeply buried within the crust. Once relieved of great overburden pressures by mass erosion processes, these rock bodies swelled slightly and formed stress release fractures. This is particularly true of granitic intrusions.

The Condrey Mountain rocks have well developed joints and fractures associated with original sedimentary layering as well as those created during folding and metamorphism. These joints are often large and weak enough that mature stands of conifers have been observed growing directly on rock outcrops of north facing slopes.

Fractures in bedrock expose the rock to a greater amount of weathering forces from effects of groundwater and air contact. Differential rates of erosion can be expected from rocks with different joint density. The metavolcanics in the north portion of the Analysis Area are fractured, but do not have the same density of open, continuous fractures and joint sets as granitic intrusions. Consequently the metavolcanics tend to be less deeply weathered.

Open joints and fractures in bedrock act as transmission conduits to the intake and release of groundwater following infiltration of precipitation. Highly fractured rock can hold a good deal of water and then slowly release it back as springs or groundwater to stream systems.

6. Rock Type

The type of rocks found distributed throughout the Analysis Area has an effect on associated soils. Different mineralogy, structures, inherent strength of the bedrock, and resistance to erosion and mass wasting have an influence on the landforms.

Schist bedrock of the Condrey Mountain formation weathers to soils which are rich in silt and clay size particles. Soils range from thin and rocky (skeletal) near ridges to extremely deep and fine-grained associated with landslide deposits. The high content of mica mineralogy and low cohesion causes these soils to exhibit low shear strength. This is particularly true for black schist soils which contain significant amounts of graphite along with mica.

Granitic rocks, (and to a large extent, amphibolite rocks) are noted for their high strength when fresh. However, after exposure to weathering, the coarse mineral grains are readily separated from each other by a process known as decomposition. Thus, relatively fresh crystals of feldspar and quartz form sandy decomposed granite (DG) soils that are very easily transported off site through surface erosion or debris slides. This process is very active in the headwaters of the

Squaw/Elliott/Lake Watershed Analysis Area

Geologic Rock Types

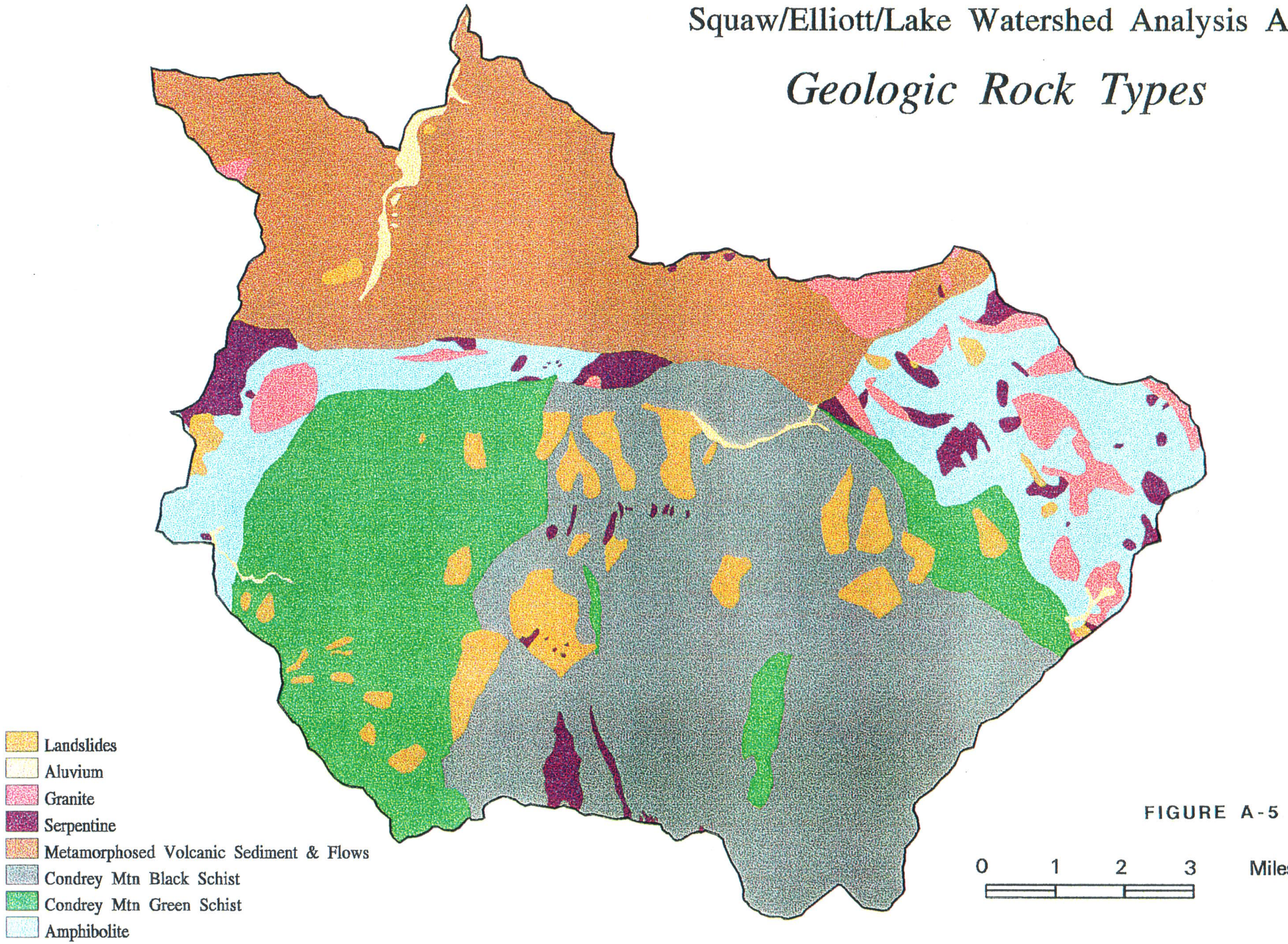


FIGURE A-5

Analysis Area where rapid weathering and erosion processes keep fresh granite and amphibolite bedrock near the surface rather than producing a thick soil mantle.

Ultramafic rocks (peridotite and serpentine) have minerals which are relatively quickly altered to clay rich soils. Where erosion does not outpace weathering, thick, potentially unstable soil deposits can form. Ultramafic rocks in the upland or glaciated headwaters produces thin rocky soils where erosion strips away the weathering products as rapidly as they are formed.

The **metavolcanic and metasedimentary** rocks found in the Analysis Area are relatively resistant to erosion. Soils are shallow; composed of silts and clays with variable amounts of rock fragments, with a thin weathering zone of the upper fractured bedrock. Volcanic rock forms a very dense, tight formation as a result of interlocking crystals in the original lava flows and the low grade metamorphism. Unlike granitic intrusions which are formed miles below the earth surface, the lava flows and sediments are in a pressure and temperature environment much closer to those under which they were formed (atmospheric). As a result, they are more resistant to weathering and erosion forces. This, coupled with their position in the low precipitation zone of the Analysis Area, leads to rugged relief of the metavolcanics.

7. Erosion

Erosion is the dislodging, transportation and deposition of surficial soil and rock from the landscape in response to water, wind or ice. These forces are related to the climate of the region.

Running water is the chief cause of surface erosion in the forms of sheet, rill, gully, and channel erosion. This is particularly important in the high precipitation zones of the upper elevations. Summer thunderstorms are known to be particularly erosive events impacting the high elevation granitic and amphibolite derived soils. Where the protective cover of vegetation and/or snowpack is removed the granular, sandy soils are easily dislodged and moved downslope. The fine sands and silts derived from the Condrey Mountain rocks are highly prone to severe erosion when exposed to concentrated overland water flow. The soils can become deeply gullied by a single storm, with subsequent storms aggravating previously established erosion channels.

Figure A-6 depicts the relative erosion potential of soils in the Analysis Area. The map was created by modifications of the Rogue River National Forest Soil Resource Inventory. This interpretation focuses on inherent erodibility based upon soil textures of the surface horizon and assuming total loss of surface vegetation. The rating also considers geology, slope, landform, aspect and precipitation zone.

The erosion potential rating considers sediment types delivered to waterways and potential for impact to riparian habitat. For instance, ravel potential of gravelly soils may be relatively high on steep slopes, but the input of clean gravels to drainages is considered low impact. Conversely, soils rich in noncohesive grains such as silt, fine sand and coarse sand are highly erodible and can readily embed spawning gravels and macroinvertebrate habitat. The rating also considers geology, slope, landform, aspect and precipitation zone. Use of this map is limited to

Squaw/Elliott/Lake Watershed Analysis Area

Soil Erosion Potential

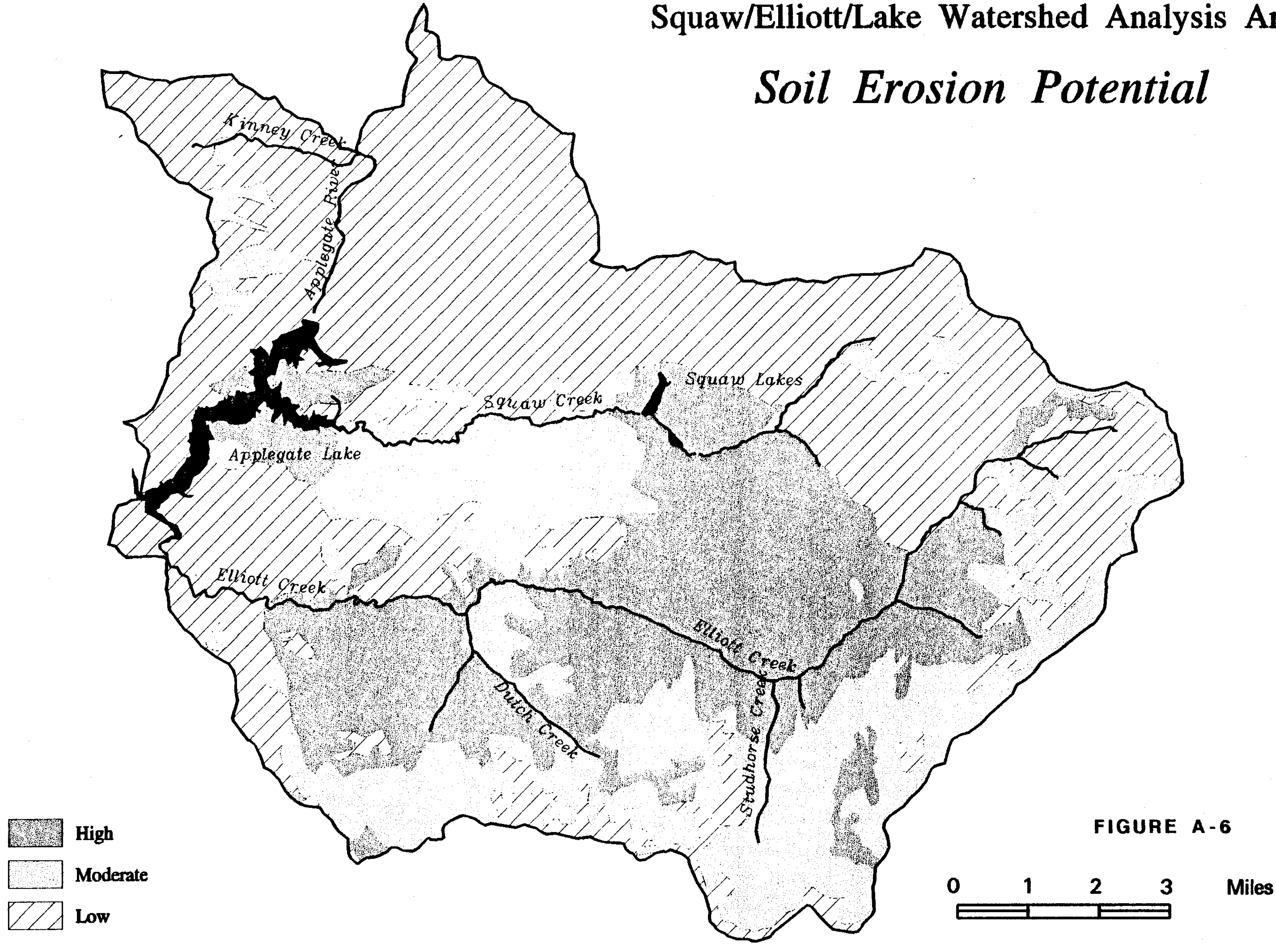


FIGURE A-6

planning level assessments. A soil scientist is necessary to assist with interpretations of project level designs.

About half of the Analysis Area is considered to have moderate to high erosion potential, with the vast majority of these soils being derived from the Condrey Mountain schist. Of the highly erodible soils, most are associated with the black schist bedrock. Low erosion potential is found in the majority of the lower portion of the Analysis Area. The following table displays erosion potential by percent for each of the subbasins. It also shows the percentage of the Watershed Analysis Area (WAA) represented by each of the subbasins.

Table A-1. The Erosion Potential by Percent of Each Subbasin.

	Lake	Mule	Kinney	Dutch	Joe	L. Squaw	U. Squaw	L. Elliott	U. Elliott
High	17	0	0	44	36	5	33	52	33
Moderate	8	0	12	44	34	54	3	15	39
Low	75	100	88	11	30	40	64	33	28
% of WAA	10	9	6	9	5	10	16	13	23

Glaciers scoured the eastern and portions of the southern headwaters of the Analysis Area during the Pleistocene. They are responsible for carving the bowl-shaped cirques and associated rock outcrops/headwalls, U-shaped valleys and rocky morainal deposits found in the upper elevations. The headwaters of Silver Fork, Donomore, Tamarack, Kettle, Studhorse, Alex, Dutch and Joe Creeks all show classic alpine glaciation features. Glacial ice in the Silver Fork basin is thought to have extended down to 5,500 feet elevation.

In the upper elevations precipitation and snow melt water finds its way into surficial rock fractures. As water in the joints freezes it exerts very high forces that tends to wedge and split apart boulders and rock outcrops. The effects of this frost/ice wedging process are evident in the very rocky slopes surrounding high elevation outcrops.

Wind plays a roll in erosion of cohesionless soils. These soils require a degree of cohesion to remain stable on the steeper slopes. In many instances capillary tension provided by soil moisture can add a small component of cohesive strength to soils. Wind and sun act to dry the uppermost layer of soil with a resulting loss of capillary tension. This loss of cohesion allows fine soil grains to be carried away by the wind, leading to raveling of remaining soil and rock particles.

8. Mass Wasting

Mass wasting is the wearing away of the landscape brought about by downslope movement of soil and rock due to gravitational forces. The steeper the slope, the more likely to be influenced by mass wasting processes. Within the Analysis Area the most commonly recognized forms of mass wasting are earthflow and debris slide types of landslides. Landslides are responsible for moving tremendous volumes of soil and rock from higher to lower positions in the Analysis Area; however other processes are active.

Rock fall and topple occur wherever rock outcrops are exposed on slopes. The products are seen as talus slopes below cliffs. The glaciated peaks and ridges along the southern and southeastern Analysis Area boundary show abundant signs of these processes.

Frost heave of the upper soil surface causes soil and rock fragments to move upwards perpendicular to the slope surface during freezing and then back downwards upon melting. When frost heaving occurs on slopes, the net movement of particles is downslope as ice in the soil melts. This process is known to lift and redeposit rock of considerable size. Observations were made in the field that deep snowpack in the upper elevations imposes shear stresses on surficial rock fragments. These stresses can result in annual downslope movement of rock.

Creep is the imperceptibly slow, persistent downslope movement of the soil mantle from gravitational stress. It acts on all slopes. Although extremely difficult to quantify, it is likely that all other forms of mass wasting combined accomplish but a small fraction of the volume of material moved when compared to that transported by creep actively working on all slopes of the Analysis Area.

Ravel is an important process acting on slopes in the Analysis Area. It is particularly active on dry slopes with sparse vegetation. It involves the surface soil layer whereby individual soil grains are dislodged and moved by gravity. Cohesionless soils are particularly susceptible. The semi-arid climate, sparse vegetation and sandy/gravelly soils combine to make the low elevation amphibolites and metavolcanics particularly prone to surface raveling processes. The ravel process tends to smooth slope profiles by filling in low slope positions with material derived from upslope.

There are two general categories of **landslides** important to sediment yield in theSquaw/Elliott/Lake Watershed Analsyis Area. These can be broadly classified as **earthflow and debris slide** types of landslides. They involve movement of soil and or weathered rock with variable amounts of water content, as either a cohesive or noncohesive mass. For slopes subject to mass wasting there is a continuum with respect to the content of rock and soil, as well as material cohesiveness, slope angle and associated vegetation. Therefore, the types of landslide processes found in the field may not always fit into the general categories given here. Furthermore, a particular landslide may exhibit characteristics of more than one type of failure mode. Appendix C contains a more detailed descriptions of the factors affecting landslides and some of the considerations for management in unstable terrain.

Earthflows are a naturally occurring dominant slope degradation process in this Analysis Area due to the vast expanse of Condrey Mountain schist. Earthflows are normally associated with cohesive, relatively thick, fine-grained soil (silts and clays) profiles. However, the schist is composed predominately silts and clay size material, with low cohesion. It is the low frictional strength, poor drainage of the soils lying atop weak, planar, dipping bedrock of the schists that causes them to be prone to earthflows (and debris slides).

While the green schist has numerous earthflows, the vast majority are found in the black schist portion of the Condrey Mountain terrane. They dominate slope forming processes and commonly develop huge earthflow complexes that run from ridge top to creekside. The Summit Lake earthflow is a classic example of the magnitude of such features. During prehistoric time, this 1.5 mile long, 20 million cubic yard slide blocked Squaw Creek and formed Squaw Lakes. Like a giant soil glacier, this earthflow complex periodically creeps forward and calves-off tens of thousand of tons of soil and rock into Squaw Creek.

Noteworthy areas with active and ancient earthflows include: lower Dutch Creek basin, north facing slopes above Squaw Creek between Pearce Gulch and Dividend Bar, and south facing slopes above Elliott Creek between Wards Fork and Oak Flats.

Landslides periodically threaten transportation and recreation facilities. The Squaw Lakes recreation/camping site is located at the toe of the massive Summit Lake earthflow. During periods of advancement, the upper parking lot and streambanks below the dam have historically been damaged by slope movement. The Manzanita earthflow in the NE 1/4 of Section 10, at the south end of the Applegate Lake, creates vertical scarps in and adjacent to road 1041. Just north of this site, another earthflow near Panther Gulch has interrupted the lake perimeter trail. A debris slide failure at the Hart-Tish site at Applegate Lake threatens to engulf portions of the trail and overlook site.

Debris slides are less important in this Analysis Area than earthflows in terms of total area affected. However, they very important to the stream channel and riparian habitats that they most often times impact. Debris slides most frequently are found in the rain-on-snow elevation band where high intensity storms can initiate slope failures.

Noteworthy areas with a debris slide history include: Roads 1055 and 1060 and slopes above Joe Creek, West Fork of Dutch Creek, Road 1065 above Dutch Creek, and north facing slopes above Elliott Creek.

The Applegate group formations are conspicuous for the low incident of debris slides and earthflows.

9. Natural Processes Affecting Slope Stability

Earthflows may be reactivated or new earthflows may form when long duration storms or a series of high precipitation years occur.

Debris slides can be expected when significant precipitation events bring sustained or high intensity rainfall. Rain-on-snow events can also cause saturation of steep slopes leading to debris slides.

The majority of debris slides are found in the terrain above 4,000 feet elevation. This corresponds to the higher precipitation region of the Analysis Area, as well as the elevation above which rain-on-snow events occur. The metavolcanics/metasediments have very few signs of debris slide activity. The glaciated terrain is relatively resistant to debris slide initiation due to its well drained, high rock content glacial deposits.

The Condrey Mountain terrane is also noteworthy for the concentration of known and potential debris slide sites. This is due to its highly erodible, low strength, poorly drained, silty sandy soils atop dipping, planar bedrock surfaces.

During the 1974 flood, a nearly 250,000 cubic yard debris slide was initiated on the lower south slope adjacent to Silver Fork. This naturally occurring slide deposited a tremendous volume of soil, rocks and boulders into Silver Fork. The slope failure created a nearly 40 foot high debris dam in the channel. Since damming the creek, accumulated stream sediments have filled in behind the dam and aggraded the channel.

Debris torrents in the West Fork of Dutch Creek occurred during the 1974 flood event. Long sections of the banks were stripped of vegetation and soil and rock as torrents scoured the drainage.

10. Human Activities Affecting Slope Stability, Erosion and Sediment Production

Road Associated Landslides

Humans can inadvertently accelerate or reactivate earthflows by:

-undercutting the slide deposit toe with road cuts;
-overload the slide head with road fills;
-diversion of excessive surface water from road drainage onto the slide body;
-loss of soil cohesive strength provided by mature conifers roots resulting from timber harvest;
-increased groundwater within the soil mass due to loss of evapotranspiration resulting from timber harvest.

Scores of slope failures have impacted road systems in the Analysis Area since their construction. The most disruptive of these are commonly found within the Condrey Mountain formation, particularly along Elliott, Joe, Dutch and Squaw Creek road systems. The timing of most of these can be directly attributed to storm related saturation of the soil mantle.

Vegetation Removal or Loss

Extensive timber harvesting, wildfires, or road construction can lead to the loss of the cohesive contribution to soil shear strength from tree and brush roots. Rooting strength is important to minimizing debris slide initiation because the soil mantle is often shallow enough that roots may penetrate through the soil and anchor into fractured bedrock below. Large roots can grow towards adjacent trees to act as a reinforcing mat or buttress the soil mass.

Road Associated Erosion

One of the most significant sources of soil disturbance and associated accelerated sediment production in the Analysis Area comes from roads. Roads expose large areas of unprotected soil and also have potential to initiate new or reactivate dormant slope failures.

A number of factors are important when judging the relative impact of roads in terms of sediment production. These factors include such things as:

- soil erodibility,
- bedrock stability,
- steepness of terrain traversed,
- proximity to riparian zones,
- number of riparian crossings,
- age since construction/reconstruction,
- road grade,
- exposed surface area of cut slope, ditch, roadway and fill slope,
- surfacing type (native soil, aggregate, asphalt),
- drainage frequency and types,
- construction standards,
- road density,
- precipitation patterns,
- maintenance level,
- traffic intensity (number of vehicles and axle loads),
- season of traffic use (soil moisture content),
- amount and type of revegetation on cut and fill slopes.

With so many interactive and variable factors its is difficult to readily assess which elements have the greatest influence on yield of sediment. The factors are not listed in order of importance, and the relative contribution of each may change over time. The most difficult of all variables to assess is the erratic return frequency of major storm events which trigger the most significant amounts of road related erosion and sedimentation.

To display the relative impact of roads and sediment production Table A-2 has been prepared. The table focuses upon soil erodibility, riparian zones, unstable terrain, road surfacing, and road density. The premise is that the table shows the number of road miles associated with sites that are sensitive to erosion/sedimentation. That is, the subbasins of greatest concern are those with the highest density of unsurfaced road miles, adjacent to riparian zones or unstable terrain. Conversely, subbasins with low road density, asphalt surfaced roads in stable terrain, with low erosion potential and not adjacent to riparian zones should have the least concern. Information from this table can be very useful in prioritizing watershed restoration efforts which focus on road related sedimentation to streams.

Table A-2 reveals that effective road density within subbasins are generally higher when the unroaded portions of the subbasin are excluded. For example, road density of the Dutch Creek subbasin is 1.4 miles per square mile. However, when only the roaded sections of the subbasin are considered, the density jumps to 4.5 miles per square mile.

Using Dutch Creek as a further example of the data; 93% of the roads are within the Riparian Reserves, and 63% of those miles are crossing geologically sensitive terrain. It is notable that 98% of the road miles in the Dutch Creek subbasin traverse high to moderately erodible soils, but only 2% of those miles are unsurfaced. In comparison, within the Lower Elliott subbasin, 70% of the road miles are within Riparian Reserves, while 34% of those miles are unsurfaced and traverse highly erodible soils. It is noteworthy that the Mule/Lake/Kinney subbasins have no unsurfaced system roads crossing Riparian Reserves with soils that are considered highly erodible.

An aerial photo inventory of tractor skid roads and log landings on public lands was completed for a soil porosity analysis (Appendix A, Site Productivity). It is important to note that tractor skid roads and log landings on private lands have not been inventoried or evaluated for this assessment. Many of the factors contributing to system road erosion are anticipated to have an even greater influence on these non-system roads.

Table A-2: Roads Associated with Riparian Reserves and Geologically Sensitive Terrain

Subbasin	Area	Total System Roads	Density of Roads Miles/Square Mile		Road w/in Riparian Reserves		Roads crossing U3, LHZ (1,2), Debris Slides and Earthflows		Roads in Highly & Mod. Erodible Soils		Unsurfaced roads in Highly & Mod Erodible Soils w/in Riparian Reserves	
	square miles	miles	including roadless	excluding roadless	miles	percent	miles	percent	miles	percent	miles	percent
Analysis Area Total	114.2	287.7	2.5	3.6	126.0	44	62.8	22	182	63	24.2	19
Mule, Lake, Kinney	28.3	39.9	1.4	2.8	12.4	31	0.06	<1	3.5	9	0.0	0
Mule	9.9	10.3	1.0	2.9	2.9	28	0.0	0	0.0	0	0.0	0
Lake	11.7	17.3	1.5	2.1	5.7	33	0.06	<1	2.2	13	0.0	0
Kinney	6.7	12.5	1.9	5.4	3.8	30	0.0	0	1.3	10	0.0	0
Squaw	29.4	94.6	3.2	3.7	29.0	31	15.2	16	76.0	80	7.5	26
Upper	18.5	71.2	3.8	4.2	15.7	22	8.2	12	57.8	81	6.8	43
Lower	10.9	23.4	2.1	2.9	13.3	57	7.0	30	18.2	78	0.7	5
Elliott	56.5	153.2	2.7	3.7	84.4	55	47.5	31	102.4	67	16.7	20
Upper	26.2	91.5	3.5	4.4	38.2	42	16.0	18	55.6	61	7.2	19
Lower	14.2	29.1	2.0	2.2	20.5	70	12.7	44	21.3	73	7.0	34
Dutch	10.7	15.2	1.4	4.5	14.1	93	9.6	63	14.9	98	0.3	2
Joe	5.4	17.4	3.2	4.0	11.6	67	9.2	53	10.6	61	2.2	19

Note: This table only includes system road mileages, densities

11. Inventory Methods

Four separate sources of information were utilized to identify the location and types of landslides within the Analysis Area. Each source of inventory was put on a separate GIS layer so that the source of landslide delineation and its associated (un)certainty can be tracked. Figure A-7 combines all sources of stability mapping as a single product. It is utilized for a preliminary determination of the slope stability portion of Interim Riparian Reserves. Only the regions identified on the project level map, Figure A-8, can relied upon for accuracy. Other areas shown on Figures A-9 through A-11 must have site-specific field mapping to confirm the presence of unstable terrain or detect previously unrecognized or newly destabilized slopes. This project level work is also the time to delineate the appropriate extent of riparian reserve boundaries surrounding unstable or potentially unstable terrane.

It is important to recognize that many of the earthflows depicted on Figures A-7 and A-9 are not currently active. Many of the mapped sites are dormant to ancient in age, may not have moved for decades, hundreds or even thousands of years, or may have only portions which are currently active. However, depending upon the input or removal of factors that contribute to slide movement (Appendix C), ancient earthflow sites may be reactivated or recently active slides may go dormant.

A synopsis of the slope stability inventories follows:

-- The first source is from detailed slope stability mapping performed for timber sale study areas on National Forest lands. The terrain considered unsuitable for timber harvest due to the potential for irreversible impacts to conditions (Hazard Zone One) was obtained from these maps. Figure A-8 shows the locations of these unstable sites and their associated management buffer zones.

--Second, a 1:24,000 scale topographic map interpretation was carried out to identify sites with high potential to represent earthflow features. This method does not allow the determination of landslide activity level or detection of small features. The earthflow map is Figure A-9.

--Third, 1:24,000 scale color stereo aerial photos were reviewed to detect recent debris slide features as well as confirm or delete the sites of topographically interpreted earthflows. The debris slide map is Figure A-10.

--The fourth inventory source was utilization of GIS style mapping of known and potentially unstable terrain designated in the 1990 Land and Resource Management Plan, FEIS for Rogue River National Forest Lands. The sites located on this interpretive map are called U-3, and comes from planning level work performed in the early 1980's. The Forest Plan U-3 map is Figure A-11.

Squaw/Elliott/Lake Watershed Analysis Area

Composite Map of Unstable or Potentially Unstable Terrane

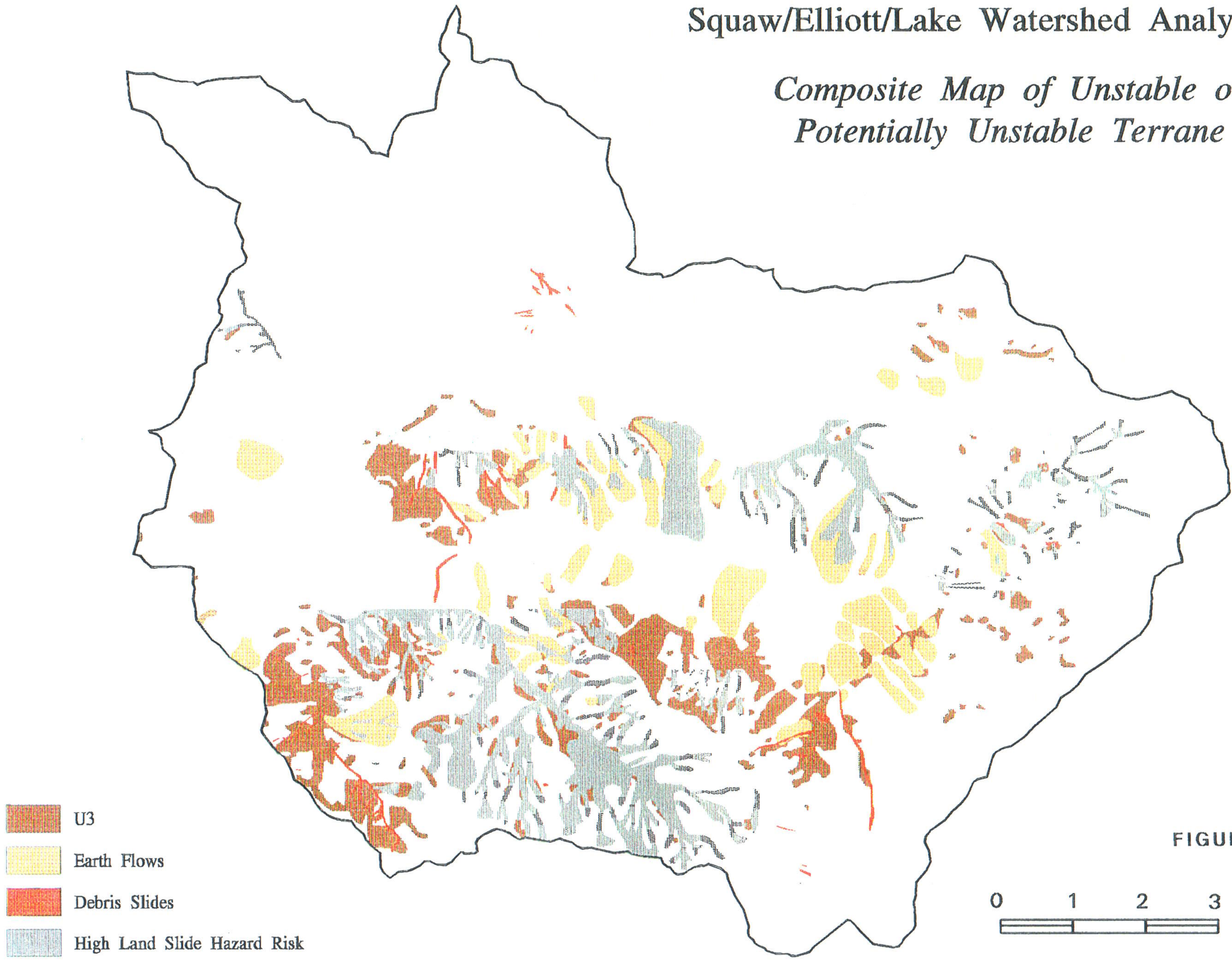


FIGURE A-7

Squaw/Elliott/Lake Watershed Analysis Area

Unstable or Potentially Unstable Terrane Determined by Detailed Field Mapping

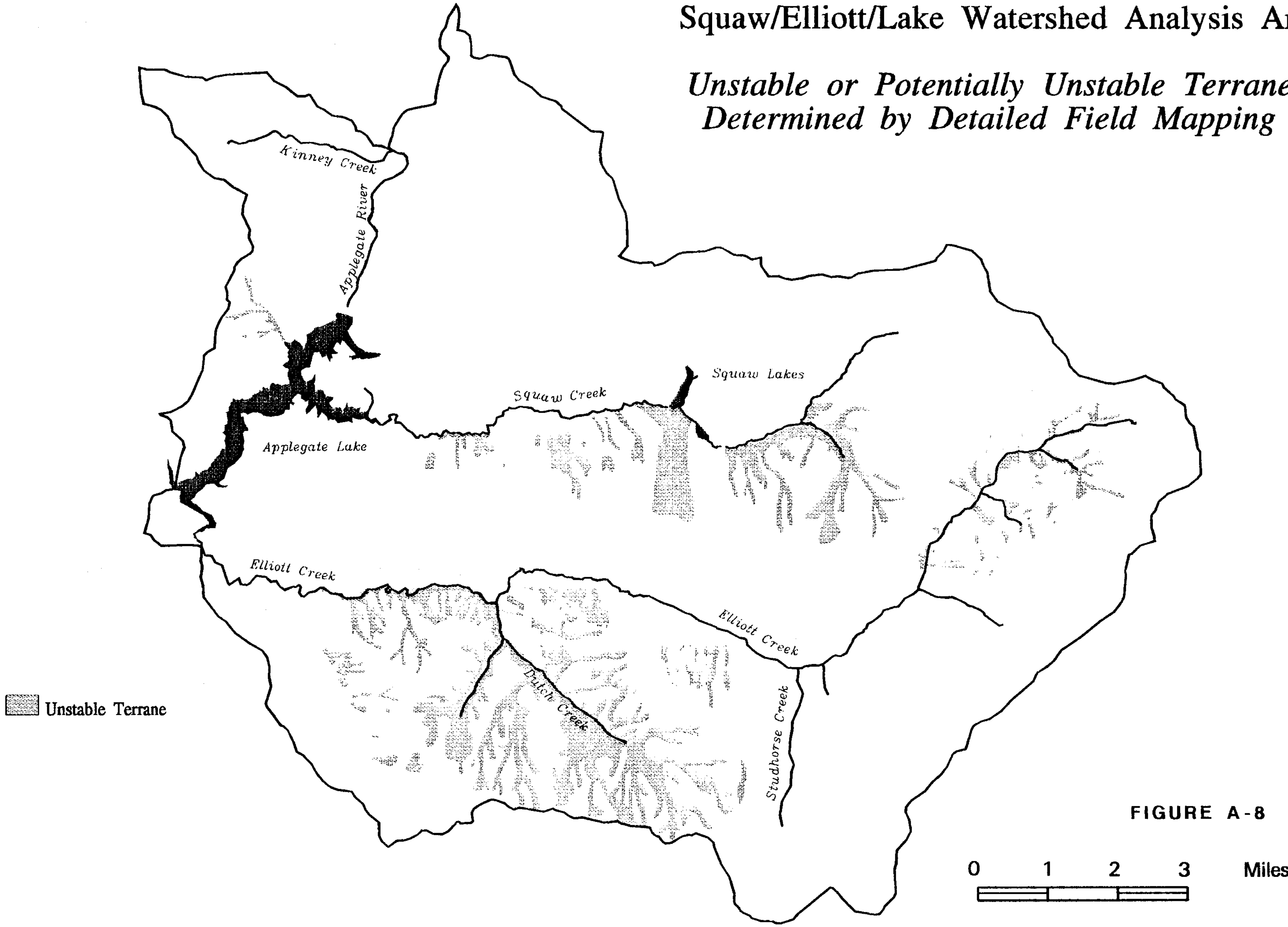


FIGURE A-8

Squaw/Elliott/Lake Watershed Analysis Area

Earth Flows Interpreted From Topographic Maps & Aerial Photos

Landslide Activity Level Undetermined

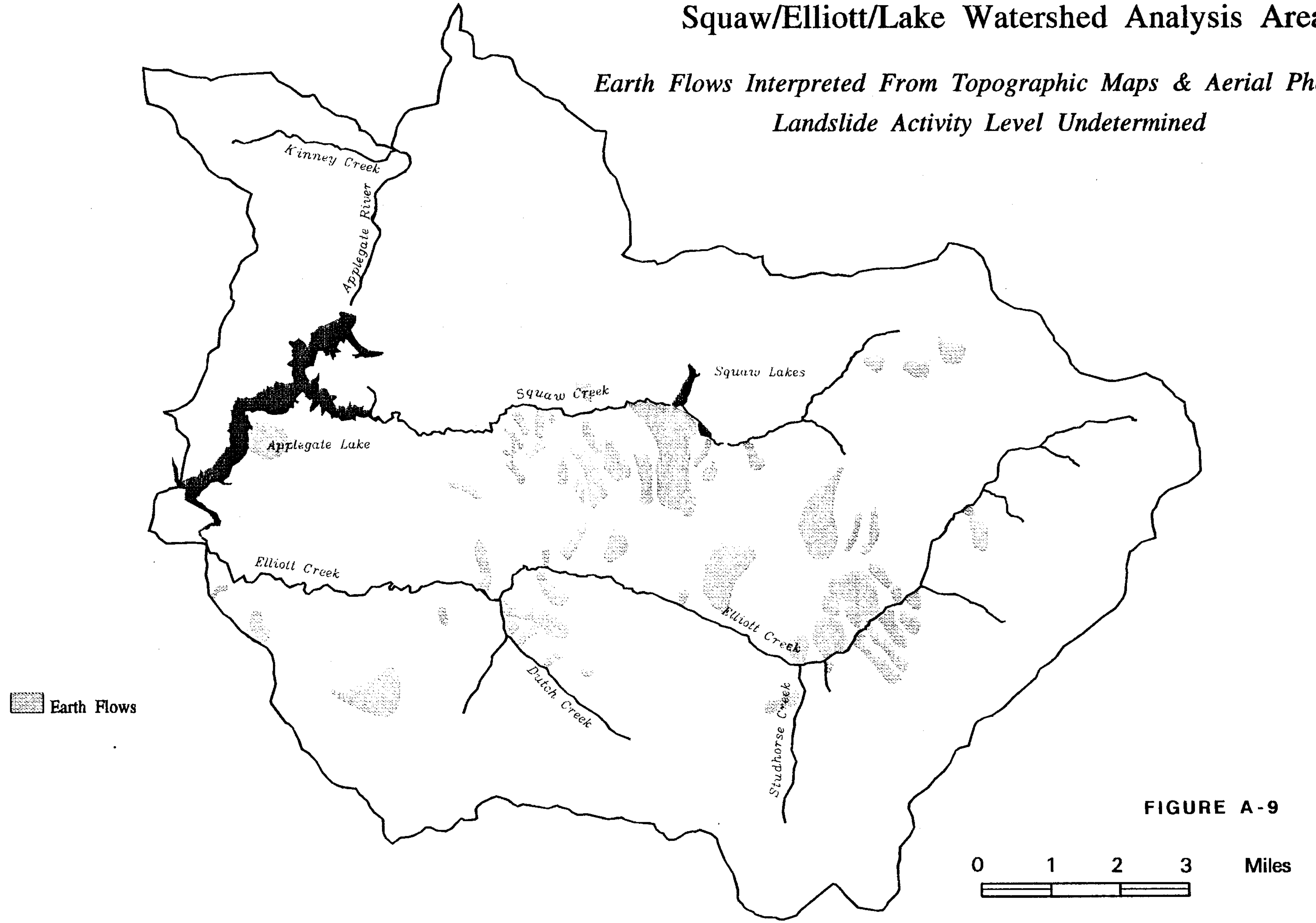


FIGURE A-9

Squaw/Elliott/Lake Watershed Analysis Area

Debris Slides Interpreted From Aerial Photos

Landslide Activity Level Undetermined

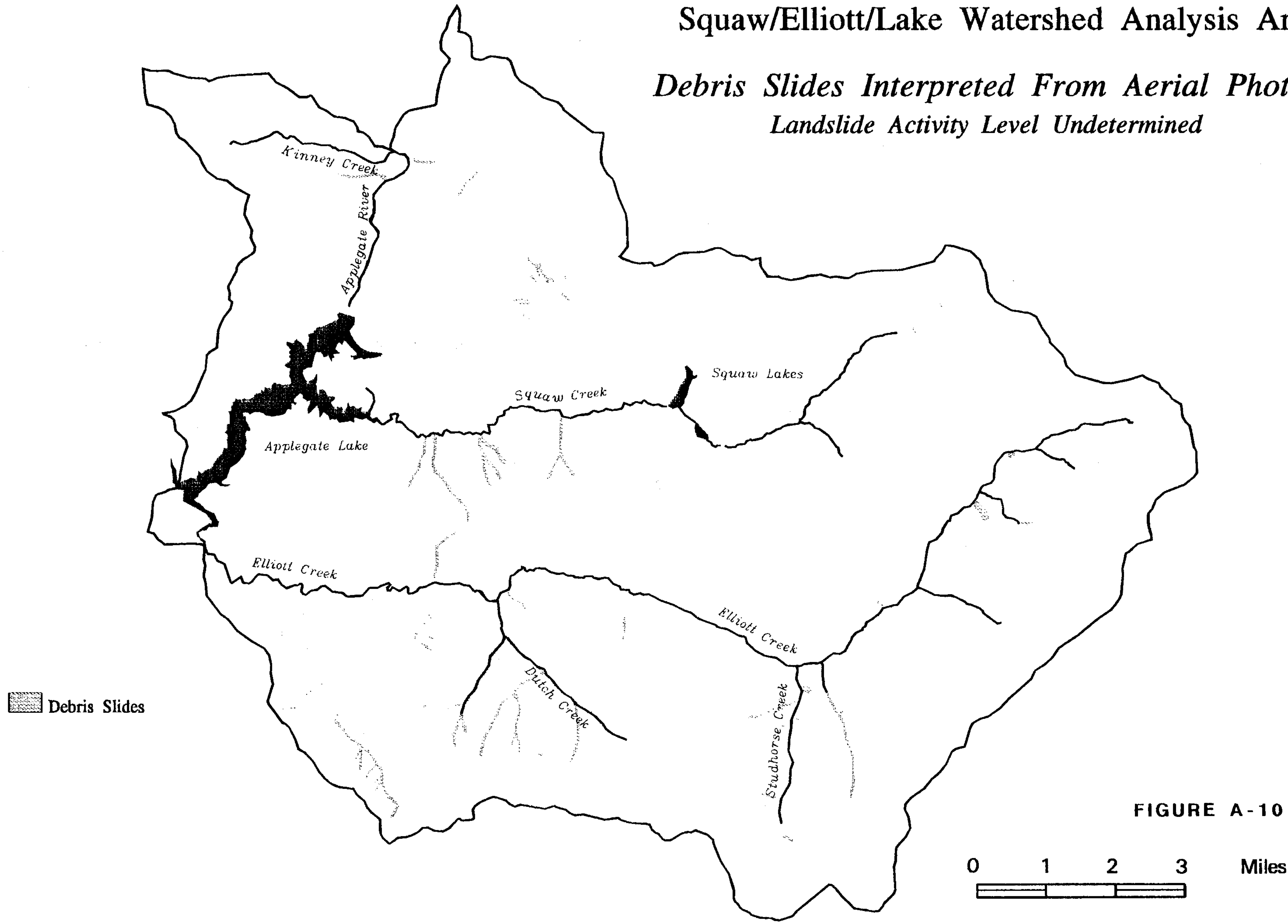


FIGURE A-10

Squaw/Elliott/Lake Watershed Analysis Area

Unstable Terrane As Determined by 1990 LRMP

Landslide Activity Level Undetermined

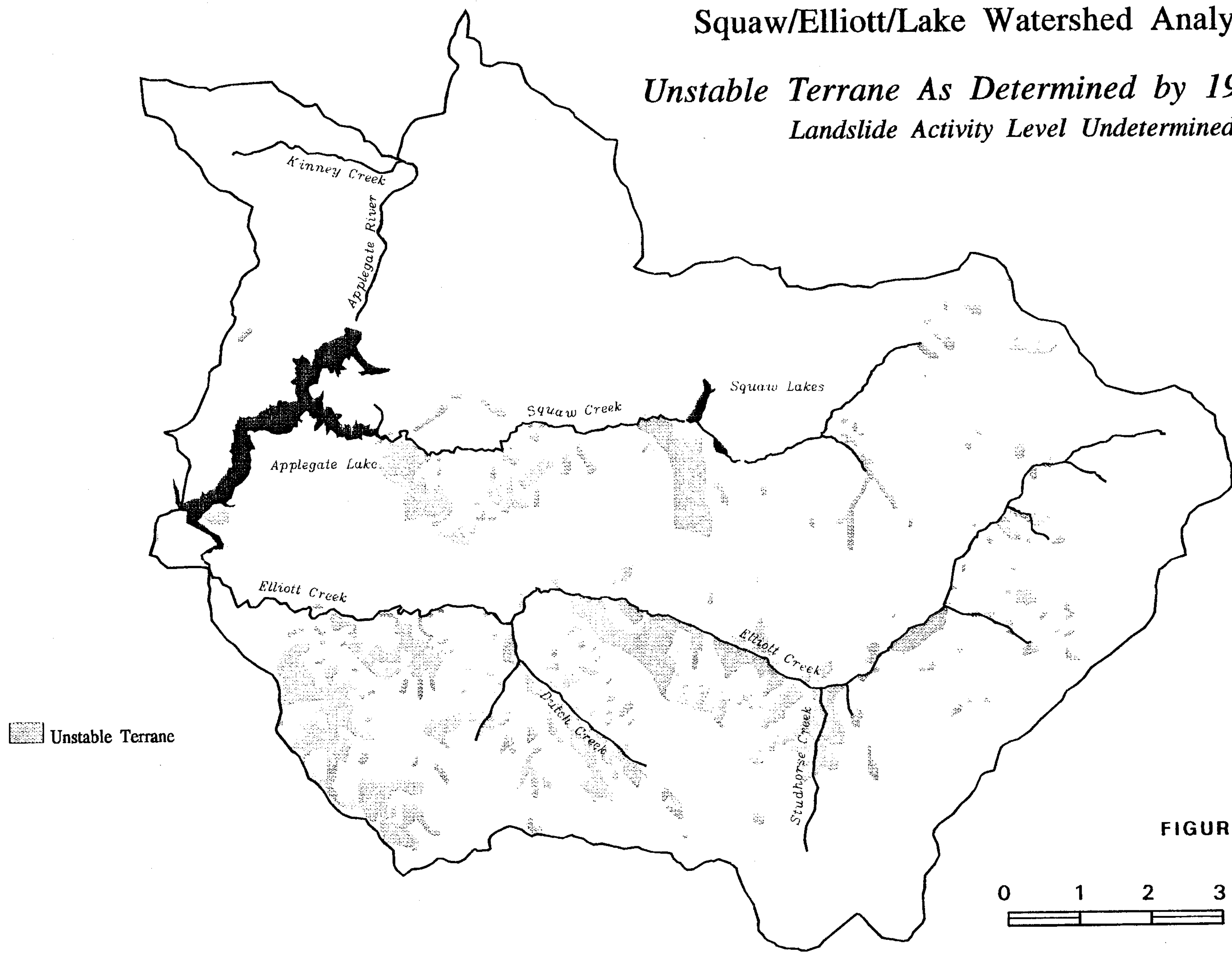


FIGURE A-11

Refer to site specific detailed slope stability mapping on file for the exact locations of Landslide Hazard Zones and other landslide features.

12. Mineral Resources

Metallic Mineral Resources

Refer to Figure A-12 which shows the location of known mines/prospects and the metals being pursued. Gold and copper are the two metals of historic significance that have been mined in the Analysis Area. The Blue Ledge and Tin Cup mines are located in headwaters of the Joe Creek basin. The Blue Ledge Mine was a particularly important producer of copper, along with lesser amounts of gold and silver, during the late 1800's and early 1900's. The mines were patented and became private land in 1912. As recently as 1984 there was core drilling at these sites by a mining company assessing potential for renewed mining activity spurred by elevated gold prices.

The Blue Ledge/Tin Cup ore deposits are known as massive sulfide deposits. They were created millions of years ago during the original deposition of shallow marine sediments of the Condrey Mountain formation. The minerals were generated at crustal plate spreading centers where metals and sulfur combined in upwelling geothermal waters erupting onto the ocean floor.

Gold production from historic mining has been predominately associated with placer gold deposits found along Elliott Creek. The Cobb Mine along Elliott Creek contains patented mining claims and is intermittently mined on a small scale basis. Nearby the Cobb Mine is found the Boggs Mine which was operated by hydraulic and ground sluicing techniques.

Small scale underground gold mining/prospecting also occurred at: the Grubstake Mine, Grouse Creek, Stringtown Gulch, Bloomfield Pass, and at the confluence of Slick Taw Gulch and Squaw Creek. In addition, small mines for antimony and gold are located in Kinney Creek and Kanaka Gulch. A small mercury mine and processing site is located near the confluence of Lyman Creek and Doe Hollow.

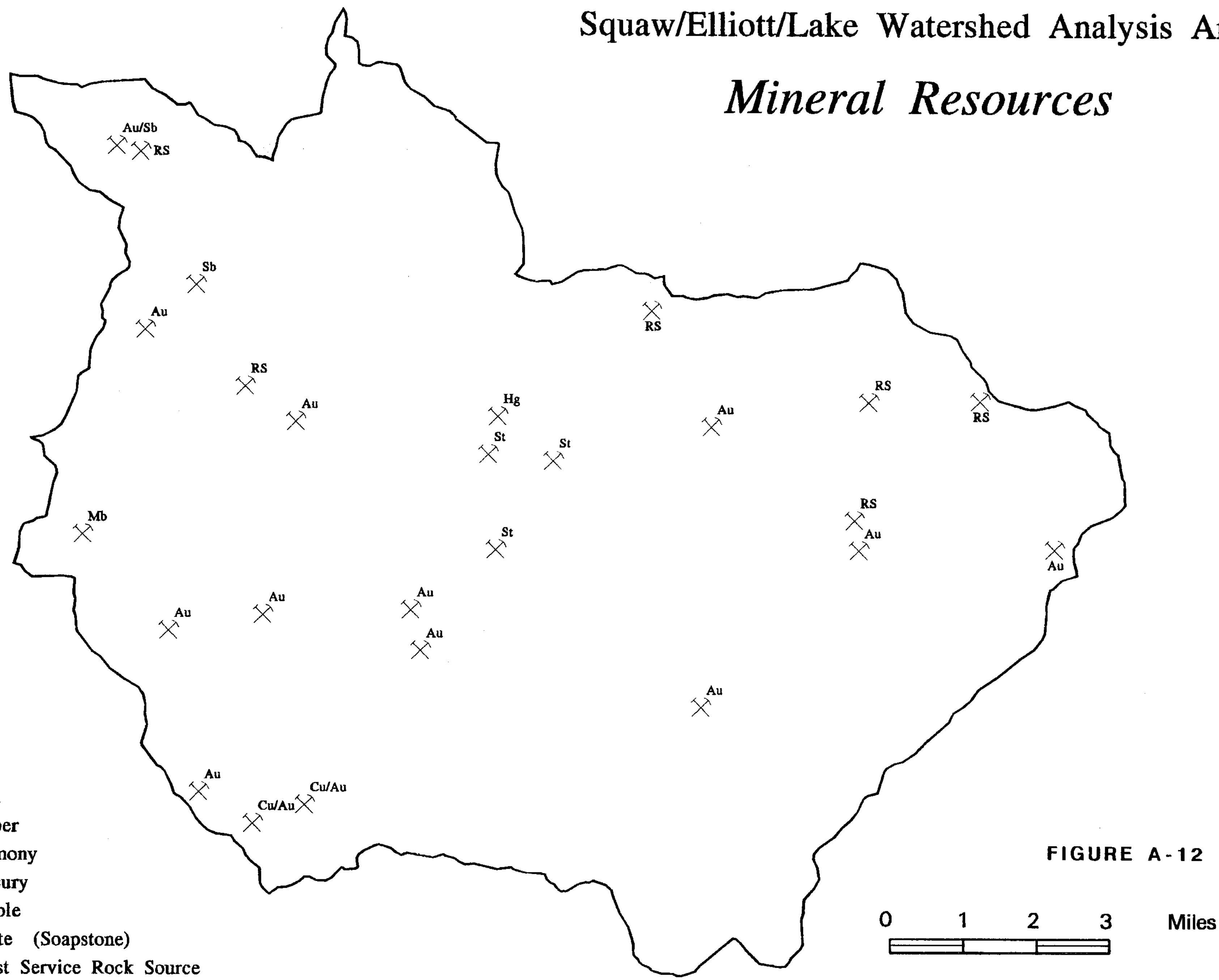
Nonmetallic Mineral Resources

The location of nonmetallic mineral mines are also shown on Figure A-12. There are numerous unpatented mining claims for soapstone (steatite) which are currently being mined along Elliott Creek Ridge between Mingo Gap and Summit Lake. There are additional actively operating sites adjacent to and downstream of Squaw Lakes. These deposits consist of hydrothermally altered forms of peridotite that contains various forms of talc minerals. The steatite is selectively mined in small open pit excavations. The miner sells blocks of the soft stone which are then carved to create ornamental art works. Recent evaluation suggests that if an application is made by the claimant, these claims could be granted patent status.

A small deposit of marble located at the junction of where Elliott Creek Ridge meets the Applegate Lake. The open pit mine was producing ornamental stone but has been inactive since the reservoir was completed.

Squaw/Elliott/Lake Watershed Analysis Area

Mineral Resources



Au - Gold
Cu - Copper
Sb - Antimony
Hg - Mercury
Mb - Marble
St - Steatite (Soapstone)
RS - Forest Service Rock Source

FIGURE A-12

Aggregate Resources

Rock quarries currently operated by the Forest Service within the Analysis Area are likewise shown on Figure A-12. A review of this map shows that there is a notable lack of rock within the Condrey Mountain formation that is suitable for road aggregate. This is significant because this region is where rock for road surfacing and buttressing is most needed. The cost for extensive rock haul from outside of the Condrey terrane is substantial.

The following lists the currently active rock pits that are used within the Analysis Area. The potentially available volume and comments/limitations are also given.

Table A-3: Existing U.S. Forest Service Rock Sources

Rock Source	Potential Volume (cubic yards)	Comments
Kinney Creek	5,000	Good quality, needs expansion for additional rock.
French Gulch	100,000	Good quality, stock pile is below highwater level of Applegate Lake much of the year.
Squaw Mountain	10,000	Marginal quality, Siskiyou Mtn. Salamander potential habitat on north slope limits expansion.
Maple Dell	75,000	Good quality, no additional rock available without expansion.
Yellowjacket	30,000	Marginal quality
Silver Fork	25,000	Good quality, 1/8 mile outside the Analysis Area, needs expansion to provide additional rock.

13. Future Trends

A number of factors suggest that the trend for initiation of human-induced earthflows will sharply decline. A large proportion of timber access roads have already been constructed, reducing the possibility that earthflows could be triggered by new road construction. Extensive timber harvesting has already occurred and trees are becoming well established in many areas that were previously cleared of vegetation.

The identification of unstable or potentially unstable terrain on Forest Service administered lands within the Analysis Area will trigger requirements in the Land and Resource Management Plan to utilize detailed landslide mapping and hazard identification prior to implementing project plans. Programmed timber removal from this terrain would only occur in stable areas under the restrictive guidelines for management in sensitive terrain (see Management Strategy 21, Land and Resource Management Plan).

Active earthflows and those areas deemed likely to become reactivated would be classified as unsuitable for timber production. However, under the provision of this Adaptive Management Area, it is possible that some experimental timber density management may be attempted in sensitive terrain portions of the Interim Riparian Reserves where the intent is improvement of forest health. The objective at these sites would be to create healthy stands that help to maintain long term slope stability. Detailed geologic field mapping, close coordination with silviculturalists and other forest specialists and monitoring for effectiveness would be required for implementation. Additional management considerations for project level work will be provided by an engineering geologist assigned to the area.

Under the standards and guidelines described in the Aquatic Conservation Strategy, riparian restrictions on timber harvest located adjacent to earthflows would act to buffer potential impacts on unstable slopes.

With regard to expected impacts from human activities on debris slide occurrence, the same comments apply as stated previously for earthflows. That is, on Federal lands in-place regulations for protection of unstable or potentially unstable slopes will be applied to terrain susceptible to debris slides/flows. Appendix C gives some general guidelines for management consideration in designing projects in debris slide/flow terrain.

Watershed restoration activities can be expected to continue. These activities will concentrate on erosion control, slope and channel bank stabilization, reforestation, stand density management, road closures and drainage improvements. As a part of this effort, a Watershed Improvement Needs (WIN) inventory is currently being completed to identify and prioritize projects. Site specific surveys and investigations are needed to evaluate potential for stabilization of active landslides within the Analysis Area.

Appendix E contains descriptions of the current status of road right-of-way. It is important that prior to implementation of restoration activities that this appendix be reviewed to be assured that trespass onto private land or unauthorized activities is prevented. A map showing the location of trails and roads without existing right-of-way is on file for review.

Access and Travel Management planning for the Applegate Ranger District is scheduled for completion in the near future. This process is described in Appendix E. It is anticipated that this effort will identify road systems that are no longer needed for near-future management. It is likely that some road segments will undergo various levels of decommissioning. This could involve a wide range of treatments including, but not limited to, establishing maintenance free drainage systems, blocking the road entrance, or even obliteration and revegetation of the roadway. This program is expected to lessen impacts to the Analysis Area resulting from road associated acceleration of erosion and slope instability.

B. SITE PRODUCTIVITY

Three factors that define site productivity in general terms are soil porosity, topsoil, and organic matter. For the Squaw/Elliott/Lake Watershed Analysis, the discussion of site productivity will focus on soil porosity. Topsoil loss through mass wasting and surface erosion is discussed in the Appendix A, Geology and Geomorphology. The analysis of soil organic matter would require more resources and time than was available to complete this Watershed Analysis.

1. Soil Porosity Analysis

For reference, a discussion of the relationship of porosity to site productivity, can be found in the Long Term Site Productivity Analysis (pages 2 through 7), completed with the Little Applegate Watershed Analysis. Soil porosity is strongly affected by ground based logging equipment, such as tractors and skidders, which will compact the soil under most conditions. In this assessment, the aerial extent and location of compacted areas is evaluated.

The purpose of documenting the present condition of soil compaction for this Watershed Analysis is to identify areas that might have cumulative watershed problems, identify areas for possible restoration work, and for use in future timber sale planning.

The **method of analysis** used 1:400 county mylar aerial photographs flown in 1991 to determine the amount of a harvest unit in skidtrails. From the District's Managed Stand Layer in GIS, units were identified that showed signs of ground based skidding. Using a 64 dots/inch grid placed randomly on these units, the number of dots landing on observable skid trails were counted on a total of two square inch area. This number was divided by 128 to obtain the percentage of area estimated to be in skid trails. Each unit was assigned a skid trail percentage class (0-9%, 10-19%, 20-29% etc). Data was entered into a GIS database for display (Figure A-13) and summarized (Table A-4). Only Forest Service lands were evaluated. Since the photos were taken in 1991, ground disturbing activities that occurred after 1991 were not documented in this assessment. Measurements were made by Rudy Weidenberg, with the help of David Arthur and David Steinfeld.

Table A-4 displays the overall area of the Watershed Analysis Area in skidtrails. The "moderate" and "high" categories displayed in Table A-4 exceed the Forest Service Regional standards of 20% for allowable soil disturbance (Forest Service Manual 2500-90-1, 8/1/90) and thus indicate that these sites are likely to have undergone a significant reduction in site productivity. These sites would be expected to produce a lower yield of timber for at least one rotation.

Table A-4: Skidtrail Disturbances before 1991

Skid Trail Class	Disturbance Rating	# Acres	% of Watershed
10-19%	Low	1,698	2.3
20-39%	Moderate	3,229	4.4
>40%	High	230	.3

Compaction on skidtrails does not occur uniformly across the Watershed Analysis Area. Figure A-13 displays a pattern of higher density in the eastern half of this Analysis Area. It is primarily associated with the gentle to moderate steep slopes typical of the Earthflow Black Schist Landscapes and to a lesser extent the Subdued Metavolcanic Landscapes and Glaciated Headlands.

The concentration of skidtrails is especially high in the Upper Squaw, Upper Elliott and Joe subbasins; this could play some role in the hydrology and stability of these areas (see Appendix A, Geology and Geomorphology and Hydrology). Surficial water intercepted by skidtrails can decrease the delivery time to the stream system, thus increasing the amount of flow that normally would occur during these events. Intercepted water can be moved into areas that are not adjusted to an increased in water, causing gullies or increased localized instability. This would be of most concern in the Earthflow Black Schist Landscapes. Conversely a quicker delivery time, could also reduce the amount of water that enters earthflows, reducing pore pressure and possibly increasing stability.

Although soil porosity analysis did not cover private lands which comprise approximately 15 percent of that analysis area, a cursory view of high elevation aerial photo quads show that private lands have had as much or more disturbance from ground based equipment as the Forest Service lands.

Limitations of Aerial Photo Analysis: A central assumption in this analysis is that any skid trail that can be seen on a present day aerial photograph is in a condition where the bulk density has increased by at least 15 percent over its undisturbed natural range. This condition is also referred to in the Forest Service Manual as "detrimentally compacted". This assumption has some limitations because on many older sites, trees and other vegetation can visually conceal compacted soils.

This analysis is also limited by what can be accurately interpreted from low elevation aerial photographs. The skid trail categories are broad enough that minor inaccuracies are probably not significant. The greater limitations of this analysis centers around the questions, how compacted are these skidtrails and how quickly do compacted soils recover. Research on volcanic soils has indicated that recovery to a natural condition can take about 70 years (Froelich et al 1983). Wert and Thomas (1981) working in the Oregon Coast Range found that in the areas logged thirty two years prior to their study, soils were still compacted at 8 to 12 inches while the surface soil had recovered. This gives us some idea about how the soils derived from metavolcanic soils might recover. But schist soils have not been investigated and because of their uniqueness, might not respond similarly to volcanic soils. To understand schist soils will require soil monitoring of bulk density and soil strength on selected sites.

Squaw/Elliott/Lake Watershed Analysis Area

Skid Trails

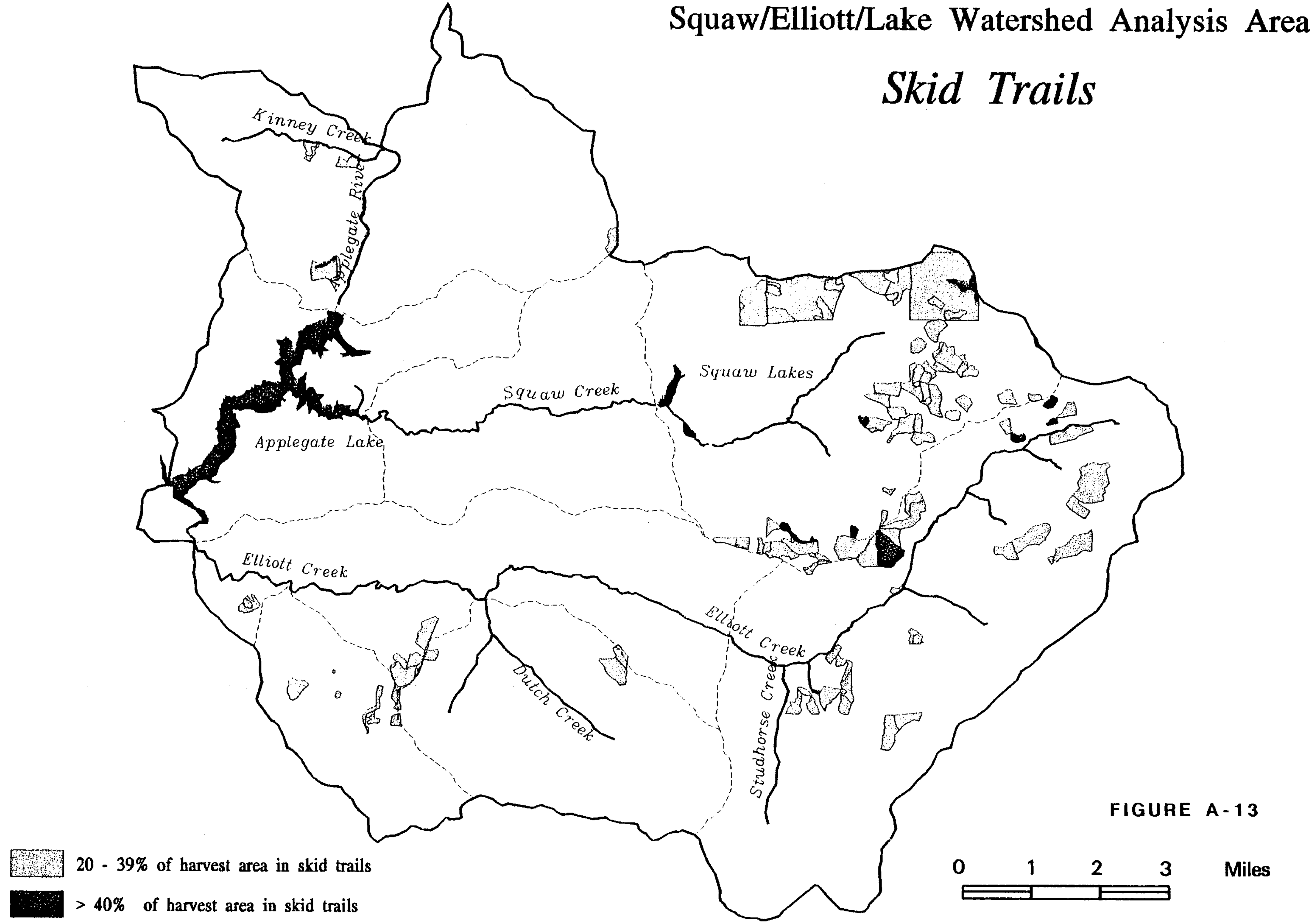


FIGURE A-13

2. Management Strategies

The Standards and Guidelines in the RRNF, LRMP allow up to 20 percent of a unit to be in a compacted, puddled or displaced state. Under most conditions, helicopter, skyline and hi-lead yarding systems will not exceed these soil disturbance standards, but with uncontrolled high ground-pressure equipment, they will almost always be exceeded. Froelich (1981) estimates that between 18 and 36 percent of an area is typically compacted under these conditions. However, on certain landscapes and soils, 20 percent allowable compaction might be too high from a watershed standpoint, especially on the Earthflow Black Schist and Subdued Metavolcanic landscapes.

3. Restoration Strategies

The probability of restoring an abandoned road surface and cutbank to previous productivity levels is nearly impossible since topsoil, organic matter and porosity have been removed or reduced. Bringing these sites back to some level of productivity is still possible, yet how this is accomplished and to what degree should not be based on site productivity alone but hinge on the objectives of other benefiting resources such as watershed improvement, wildlife habitat and range improvement.

The most common method of obliterating skid trails and road surfaces has been the use of the subsoiler. If used in the right conditions, this tool can reduce compaction. Unfortunately the lasting effects of this operation are not well understood, especially the restoration of roads and skidtrails on schist soils. Since schist soils lack clays that bind soil particles together, subsoiling these soils might be beneficial and long lasting.

Experience with agricultural soils at J. Herbert Stone Nursery has shown that subsoiled soils will revert to their pre-subsoiled bulk densities within a year unless the site is fully vegetated and the soil is occupied by roots.

C. TERRESTRIAL VEGETATION

The Squaw/Elliott/Lake Watershed Analysis Area contains a wide range of vegetation types. Elevation in the Analysis Area ranges from approximately 1,800 feet at Flumet Campground to 7,418 feet on top of Dutchmans Peak. Soils in these watersheds are very diverse, developing from three different geologic parent materials (Appendix A, Geology and Geomorphology). A multitude of topographic features and disturbance mechanisms within this vast 60,000 acre Watershed Analysis Area, further accounts for this high diversity of vegetation.

1. Vegetation Zones

The Squaw/Elliott/Lake Watershed Analysis Area is comprised of four vegetation zones. Beginning at the lowest elevation and extending to approximately 2,500 feet is the **Interior Valley Zone**. This zone includes forest stands and savannahs dominated by Oregon White Oak, California Black Oak and Pacific madrone. South slopes include savannahs occupied by grass and "brushfields" of Ceanothus and manzanita spp. Douglas fir is the dominant conifer in this zone. Ponderosa pine, sugar pine and incense-cedar are common associates. Above this zone extending to approximately 4,500 feet is the **Mixed Evergreen Zone**. "The landscapes of this zone are made up of a complex mosaic of habitat and vegetation types reflecting environmental mosaics since the last disturbance." (Jerry F. Franklin 1979). On north slopes, this zone is dominated by Douglas-fir. Hardwoods present may include Pacific madrone, canyon live oak and golden chinquapin. Associated conifers often include ponderosa pine, sugar pine, incense-cedar and white fir at the highest elevations. On south slopes ponderosa pine is often the dominant conifer with incense-cedar, sugar pine and Douglas-fir as associates. Hardwoods including canyon live oak and madrone with manzanita spp. and poison oak shrubs are common at the lower elevations. Ponderosa pine stands extending up to 6,000 feet on south slopes are found within this zone. The **White fir zone** extends from approximately 4,500 feet to 6,000 feet. On north slopes white fir is found at the lower elevation range. Associated conifers may include Douglas-fir, sugar pine and ponderosa pine and at the higher elevations it includes Shasta fir. The **Shasta fir zone** begins above approximately 6,000 feet. This zone is not distinct by elevation and appears to be correlated more with the cooler east and north high elevation areas, which usually maintain heavy snowpacks through winter and early spring.

2. Site Potential

Site potential within these watersheds is highly variable. The Interior Valley Zone includes poor sites with rocky, droughty stands that are Site Class V. The Mixed Evergreen and White Fir Zones on north aspects and deep soil/riparian areas include very productive sites (high Site Class III). The southern portion of the watershed area, where the soils are formed from mica-shists, has the highest site potentials. Here the ridge tops and south slopes support conifer stands dominated by ponderosa pine. Whereas the adjacent areas to the north (same elevation and aspect), which have soils derived from metamorphic or igneous rocks can only support grass savannahs and "brushfields" dominated primarily by manzanita spp.

3. Distribution of Successional Stages

Table A-5 displays the current distribution of successional stages for this Analysis Area. The high percentage of the early successional stand component reflects the lack of natural fires (fire exclusion) over the past 90 years. The low percentage of the late successional stand component is due largely to the harvesting of the higher value, mature stands both on private and federal land over the past 50 years. The mature component of ponderosa and sugar pines has also been significantly reduced by bark beetles.

Table A-5: Acres of Successional Stages by Subbasin

Subbasins	**Grass, Rock,& Water**	**Shrub**	**Seeds & Saps**	**Early Successional**	**Mid-Successional 11" - 16.9"**	**Mid-Successional 17"-24"**	**Late-Successional**
Upper Elliott	865	839	816	4,943	2,777	4,712	1,749
Lower Elliott	416	118	568	3,123	3,092	2,181	1,308
Upper Squaw	460	160	1,183	2,958	2,156	2,931	2,098
Lower Squaw	93	208	720	695	2,181	2,340	750
Lake	1,144	220	85	1,292	2,317	2,103	419
Dutch	93	287	170	850	990	2,817	1,833
Kinney	141	86	121	973	1,053	1,442	455
Joe	48	252	472	382	1,169	979	419
Mule	441	191		1,765	1,567	1,993	285
Total Acres	3,701	2,361	4,135	16,981	17,302	21,498	9,316

For this analysis, successional stages were defined according to stand structure, rather than stand age. Late-successional stands were defined as stands dominated by conifers at least 24 inches in diameter at breast height. The mid-successional stands were separated into two categories; young stands 11-16.9 inches in diameter and older stands 17-24 inches in diameter. The early successional stands are defined as small sawlog to pole stands 5.9-10.9 inches in diameter.

4. Disturbance Mechanisms and Vegetative Health

The general health of vegetation throughout most of the Watershed Analysis Area is poor. Species diversity, which historically has provided the backbone for the health of these ecosystems has either been reduced or is in jeopardy of being lost over much of the watershed.

a) Fire Exclusion & Drought

Historically, fire has been the primary natural disturbance mechanism throughout these watersheds as well as in Southwest Oregon and Northern California. Fire exclusion since the early 1900's has led to high vegetation densities, causing extreme competition for moisture, nutrients, and growing space. In the past decade, mortality rates have dramatically increased. Both the large tree components of the stands and the conifers growing near the valley floor, at the lowest forested zone, have experienced severe mortality. Southwest Oregon has been in a drought for the past 9 years, which has contributed to the recent increase in tree mortality. In 1988-1989 the drought was severe in the local area, resulting in high mortality in the older stands, particularly those with a large sugar pine and ponderosa pine tree component. In many stands the large sugar pine and ponderosa pine trees experienced near total mortality due the drought and subsequent bark beetle attacks.

Prior to the current drought cycle, the area experienced a 48 year period of above average precipitation, from 1937 to 1985, in which vegetative growth increased. The resulting competition for moisture compounded by the effects of fire exclusion and the current drought have brought on very low tree vigor due to moisture stress. This condition is most severe in the Interior Valley and the Mixed Evergreen Zones, white fir and Douglas-fir now exist at lower elevations than found in historic stands. In the lower elevation areas, below 2,500 feet, the stands are comprised of an overly dense understory of seedlings, saplings and pole sized Douglas-fir, and varying amounts of hardwood and brush species. Dead ponderosa and sugar pine trees are common. Ponderosa pine and sugar pine regeneration is generally absent, except on heavily disturbed sites with a viable seed source. The species diversity and associated forest health is at severe risk over nearly all the Interior Valley Zone and much of the Mixed Evergreen Zone. The ponderosa pine, sugar pine and California black oak component of many stands have been nearly eliminated. These species are at severe risk, particularly on south and west aspects. This zone also contains brushfields of manzanita and ceanothus species that are in very poor health.

The low timber line is literally moving elevationally further above the valley floor as high mortality rates continue. In this low forested zone the white oaks have survived and exist at much higher densities than were historically maintained by the natural fire regime. Insects (primarily bark beetles) and diseases are disturbance agents which are influencing the vegetation composition within these watersheds. Dwarf mistletoe infections, primarily in Douglas-fir and white fir, are having severe affects on both species longevity and distribution; on the moisture limited sites. Generally bark beetles are considered a secondary causal agent for tree mortality. The conifer forests of the area are stressed by increased competition for moisture and are becoming increasingly susceptible to insect and disease infestations.

b) Insect and Disease Conditions

A variety of insects and diseases are active in the Squaw and Elliott Creek Watersheds. Bark beetles, woodborers and dwarf mistletoe are the most noticeable, but white pine blister rust, other rust and canker fungi, root diseases, and stem and butt decays are also present. These organisms are having effects on the forest ecosystem at both the small and large scales.

Insects and diseases have significant roles in forest ecosystems. Along with other agents such as fire, wind and timber harvesting (and often acting together in "complexes") they create disturbances that trigger changes in the species composition, structure and densities of the vegetation.

The level of activity of insects and diseases in these watersheds has probably increased since the turn of the century due to the suppression of fire, the introduction of exotic pests and timber harvesting. In many natural stands the density of the vegetation is significantly higher than it was when early Euro-American explorers documented their travels. The recent drought has also contributed to decreased tree vigor. Single species, even-aged plantations of Douglas-fir and ponderosa pine are providing more uniform hosts for insects and diseases to attack. Harvesting with tractors has resulted in areas of compacted soil. Table A-6 displays a list of insects and diseases observed in the Squaw and Elliott Watersheds along with the tree species where each was seen.

Five needle pines, mountain pine beetles and white pine blister rust: There is extensive mortality among sugar pines in these watersheds caused by the mountain pine beetle (Dendroctonus ponderosae). In some areas, particularly at low elevations on the south-facing slopes of Elliott Ridge and Iron Hand, 1/3 to 1/2 of the overstory sugar pines have been killed by these beetles over the last ten years. White pine blister rust is present, but at low elevations the main factor predisposing the trees to beetle attack is competition for water. This has resulted from almost a century of fire exclusion and lack of stocking control in the understory of natural stands. The recent drought has intensified the competition for water. On moderate sites, sugar pines greater than 14" in diameter, more than 140 years old and those occurring in stands with basal areas greater than 140 sq. ft. per acre have a high risk of being attacked by mountain pine beetles. Today, almost all the natural stands in the Squaw and Elliott Creek watersheds are at high risk because of densities far exceeding this threshold.

At low elevations in these watersheds (below ~4000'), the effects of white pine blister rust (caused by the introduced fungus Cronartium ribicola) appear to be relatively minor. Above 4000' the effects become much more noticeable. The disease causes topkill and branch flagging of large sugar and western white pines and predisposes them to attack by mountain pine beetles. Seedlings, saplings and poles are killed outright. Mortality of young sugar and western white pines is particularly evident above 5500' between Big Rock and Jackson Gap. Clouds hang around the high ridges here during the summer and fall and provide the moisture that favors the spread of this disease.

At low elevations, where the blister rust hazard is relatively low, the large sugar pines that are killed by mountain pine beetles may eventually be replaced by natural regeneration if the stocking levels are controlled. However, at the higher elevations the chances that sugar and western white pines will be replaced by natural regeneration are poor because of the high levels of seedling mortality caused by blister rust. In these areas, rust resistant stock will need to be planted to maintain sugar and western white pines in the stands.

Ponderosa pine and bark beetles: There is widespread mortality in ponderosa pines of all size classes caused by western pine beetles (Dendroctonus brevicomis) and mountain pine beetles. Pines greater than 8" in diameter are at risk as long as the surrounding stand density is greater than 120 sq. ft. per acre, or they are surrounded by dense regeneration or brush. The potential for natural regeneration to replace the trees that have been killed over the last ten years is poor unless openings are created and stand densities are controlled. Without stocking control, the ponderosa pine plantations will also be at risk of attack by these bark beetles in the future when they reach the size and density to become susceptible.

Woodborers, Douglas-fir beetles and fir engraver beetles: Woodborers in the family Buprestidae and the Douglas-fir beetle (Dendroctonus pseudotsugae) are killing many pole size and larger Douglas-fir, particularly on south-facing, low elevation sites. The fir engraver beetle (Scolytus ventralis) and woodborers are responsible for much of the mortality of white fir. Trees are predisposed to attack by a number of agents, including drought, dwarf mistletoe infection, root diseases and white fir broom rust (caused by the fungus Melampsorella caryophyllacearum). In low elevation, mixed hardwood stands on south aspects, Douglas-fir is probably growing on sites that are drier than optimal, even without considering the recent, prolonged drought. The number and density of Douglas-fir on these sites is probably higher than it was prior to organized fire suppression. White fir has also invaded the understories of stands on drier sites than it would have when ground fires were frequent.

Dwarf mistletoes: Dwarf mistletoes are most widespread and severe on Douglas-fir and ponderosa pine in these watersheds. They are also found on white fir and Shasta red fir. Arceuthobium douglasii, Arceuthobium campylopodum, Arceuthobium abietinum f.sp. concoloris and Arceuthobium abietinum f. sp. magnificae are, respectively, the species that infect these trees. On Douglas-fir, dwarf mistletoe causes growth loss, distortion, topkill and tree mortality. The effects are most severe when more than half of the trees' crowns are affected, or the infections are in the upper portions of the crowns. Many of the young Douglas-fir plantations in these watersheds have infected residual trees in the plantations or at the edges of the surrounding stands. The seedlings in these plantations have a high risk of becoming infected once they reach 10' in height. Seedlings that are infected at a young age have little chance of surviving to large sizes. Severe infections of ponderosa pine dwarf mistletoe are also causing growth loss and distortion and predisposing ponderosa pines to bark beetle attack.

On white fir and Shasta red fir, dwarf mistletoe often does not severely affect host vigor. However, in these watersheds dwarf mistletoe is contributing to decline and mortality in the true firs. This is due to the canker fungus Cytospora abietis invading and killing branches of most mistletoe-infected true firs in this area, especially at higher elevations. The loss of vigor in trees that are infected by this combination of dwarf mistletoe and Cytospora canker predisposes them to attack by the fir engraver beetle.

Root Diseases and associated bark beetles: Blackstain root disease, caused by the fungus Leptographium wageneri, and annosus root disease, caused by the fungus Heterobasidion annosum, occur in small, scattered pockets in this watershed. Laminated root rot, caused by the fungus Phellinus weirii has been found in the area of Studhorse Creek, near Scraggy Mountain. Armillaria root disease, caused by the fungus Armillaria ostoyae is probably also present in small pockets, although none was found during the roadside survey of the watersheds.

Blackstain root disease affects only Douglas-fir in western Oregon. It is associated with soil compaction and disturbance so it often occurs along roads, skid trails and at the edges of landings. Unlike the other root diseases, new infection centers of blackstain root disease are readily established by insect vectors. These insects (root feeding weevils and bark beetles) are attracted to wounded roots, stumps and thinning slash. The disease then spreads along the edges of established centers by root contact. These centers can enlarge much more rapidly than those caused by other root diseases (at a rate of 3-5 feet per year). In plantations this rate usually decreases substantially once the trees are 30 to 35 years old. However, individual trees that are growing in areas of compacted or disturbed soil will still be susceptible to infection at older ages.

Douglas-fir and white fir are the two species most readily infected and killed by laminated root rot. Other conifer species may be infected, but are not often killed. However, these other species can perpetuate the disease on the site. The fungus can also survive for up to 50 years in large stumps. Susceptible hosts become infected, regardless of their vigor, when their roots contact infected material. Thus, over many years the disease spreads around the edges of an infected area as new root contacts are made.

Within infected areas the disease will persist as long as susceptible hosts are present.
The incidence and impact of blackstain root disease and laminated root rot may increase in the future due to the large number of Douglas-fir plantations in this watershed. Both diseases are probably present in locations that have not yet been identified. Seedlings will die when their roots contact stumps infected by the laminated root rot fungus, or when stressed trees are attacked by the beetles that carry spores of the fungus responsible for blackstain root disease or when they contact the roots of other infected trees. The impact of blackstain root disease should eventually diminish as the plantations age, as long as the infection centers regenerate with non-susceptible species and the surrounding trees are vigorous. However, the impact of laminated root rot will continue indefinitely, because host tree species of any age and vigor level are susceptible.

Annosus root disease is present in true fir stands at the higher elevations. This disease kills white and Shasta red fir seedlings and saplings that are adjacent to large, infected trees and stumps. Older infected trees mainly develop butt rot. Annosus root disease spreads both via root contact and airborne spores. Spores can spread the disease to new sites by infecting fresh stumps, which then become a long term source of infection. The extensive partial cutting in true fir stands has provided conditions that will favor the spread of this disease from stumps to regeneration.

White fir and Douglas-fir are the most common hosts of Armillaria root disease, but all conifers and some hardwoods are also susceptible. This disease is often associated with trees that are under stress, such as white fir that have invaded dry sites. Healthy seedlings may also become infected if their roots contact infected stumps. However, in Douglas-fir plantations, susceptibility to this disease usually becomes much less once the trees reach about 25 years of age.

The Douglas-fir beetle, fir engraver beetle and woodborers are attracted to root disease weakened Douglas-fir and white fir. The root disease centers provide habitat for endemic populations of these beetles. Douglas-fir beetles in particular are often found in large Douglas-fir that have blown over after their roots were decayed by laminated root rot. Outbreak populations may result when the surrounding trees are stressed by environmental conditions or when large-scale windthrow events occur. The Douglas-fir pole beetle (Pseudohylesinus nebulosus) and Douglas-fir engraver beetle (Scolytus unispinosus) attack sapling or pole size Douglas-fir that have been weakened by root diseases or are under stress due to overstocking or soil compaction.

Stem and butt decays: Trees with decay caused by the fungi **Phaeolus schweinitzii, Phellinus pini and Echinodontium tinctorum** are scattered throughout mature stands in these watersheds. The heartwood of infected trees is attacked by these fungi, causing decay and eventual breakage. Phellinus pini invades the heartwood of Douglas-fir, ponderosa and sugar pines through living and dead branches or branch stubs. Echinodontium tinctorum also invades through small branch stubs on suppressed true firs, but seems to require subsequent wounding to develop. Regeneration that has been suppressed in the understory below infected trees is likely to have a high incidence of infection. Phaeolus schweinitzii generally infects Douglas-fir (and occasionally pines) through basal wounds or fire scars. Infections can spread via airborne spores or root contacts. Conversion of many mature stands to plantations has reduced the incidence of these diseases from past levels. As the trees in these plantations age and develop heartwood, the incidence of decay will increase.

5. Implications of Insect and Disease Activity for Future Management

At endemic levels, the activities of insects and diseases are responsible for many of the small openings in the forest. These are where small-scale changes in species composition, structure and density take place that bring about the mature, transition and shifting-gap stages of old-growth forest development. Large conifers killed by insects and diseases are a source of long-lasting, large, woody debris in riparian zones as well as throughout forested lands. Insects and diseases are responsible for many of the platforms, cavities, snags and down logs utilized by many species of wildlife. Some of these species such as ants, spiders, woodpeckers and other insectivorous birds and small mammals are natural enemies of the insects that feed on trees. These natural enemies do not control outbreak populations of insects, but play an important role in limiting their numbers at other times.

At higher levels of activity, insects and diseases can have profound effects on species composition, stand structure and stocking levels that may interfere with management objectives.

The widespread loss of large sugar and ponderosa pines due to the western and mountain pine beetles is a good example of the effect insects can have on the ecosystem, particularly in terms of species composition and stand structure. As these large trees are removed from the ecosystem the values they provide for wildlife habitat, large, long-lasting woody debris and timber products are also being lost.

Controlling the density around the remaining large sugar and ponderosa pines will be necessary if it desirable to keep more than a remnant of these trees in the Squaw and Elliott Creek watersheds. It will also be important to control stocking in the ponderosa pine plantations to prevent future bark beetle mortality. Bark beetles have killed large numbers of trees in overstocked pine plantations in other areas once they reached 50 to 80 years of age. Stocking control will be essential if these plantations are expected to develop into vigorous stands that will provide closed canopies for wildlife and acceptable growth rates for timber production.

Wood borers, Douglas-fir beetles and the fir engraver beetle will continue to attack Douglas-fir and white fir as long as these trees are under stress caused by environmental conditions or diseases. At low elevations and on south-facing slopes, it may be advantageous to favor other tree species. This is especially true where large, long-lived conifers are desired.

Where root disease centers are active and become large, it may be difficult to develop well-stocked stands of conifers that survive beyond pole size as long as the stocking is primarily Douglas-fir or white fir. This will affect the development of stands with large conifers and closed canopies that are desired in riparian and late successional reserves, as well as the production of timber. Large, active root disease centers with considerable blowdown, standing snags and dense regeneration contain large amounts of fuel that may contribute to hot fires. This may be of concern in riparian reserves where water quality is an issue.

Regeneration of root disease centers with pines and cedars (either natural or planted) will replace the susceptible species with trees that can survive to large sizes. In plantations where root diseases are present, the level of disease should be assessed before thinning. Where the level of disease is relatively low, it may be possible to manipulate species composition to minimize its impact. In severely affected plantations, it may be better not to thin if only highly susceptible species are present.

Dwarf mistletoe brooms, especially those in Douglas-fir, provide nesting and hiding cover for many small mammals and birds. The seeds of dwarf mistletoes are also a source of food. Severe infections, particularly in Douglas-fir and ponderosa pine, can result in growth losses and mortality. Trees that are severely infected early in life are unlikely to survive to large sizes that may be desirable in riparian or late successional reserves. Large brooms create fuel loads that increase the risk of crown fires. Growth loss and mortality can also be significant in true firs heavily infected with both dwarf mistletoe and Cytospora canker.

Broken snags and rotten wood caused by stem decays are very valuable as habitat and sources of food for many species of wildlife. They are also valuable contributors of large, woody debris in riparian reserves. Second growth stands that are managed in short rotations may not have time to develop the minimum diameter of decayed heartwood needed by cavity nesting species. On the other hand, stands that are managed in long rotations with multiple entries of cutting or underburning may have higher levels of stem decay than are currently present.

6. Summary

The insects and diseases that are present in the Squaw and Elliott Creek watersheds are responsible for both small and large scale changes in the species composition, stand structure and density of the forest. At endemic levels these small scale changes are an important part of the process through which old growth stands develop. Relatively recently, however, the combined effects of many years of fire exclusion, timber harvesting and drought have contributed to levels of insect and disease activity that in some cases, may have significant, large scale effects. This is now evident in many stands where large ponderosa and sugar pines were once common, but have been killed by western and mountain pine beetles. Douglas-fir and white fir, especially at low elevations, are also experiencing high levels of mortality caused by bark beetles and woodborers. They will continue to be attacked by these beetles as long as they are subject to stressful conditions caused by drought, dwarf mistletoe or root diseases. In the future, ponderosa pine plantations will be at great risk of attack by bark beetles unless stocking levels are controlled.

The potential that insects and diseases may have for significant effects on the development of stands in these watersheds should be accounted for during the analysis and planning process so that the goals and objectives of forest management can be met.

The staff of the Southwest Oregon Forest Insect and Disease Technical Center is available to provide additional information and assistance with watershed analysis and project level surveys and planning. Please call us at 858-6125, or contact us on the DG: R06F10D19A.

Table A-6: Insects and Diseases observed in the Squaw and Elliott Creek Watersheds 8/95

INSECTS	SCIENTIFIC NAME	SEEN ON
wood bores	family Buprestidae	Douglas-fir, white fir
mountain pine beetle	Dendroctonus ponderosae	white pine, sugar pine, ponderosa pine
western pine beetle	Dendroctonus brevicomis	ponderosa pine
Douglas-fir beetle	Dendroctonus Pseudotsugae	Douglas-fir
turpentine beetle	Dendroctonus valens	sugar pine
Douglas-fir pole beetle	Pseudohylesinus nebulosus	Douglas-fir
Douglas-fir engraver beetle	Scolytus unispinosus	Douglas-fir
fir engraver	Scolytus ventralis	white fir
DISEASES		
white fir dwarf mistletoe	Arceuthobium abietinum f.sp. concoloris	white fir
red fir dwarf mistletoe	Arceuthobium abietinuum f.sp. magnificae	Shasta red fir
Douglas-fir dwarf mistletoe	Arceuthobium douglasii	Douglas-fir
ponderosa pine dwarf mistletoe	Arceuthobium campylopodum	ponderosa pine
white pine blister rust	Cronartium ribicola	western white pine, sugar pine
Cytospora Canker	Cytospora abietis	shasta red fir, white fir
brown stringy rot	Echinodontium tinctorum	shasta red fir, white fir
annosus root disease	Heterobasidion annosum	shasta red fir, white fir
incense cedar broom rust	Gymnosporangium libocedri	incense cedar
blackstain root disease	Leptographium wageneri	Douglas-fir
white fir broom rust	Melampsorella caryophyllacearum	white fir
red-brown cubicle butt rot	Phaeolus schweinitzii	Douglas-fir
red ring rot	Phellinus pini	Douglas-fir, ponderosa pine
laminated root rot	Phellinus weirii	Douglas-fir, white fir
incense cedar mistletoe	Phoradendron libocedri	Incense Cedar

D. BOTANICAL RESOURCES

The Squaw/Elliott/Lake Watershed Analysis Area contains many disjunct populations of plant species. Plants found in the Great Basin, Sierra Nevada, Blue Mountains of northeast Oregon, and the Willamette Valley also are found here in small areas and limited numbers. Five of the twelve Rogue River National Forest botanical areas are within these watersheds which indicates the richness of the botanical resource here. Rare plants are scattered all through the watersheds in all types of habitats. Two type localities, sources of original type specimens, of rare plants are found within these watersheds.

1. Rare Plant Species

a) Species Present and Listing Status

Lands within the Analysis Area are located in Oregon and California. Rare plant species are tracked differently for these two states because some species are more rare in one state than the other. Fifty-one rare plant species have been found within the Analysis Area. Twenty-two of these species are currently listed as sensitive, eighteen are on the review list, and eleven are on the watch list. These species are:

Abies amabilis	Sensitive - California
Astragalus accidens var. hendersonii	Sensitive - Oregon
Calochortus nudus	Sensitive - Oregon
Castilleja schizotricha	Sensitive - Oregon
Cimicifuga elata	Sensitive - Oregon
Cypripedium fasciculatum	Sensitive - Oregon
Epilobium siskiyouense	Sensitive - Oregon/California
Erigeron petrophilus	Sensitive - Oregon
Eriogonum diclinum	Sensitive - Oregon (Watch List - Calif)
Haplopappus whitneyi ssp. discoideus	Sensitive - Oregon
C2 *Horkelia hendersonii*	Sensitive - Oregon/California
Lewisia leana	Sensitive - Oregon
Mimulus bolanderi	Sensitive - Oregon
Mimulus kelloggii	Sensitive - Oregon
Monotropa uniflora	Sensitive - California
Perideridia howellii	Sensitive - Oregon
Rhamnus ilicifolia	Sensitive - Oregon
Saussurea americana	Sensitive - California
Sedum laxum ssp. heckneri	Sensitive - Oregon (Watch List - Calif)
C2 Sedum oblanceolatum	Sensitive - Oregon/California
Sedum spathulifolium ssp. purdyi	Sensitive - Oregon
Triteleia laxa	Sensitive - Oregon
Allium bolanderi var. bolanderi	Review List - Oregon
3C *Arabis koehleri var. stipitata*	Review List - Calif (Watch List - Oregon)
Camissonia graciliflora	Review List - Oregon

Delphinium nudicaule	Review List - Oregon
Hesperevax sparsiflora var. brevifolia	Review List - Oregon
Hieracium greenei	Review List - Oregon
Isopyrum stipitatum	Review List - Oregon
Keckiella lemmonii	Review List - Oregon
3C *Lewisia cotyledon var. howellii*	Review List - Calif (Watch List - Oregon)
Lithophragma campanulata	Review List - Oregon
Lonicera interrupta	Review List - Oregon
Pinus sabiniana	Review List - Oregon
Polystichum lonchitis	Review List - California
Rubus pedatus	Review List - California
Saxifraga fragarioides	Review List - Oregon
C2 *Sedum radiatum ssp. depauperatum*	Review List - Oregon
Triteleia hendersonii var. hendersonii	Review List - California
Veratrum insolitum	Review List - Oregon (Watch List - Calif)
Allium campanulatum	Watch List - Oregon
Angelica arguta	Watch List - California
Cypripedium montanum	Watch List - Oregon/California
Erythronium citrinum	Watch List - California
Iris chrysophylla	Watch List - California
Lilium washingtonianum var. purpurascens	Watch List - California
Lilium wigginsii	Watch List - Oregon/California
Mimulus douglasii	Watch List - Oregon
Polystichum lemmonii	Watch List - Oregon
Smilax californica	Watch List - Oregon
Triteleia crocea	Watch List - Oregon/California

C2 = Category 2 Federal Candidate, need additional information in order to propose as Threatened or Endangered under the Endangered Species Act. **3C** = Taxa which have proven to be more abundant or widespread than previously believed and/or which have no identifiable threats.

A map of these locations is located in the Applegate Ranger District's Sensitive Plant files.

b) Survey Status:

Approximately 25% of the drainage has been surveyed for sensitive plant species fairly recently (within the past 5-7 years). Most of the unsurveyed area is within brushfields and forested areas. Rare plant species found within these watersheds can be separated between low (up to 4,000 ft) and high elevation when considering their ecological history. Pre-historically, low elevations burned more frequently and at higher intensities than higher elevations. Current conditions, from fire suppression for many years, provide much higher fuel loads and more intense fires than these species would normally have co-existed with.

c) Habitats Associated With Rare Plant Species:

The following table displays the types of habitats associated with rare plant species found in the Analysis Area.

Table A-7: Habitats Associated With Rare Plant Species

Habitat Types	Low Elevation	High Elevation
Moist-wet	*Cimicifuga elata, Lilium wigginsii, Smilax californica.*	Calochortus nudus, Lilium wigginsii, Perideridia howellii, Polystichum lonchitis, Saussurea americana, and Veratrum insolitum,
Dry-open	*Allium bolanderi var. bolanderi, Arabis koehleri var. stipitata, Astragalus accidens var. hendersonii, Camissonia graciliflora, Erythronium citrinum, Iris chrysophylla, Lewisia cotyledon var. howellii, Hesperevax sparsiflora var. brevifolia, Lilium washingtonianum var. purpurascens, Linanthus bakeri, Lonicera interrupta, Mimulus douglasii, Mimulus bolanderi, Mimulus kelloggii, Pinus sabiniana, Rhamnus ilicifolia, Sedum oblanceolatum, Sedum radiatum ssp. depauperatum, Sedum spathulifolium ssp. purdyi, and Triteleia laxa.*	Allium campanulatum, Angelica arguta, Castilleja schizotricha, Epilobium siskiyouense, Erigeron petrophilus, Eriogonum diclinum, Haplopappus whitneyi ssp. discoideus, Hieracium greenei, Horkelia hendersonii, Keckiella lemmonii, Lewisia leana, Lilium washingtonianum var. purpurascens, Polystichum lemmonii, Saxifraga fragarioides, Sedum laxum ssp. heckneri, Sedum oblanceolatum, Sedum radiatum ssp. depauperatum, and Triteleia hendersonii var. hendersonii.
Forest or Forest Edge	*Astragalus accidens var. hendersonii, Cypripedium fasciculatum, Cypripedium montanum, Delphinium nudicaule, Erythronium citrinum, Iris chrysophylla, Isopyrum stipitatum, Lilium washingtonianum var. purpurascens, Monotropa uniflora, Sedum radiatum ssp. depauperatum, and Sedum spathulifolium ssp. purdyi,*	Abies amabilis, Hieracium greenei, Lilium washingtonianum var. purpurascens, Lithophragma campanulata, Rubus pedatus, Sedum radiatum ssp. depauperatum, Triteleia crocea, Triteleia hendersonii var. hendersonii, and Veratrum insolitum

d) Appendix J species - Plant species from Table C-3 (ROD)

Vascular plants from Table C-3 (Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl) have been surveyed for within the Analysis Area. Of these species, Cypripedium fasciculatum and Cypripedium montanum have been located here. Not much is known about the other plant species from Table C-3 in these watersheds and they have not been surveyed for in any of the watersheds within the Squaw/Elliott/Lake Watershed Analysis Area. It is assumed that they generally grow in mature to late successional stage forests but some grow in a variety of forest types including mixed forests with hardwoods. All plant species in Table C-3 in survey strategies 1 and 2 need to be surveyed within these watersheds.

2. Botanical Areas

Five Botanical Areas within the Squaw/Elliott/Lake Watershed Analysis Area were designated in the 1990 Rogue River National Forest Land and Resource Management Plan. These areas are: Dutchman Peak, Observation Peak, Scraggy Mountain, White Mountain, and Lyman Creek/Doe Hollow. Information about these botanical areas as well as management guidelines are found in the management plan. The Lyman Gulch/Doe Hollow Botanical Area is the only low elevation Botanical Area on the Rogue River National Forest. It is an island of peridotite in the Squaw Creek watershed. The other four botanical areas are high elevation and along the high Siskiyou Crest.

The Land and Resource Management Plan states that management plans for individual Botanical Areas will be completed during the first decade. Five years into this decade, no management plans have been written.

Three Botanical Areas (Dutchman Peak, Observation Peak, and White Mountain) located on the Siskiyou Crest are adjacent to proposed botanical areas on the Klamath National Forest. Management of these areas should be coordinated with the Klamath National Forest to manage the ecosystem system as a whole.

3. Non-Native Plant Species

a) Non-native populations of local plant species:

No known non-native populations of local plant species have been introduced in the Analysis Area.

b) Non-native species:

Non-native plant species have been introduced within the watershed. Various grass species have been introduced in timber sale units, wildlife projects, and roadsides that were seeded for "forage replacement" as well as for erosion control. Land around the Applegate Lake was seeded with non-native species to mitigate loss of forage when the lake was created. Some of these areas are in very poor ecological condition.

Many lower elevation open grasslands are now a mix of native and introduced species (Elymus caput-medusae included). The suppression of native vegetation by cattle in the area causes the less palatable non-natives to increase more than the palatable preferred native grasses. In addition, human activities have caused non-native species to increase by disturbance to these areas.

Moist, high elevation meadows have been heavily grazed for over 100 years. Although cattle numbers are lower than early grazing years, wet areas scattered all over the high country are still greatly impacted. The high Siskiyou Crest is composed of open ridges in many cases which facilitates cattle drift between allotments as well as between the Rogue River and Klamath National Forests. Managing cattle use is very difficult because of this openness and difficulty in maintaining fences in heavy snow country.

Yellow star thistle is a major problem around the Applegate Lake and the lower part of Squaw Creek Road. This area is the largest concentration of star thistle on the Applegate Ranger District. This is a major problem in dry grasslands because the plants are so competitive with native plant species. Most star thistle sites in the Squaw and Elliott Creek watersheds are along roads. A few sites are located off-road; one is located at a trail junction one mile from roads in the Baldy Peak area and another was found off a road in a very disturbed white oak/grassland community. It appears that much of the star thistle spread has occurred along roads and been spread by road maintenance equipment and vehicles as well as animals and people.

Two sites of scotch broom are located within the area. One at the northern end of Applegate Lake and one in the lower Joe Creek area.

E. FIRE REGIME

Considering the unique vegetation and climate of Southwest Oregon, and the role of "fire disturbance" influencing the successional processes within the Siskiyou Range of the Klamath Mountains, fire management planning is a very important consideration in the analysis of watershed conditions and ecosystem health.

Landscapes and associated ecosystems are not static. Landscapes are dynamic and patterns change (sometimes radically) through time. The stability of the landscape character can be described by identifying the disturbance processes, natural range of variability and general trends. Fire is identified as the key natural disturbance mechanism shaping the landscape of the area, which the Squaw/Elliott/Lake Watershed Analysis Area is a part of. Therefore, a general characterization of the local fire regime will be presented for the entire Analysis Area.

The components of the fire regime to be discussed include: fire frequency (return interval), fire intensity, smoke production, and the extent and duration of fire. These components will be discussed in relation to the fire regime, both prior to and following the implementation of organized fire suppression which began in the early 1900s.

1. Fire Environment; Before Organized Fire Suppression

Vegetation and Fire

Before organized fire suppression began in 1902 for this area, fires within ponderosa pine vegetation communities were oftentimes described as frequent, low-intensity, ground/surface fires, spreading over periods of weeks or months in the Siskiyou Mountain forests (James K. Agee; 1993).

Generally, fire maintained a set of vegetative conditions, particularly for a pine dominated/hardwood stand characteristics. Pine dominated forests had little dead and down woody fuel on the forest floor, and fewer standing dead snags as compared with today. From old photo points taken at the turn of the century, it is estimated that much of the area within the Mixed Conifer and Interior Valley vegetation zones have 5 times the vegetation today as compared with 95 years ago. On slopes outside of riparian zones (which did not burn as frequent due to higher moisture regimes) there was much less understory vegetation. Specifically, "Low elevation sites burned more frequently than higher elevation sites, mostly as a result of more frequent low-severity fires." (Peter J. Morrison and Federick J. Swanson; May 1990) On a landscape basis fires were estimated to result in stand replacement for about 20% of an area. "The intensity of pre-settlement fires encompassed a wide range of fire severity with many fires, or large portions of them, burning at low to moderate severity" (James K. Agee; 1993).

"In the Klamath Mountains further south, Atzet and others (1982) report fire frequency ranging from 15 to 50 years..." A personal conversation with Tom Atzet concerning fire return intervals for the Siskiyou Mountain, Interior Valley Vegetation Zone interfacing with Ashland, Oregon within the Rogue Valley and the upper Applegate Valley indicated that the fire return interval for these areas was probably 8 to 10 years (Atzet, 1994). This represents fire return intervals on a landscape basis rather than site specific locations of fire frequencies.

Dead Fuels

Given this frequent fire return interval, Coarse Woody Debris (CWD) accumulations would not occur within the Mixed Conifer Vegetation Zone and Interior Valley Vegetation Zone (Siskiyou Mountains) to the same degree as the amounts that exist today (see Figure: 11 for a map displaying vegetation zones). Agee (1992) and others in published information (specific to the Klamath Mountain Province) within the Recovery Plan for Northern Spotted Owl - Draft, "In pre-settlement time, the log and snag density was likely lower than that at present because of frequent fires." Frequent low intensity fires consume a great deal of down coarse woody material. In relating to fire behavior, in order for fires to be low intensity ground/surface fires, there could not have been heavy concentrations of dead and downed fuel contributing to the fire intensity. Especially, given that most of these fires occurred during the months of August and September when fuel moistures are their lowest. Live woody fuels (trees, shrubs) were of much less density (on a landscape basis) at this time before organized fire suppression.

In addition, with low elevation sites burning more frequently than higher elevation sites, it can be assumed that the amount of downed CWD accumulations would be less in the Interior Valley and Mixed Conifer Vegetation Zones than would be expected at the White Fir and True Fir Vegetation Zones. As a result of low intensity ground/surface fires and frequent fire return intervals, recruitment for CWD was also low at the lower elevation sites. Fuels did not accumulate sufficiently to create high intensity fire that would kill trees creating snags and replacement wood. Fire worked more as a mechanism which maintained stands, especially the large tree component of more fire resistant species such as ponderosa pine.

Within riparian areas, wetlands and meseic sites, fires occurred less often resulting in lower levels of CWD as compared to the drier sites where fires occurred more often.

Smoke Production

The amount of smoke and particulates produced during wildfires (on a per acre basis) in the pre-fire suppression era, can be generally described as less when compared to wildfires burning in todays vegetative conditions. More bio-mass burning today would produce more smoke. The size of particulates of concern to human health, according to the EPA, are those that are 10 microns or less in size. Generally, when the combination of live and dead vegetation burns an estimated 50 to 75 pounds of particulate (10 microns or less in size) are produced per ton of vegetation burned. Over one hundred years ago, most fires were described as ground/surface fires (for sites located within the Mixed Conifer and Interior Valley Vegetation Zones) burning within much less vegetation as compared with today. It follows that with less vegetation on the landscape available for consumption, that fewer particulates were produced (on a per acre basis) when fires occurred, given relative fuel moisture conditions of comparison.

However, it must be recognized that fires burned throughout the summer months and smoke filled the Rogue Valley area until fire ending weather events, such as fall rains, occurred.

2. Fire Environment; After Organized Fire Suppression

Vegetation and Fire

A very different set of conditions exists today within the Fire Regime for southwest Oregon. Fires are described now in general terms, as: infrequent, inconsequential or extreme during extended duration drought, and not easily extinguished.

Fire results in "stand replacement" when fire occurs during dry weather conditions within dense vegetation with multi-layered canopies and heavy accumulations of dead and down fuels. Fuels (live and dead) have built up to an un-natural state due to fire suppression efforts over the last 90 years. According to specialist input for the AMA Forest Health Assessment, areas within the Analysis Area below approximately 3,500 feet in elevation are experiencing moisture stress brought about by competition and 9 years of drought conditions. This continues to increase tree mortality and the amount of CWD. This increase in CWD will contribute to fire intensity, increasing the chance of crown and stand replacement fires. Fires are now estimated to result in stand replacement for a greater portion of the area.

With rapidly moving crown fires the likelihood of downwind spotting from firebrand production well in advance of the "main fire head" is great. Consequently, considering fire fighter safety, suppression actions are not effective until a change in wind and relative humidity allows a change in fire behavior. Most large fire episodes for interior southwest Oregon occur during the months of August and September.

Dead Fuels

The amount of CWD required by the Standards and Guidelines of the ROD is not consistent with historic levels of CWD, or with site capabilities of the eastern Siskiyou Mountains of Southwestern Oregon. The paper "Distribution of Large Woody Material On the Rogue River National Forest" (McCrimmon and Atzet 1992) describes for specific plant series the amount of Large Woody Material (referred throughout this document as CWD) that exists today. They attempted to survey CWD at sites without "...previous disturbance history and could not factor out the effects. Thus we were left with the unpredictable variability associated with disturbance." That portion of their study within the Siskiyou Mountains measured the amount of CWD (both by tons and number of pieces per acre by size class) for areas undisturbed by previous management activity. Data from the study (252 plots) showed that even with fires excluded from burning dead vegetation (as a result of aggressive fire suppression for the last 90 years) the amount of CWD required by the ROD Standard and Guidelines may be difficult to achieve within Douglas-fir, ponderosa pine, and jeffrey pine series.

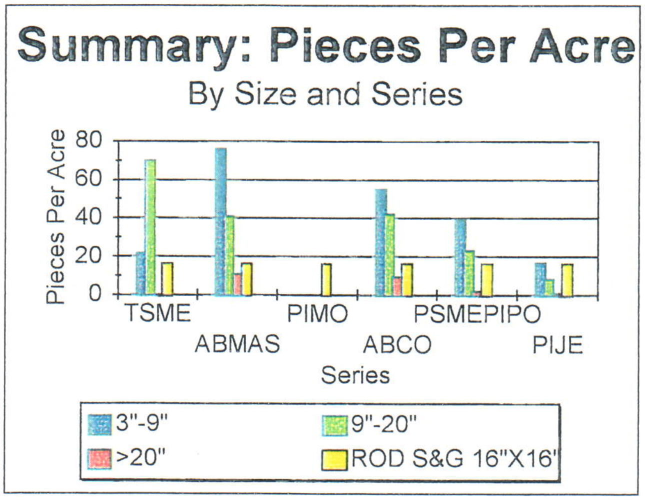


Figure A-14: Coarse Woody Debris Potential; Pieces Per Acre

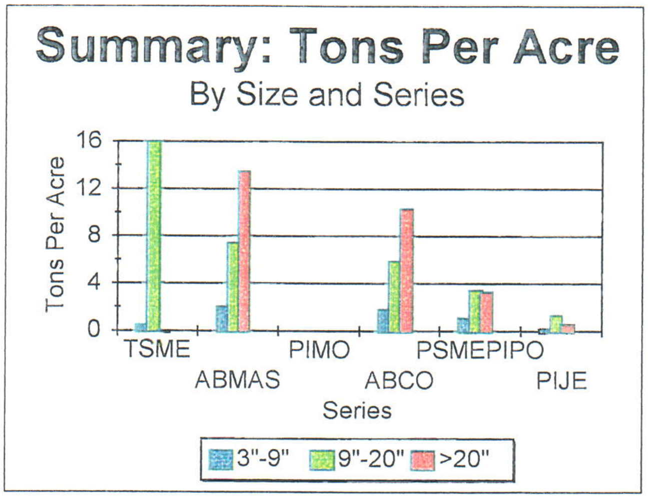


Figure A-15: Coarse Woody Debris Potential; Tons Per Acre

Key to four character forest series abbreviations: TSME = Mountain Hemlock; ABMAS = Shasta Red Fir; PIMO = Western White Pine; ABCO = White Fir; PSME = Douglas-fir; PIPO = Ponderosa Pine; PIJE = Jeffery Pine

3. Fire Risk and Fire Hazard

The following is an outline of the process steps and assumptions used in the development of the fire hazard and risk assessment for Squaw/Elliott/Lake Watershed Analysis. The wildfire potential across the landscape was characterized using a tested and universally supported method for calculating fire occurrence density, fire risk, and fire hazard. The fire hazard and fire risk assessment can provide insight from a landscape perspective as to the potential areas of concern to focus attention on fuels management, fire prevention and forest health issues. This can be of value when prioritizing areas for a more in-depth review and possible proposals for improving forest and watershed health. This process is a coarse filter assessment that will require refinement during project level planning, particularly for prescribed fire or fire hazard reduction.

Fuel Models

Assigning fuel models is the first step in developing fire hazard delineation. Vegetative conditions of the Analysis Area were assigned to National Forest Fire Laboratory fuel models. These models characterize major physical properties of vegetation and how they react to fire. The GRS satellite data and GIS were used to analyze vegetation and canopy closure information. Known locations of hazardous fuels, such as slash and conifer mortality, are then overlaid with vegetation data to assign fuel model conditions for the Analysis Area.

The fire spread model, which uses fuel models as one of its many input components, assumes the fire to be a ground/surface fire. Another assumption of the model is, the forward progress of the fire, for the projection period, is not impeded by suppression actions or a change in the fuel model. Many projections were made to evaluate the representative fuel models. The spread model and its assigned fuel models does not include crown fires and the spot fires resulting from crowning. Crown fire and spotting are considered in a separate process and is part of the fire hazard rating evaluation.

Another important consideration of fuel characteristics not addressed by the model is the influence of understory regeneration. Understory regeneration changes the "character" and behavior of wildfire dramatically as predicted from fire behavior modeling. Presence of an understory component in sufficient quantities would create ladder fuels which contribute to the potential of crown fire. Therefore, the assumptions of the fuel modeling system are adjusted to account for this; stands showing moderate hazard fuels (such as fuel model 8 and 9) are placed into a high hazard class when understory regeneration are present and contribute to canopy closures greater than 70% located on steep slopes. Detailed information on fuel model assignments is available for review in Appendix D.

Enhanced Fire Behavior

A fire starting late summertime, particularly in certain types of fuel conditions, would result in stand replacement. The more dead vegetation, either standing or on the ground, the greater the fire intensity. A combination of high density, multi-layered, closed canopy vegetation, with substantial amounts of dead wood, greatly increases the chance of high intensity crown fires that would result in stand replacement. Crown fire probability is based on the orientation of slope, aspect and overall drainage direction into the up valley/up slope winds. Fire hazard calculations used this adjustment: stands assigned fuel model 6 or 10 (see Appendix D for detailed information on fuel models), located on steep slopes greater than 40%, with northerly aspects facing the upslope and upvalley winds of the Rogue Valley, >70% canopy closure, are assumed to have an 80% chance of crown fire.

The enhanced fuel model 6 or 10, at certain elevations and aspects, are the same vegetative conditions that provide spotted owl habitat for this area. It will be difficult to maintain this habitat for the long-term, particularly at elevations below 4,800 feet, unless a systematic approach such as the re-introduction of prescribed fire and various vegetative management strategies are applied.

Topography

The next step in the process of evaluating fire hazard is determining the steepness of slope and aspect characteristics for the Analysis Area. Topographic characteristics are used in determining and comparing fire behavior applicable to each assigned fuel model, given a set of moisture and wind conditions. Three slope classes were used: 0-34%, 35-65%, and >65% for this analysis. Generally the steeper and more rugged the topography, the faster fires spread.

4. Fire Hazard Assessment and Map

Fire hazard is defined as vegetation by the kind, arrangement, volume, condition and location that forms a special threat of ignition, spread and difficulty of control.

A four layer process of overlaying an aspect map, slope map, and a fuel model map was used to develop a fire hazard map for the Squaw/Elliott/Lake Watershed Analysis Area (Figure A-16). Given the gross acres of the Analysis Area, the resulting ratings are provided on a landscape basis and are not intended to supersede site specific project level planning.

Each assigned fuel model is run through the BEHAVE program. The 90th percentile weather conditions from local records were used to model late summer afternoons of late July and August. The final process is the prediction of flame lengths, and rate of spread to determine the resistance to control. The crosswalk to fire hazard ratings takes place from the fire behavior outputs. Ratings of low, medium and high hazard are assigned.

Table A-8: Fire Hazard Assignment

Low	Flame lengths < 4 feet	Fires can generally be attacked at the head or flanks by persons using handtools. Hand line should hold the fire.
Moderate	Flame lengths 4 to 8 feet	Fires are too intense for direct attack on the head by persons using pumpers, and retardent aircraft can be effective.
High	Flame lengths >8 feet	Fires may present serious control problems, such as torching out, crowning, and spotting. Control efforts at the fire head will probably be ineffective.

Although flame lengths are generally used to define hazard it should be noted that some fuel models will have low flame lengths but extremely rapid rate of spread, which will place them into a higher hazard class. For example, some of the grass fuel models don't produce significant flame lengths, but their rate of spread exceeds 100 chains per hour on long steep slopes. This exceeds the ability of hand crews, or equipment, to make direct attack without air support.

Using the above analysis process for fire hazard determination, there are **54,925** acres of high fire hazard, **16,663** acres with moderate fire hazard, and **1,412** acres of low fire hazard, within the Squaw/Elliott/Lake Watershed Analysis Area.

5. Fire Risk Assessment and Map

Fire risk is defined as the chance of various ignition sources causing a fire, threatening valuable destructible resources, property and life. For the Squaw/Elliott/Lake Watershed Analysis, life, property and resources are the "Values at Risk".

Effective control of each source of risk requires knowledge of how it operates locally including when and where it is most likely to start fires. Wildland fire occurrence records (specific to the Squaw/Elliott/Lake Watershed Analysis Area) from the Applegate Ranger District, Oregon Department of Forestry, and the were used to develop a fire occurrence zone map. Lightning and human-caused fires occurring between 1960 and the 1994 fire season were used for this analysis. The graphs below display the results of fire history for the 34 year period analyzed.

Squaw/Elliott/Lake Watershed Analysis Area

Fire Hazard

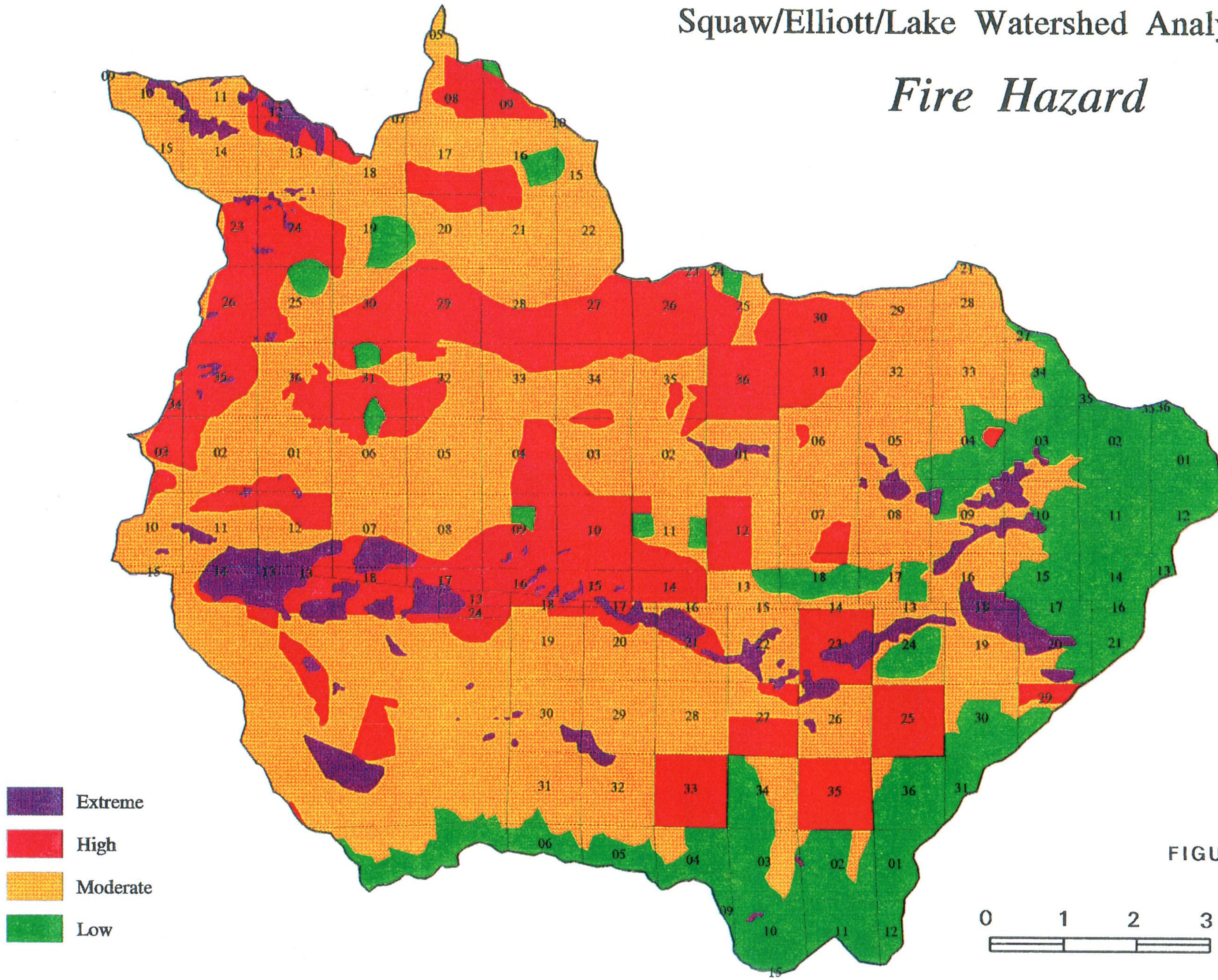


FIGURE A-16

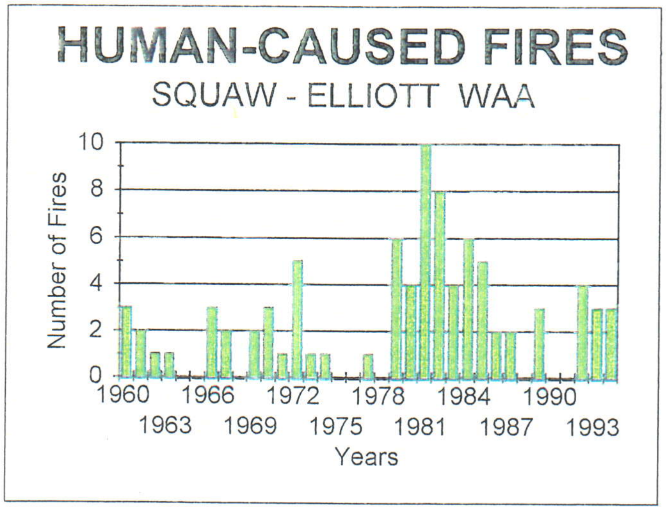


Figure A-17: Number of Human-Caused Fires

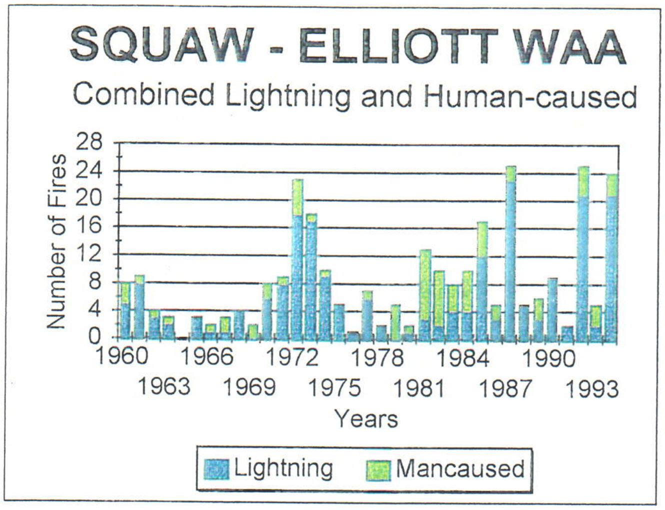


Figure A-18: Number of Human-Caused and Lightning-Caused Fires

Within the Analysis Area, for 34 years of fire records there were a total of 303 fires; 214 lightning and 89 human-caused ignitions.

The majority of the occurrences are lightning caused, predominately above 3000 feet, occurring on higher terrain within the Analysis Area.

The vast majority of the human-caused fires occurred within the lower 1/3 elevation of the watershed Analysis Area, primarily along road corridors, residential locations, and places of frequent outdoor recreation. Lightning-caused fires have burned the greatest number of acres within the Analysis Area for both the non-National Forest and National Forest portions. The

Applegate Lake Area has the highest occurrence of human-caused fires on the Rogue River National Forest.

Historically, the Analysis Area has experienced large fire episodes. The Kinney Ridge area has experienced documented and researched large fire episodes since the turn of the century. The year 1987 saw several project size fires managed by class II overhead teams. They were caused by lightning.

The Analysis Area has the highest per-thousand acres fire occurrence density rating for the Rogue River National Forest.

Based on the location of these fires, the fire occurrence zone map was developed to display high, moderate, and low zones of occurrence. These zones are established by grouping the fires based on their density:

Table A-9: # of Fires by Occurrence Zone

Low	Moderate	High	Total
2	38	263	303

From this information a fire risk rating was developed using the following formula. The formula used to calculate the risk numerical rating:

$$\{(x/y)10\}/z = \text{Risk rating}$$

where x = number of starts recorded for area from fire history records, y = period of time records cover (34 years for this analysis), z = number of acres analyzed (displayed in thousands)

Low Risk = .0-.49
Moderate Risk = .5-.99
High Risk = >1.0

Determination of rating by Occurrence Zone Risk of Ignition:
** See the attached Risk and Hazard Maps

Table A-10: Fire Risk Numerical Rating by Occurrence Zone

Occurrence Zone	Acres	# of Fires	Rating
Low	1,412	2	0.45
Moderate	16,663	38	0.65
High	54,925	263	1.41

The next step is to establish criteria for the values associated with the Squaw/Elliott/Lake Watershed Analysis Area which are threatened by wildfire. The most significant "Values at

Risk" for the Analysis Area are: life and property, watershed values, various wildlife habitats, various wildlife species, and Late-Successional Reserve sites. Other values at risk include natural resources such commercial forest lands, soils, fisheries and other wildlife habitats, and recreational values. Since a portion of the Analysis Area is located within rural/wildland interface, there is special emphasis for this Watershed Analysis on Life and Property.

The final step of developing the "Fire Risk Map" is through the intersection of values at risk with high, moderate, and low fire occurrence zones (Figure A-19).

Life, property, and resource values are the basis for risk ratings. Fire risk increases when fire occurrence increases within areas of high value associated with the land. High fire occurrence probabilities without high values associated with the land would result in a lower fire risk.

The most current maps of the forest/urban residence interface, showing where residential structures are located, do not show the housing developments of the last 15 years. Clusters of new homes within forested land, located on steep slopes with poor access have expanded outside of the urban residence area indicated on maps.

Where these values occur in combination with low fire occurrence and probability for ignition, the fire risk rating is medium.

6. Effects of Fire on Historic, Current, and Future Distribution of Wildlife Habitats

As discussed previously under Fire Environment, stand densities and structures, the amount and size of Coarse Woody Debris (CWD), and vegetative species composition was much different prior to organized fire suppression than is found today. The proportion of shade tolerant and shade intolerant vegetation has changed. Shade tolerant species have increased to the detriment of shade intolerant species. Fire intolerant vegetation species are increasing at the expense of fire tolerant species.

Snags, coarse woody, multi-layered canopies, prominent seral stages have all been changed over what would have prevailed during the pre-suppression era. Thus, habitat that may now appear today at the lower elevations of the interior valley zone and mixed conifer zone under current fire suppression (fire exclusion) strategies much different than when natural fire regimes occurred years ago.

Understory burning reduces dead fuel loads and vertical fuel continuity within a treatment area. Although this reduces catastrophic fire potential for some time, the elimination of a multi-layered understory may result in sub-optimum owl habitat for a treatment area. However, in the long-term it may be necessary to have vegetation conditions of less density and volume at some strategic locations, rather than risking catastrophic losses of habitat that may be critical to the viability of late-successional species.

Squaw/Elliott/Lake Watershed Analysis Area

Fire Risk

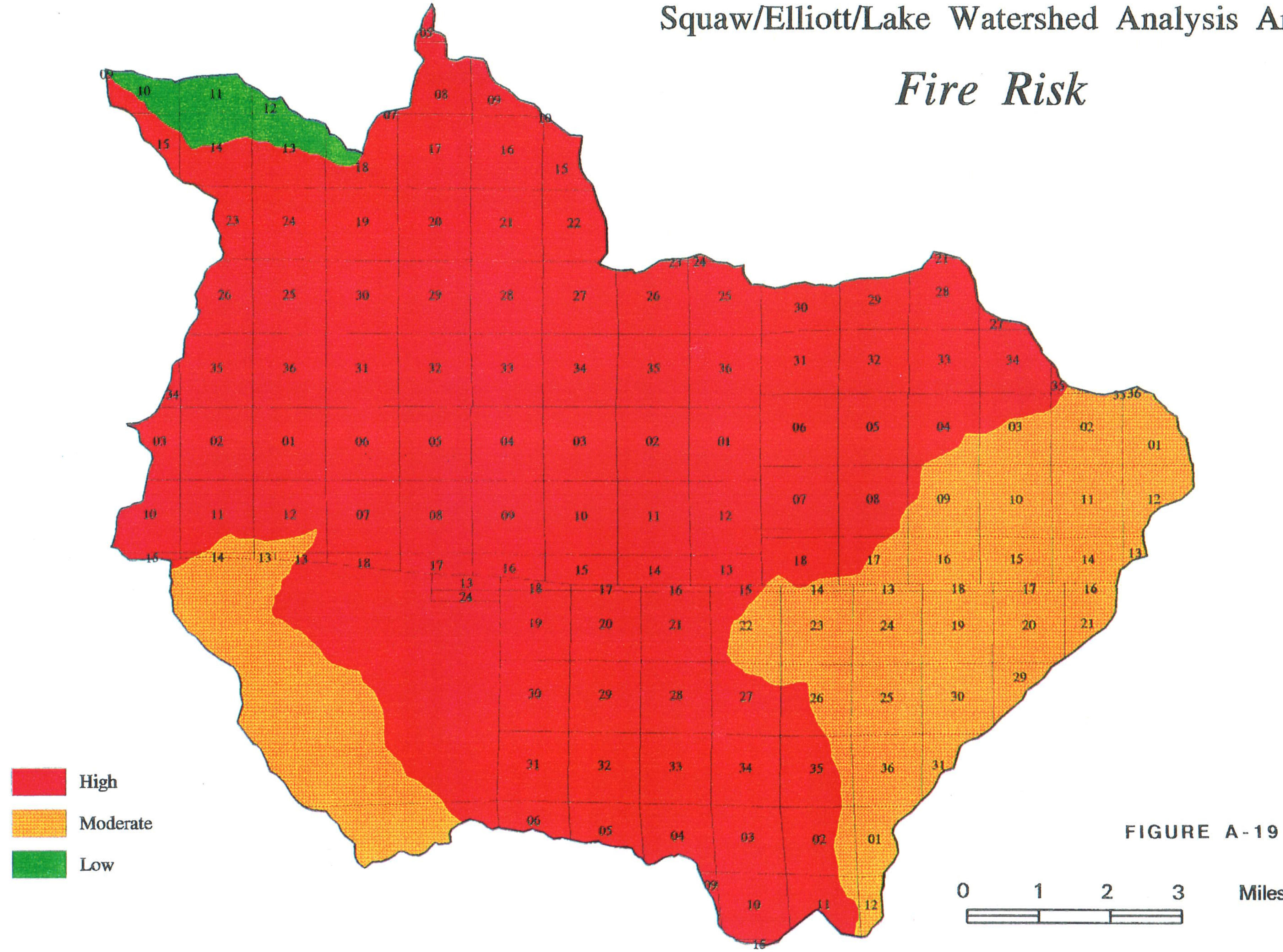


FIGURE A-19

F. TERRESTRIAL WILDLIFE

The Squaw/Elliott/Lake Watershed Analysis Area supports a diverse group of plant communities. The juxtaposition of these plant communities through time and space creates habitats for a large group of wildlife species. Conifer forests, cover much of the landscape with inclusions of hardwood forests, brushfields, and grasslands. Lakes, streams, riparian zones, talus, and rock outcrops are also found scattered throughout the Analysis Area. The diversity of wildlife that may be found within the Analysis Area is demonstrated by the wildlife species list compiled for the Applegate Adaptive Management Area (BLM, 1993). This list includes 12 amphibian species, 19 reptile species, more than 100 bird species, and greater than 60 mammal species. The Analysis Area is also home to uncommon species (i.e., the northern goshawk), endemic species (i.e., Siskiyou Mountain salamander), and Federally listed species (i.e., northern spotted owl).

1. Wildlife Habitats

For the present analysis, the vegetated lands in the Analysis Area have been grouped into several wildlife habitats. Forest habitats are grouped into late-successional forests; mature forests, and early-successional forests. Hardwood and hardwood/conifer forests are included the forest habitats group. Brushfields, grasslands, and riparian zones are uncommon but important wildlife habitats in the Analysis Area. Rock-outcrops, talus, bridges, buildings, snags, and down logs are unique habitats found within the Analysis Area. The wildlife habitat groupings were developed through the use of GRS satellite imagery data. More information on habitat data groupings can be found in District files. Spotted owl habitat data is based on Pacific Meridian Resources (PMR) satellite imagery data. PMR data is based on 1987 photos and GRS data is based on 1993 photos.

The relative amounts of each forested habitat type is based on the total acres of land within the watershed capable of supporting forests. A weakness of the GRS and PMR data analysis method used in this report is that it is pixel based. Pixel based analysis does not give an accurate representation of the total acres of each habitat type.

A description of each habitat follows.

a) Late-Successional forests, often referred to as old-growth forests can be characterized as multi-storied, with the overstory consisting of scattered large conifer trees and the understory of smaller trees. Snags and down-logs are common components of late-successional forests. Canopy closure in these forests is generally high averaging greater than 60%, but the canopy is often broken by scattered small openings. Wildlife species commonly associated with late-successional forests include the northern spotted owl, northern goshawk, and pileated woodpecker, pallid bat, and Siskiyou Mountains salamander.

Late-successional forests are uncommon within the Analysis Area. Presently, only 13% of the forested lands in the Analysis Area are late-successional forests (Table A-11). Historically a larger proportion of the forests were late-successional, but extensive and intensive timber harvest by both private landowners and by the Applegate Ranger District has removed large tracts of old growth forest. A summary by subbasin indicates that late-successional forests are most common in Upper Squaw, Dutch, and Lower and Upper Elliott subbasins (Table A-11). Mule, Kinney, Joe, and Lake sub-basins contain the least amount of late-successional forest habitats (Table A-11).

The amounts of late-successional forest habitats affects the presence, abundance, and distribution of late-successional dependent wildlife species. Within the Analysis Area, the present distribution of late-successional forests has been in large part created by past timber management practices. The practice of harvesting late-successional forests has created a mosaic of small late-successional habitat islands, with only a few large patches of late-successional forest habitats remaining. Pearce Gulch and Dutch subbasin have the largest late-successional forest patches; smaller patches are found within Upper Elliott and Upper Squaw subbasins, and on the north facing slopes above Elliott Creek.

b) Mature forests can be multi-storied, but more often consist of even-aged stands and generally lack the broken canopy common in late-successional forests. Trees in mature forests are smaller and snags and down-logs are less common than within late-successional forests. Canopy closure within mature forests is often greater than 60%. The mature forests within the Analysis Area were divided into two classes, forests with trees averaging 11-17 inches dbh (Mature) and forests with trees averaging 17-24 inches dbh (Mature 2). The large size class forests are more likely to support wildlife species dependent or that prefer older forests. The forests in smaller size class are in the earlier stages of development into mature forest habitats.

Many of the species that utilize late-successional forests may also utilize mature forests, especially the older mature stands. Mature forests surrounding or adjacent to late-successional forests increase the effectiveness of the late-successional forests by adding to the patch size. However, mature forest habitats do not function the same as late-successional forests. Structurally, mature forests and late-successional forests are different. For example, mature forests often do contain large overstory conifers with mistletoe brooms. These mistletoe brooms provide nest locations for a number of wildlife species such as the northern spotted owl and northern goshawk.

Mature forest habitats are the most common forest habitat in the Analysis Area. This habitat type comprises 64% of the forested lands in the Analysis Area (Table A-11). The relative amounts of mature forests range between 47% in Upper Squaw subbasin to 79% in Lake subbasin (Table A-11). The two size classes of mature forests are nearly equally distribution within all subbasins. Dutch subbasin has the largest difference with only 15% of the mature forests in the 11-17 inch size class and 43% in the 17-24 inch size class (Table A-11). Conversely, Lake subbasin contains 52% of the mature forests in the smaller size class and 27% in the larger size class.

c) Early-successional forest habitats are generally areas where timber harvest has occurred. These habitats generally consist of young conifer plantations. The difference between Early and Early-2 habitats is that the latter habitats contain scattered overstory trees (Table A-11). Canopy closure Early-2 habitats is less than 40%. Early-successional forest habitats support a diverse group of wildlife species that do not require a closed canopy forest for all of their habitat needs. Game and non-game species utilize these habitats: Blacktail deer, and black bear forage extensively through these areas. Species such as flycatchers, woodpeckers, and small mammals are common in these habitat types.

Open forests of ponderosa pine were more common on the hotter drier portions of the watershed, i.e., low elevation sites and south slopes, than they are today (Appendix A, Terrestrial Vegetation). These open forest habitats could be described as savannahs consisting of an overstory of scattered large ponderosa pines with an understory of large oak and madrone trees. Ground cover consisted of scattered shrubs and numerous grass and forb species; snags and down logs were present, but were widely scattered and were mostly in the large size classes. These forest habitats are mostly non-existent today. Wildlife species associated with the pine savannahs have been impacted by the loss of this habitat type. The flammulated owl and white-headed woodpecker are two examples of species that utilize pine savannahs.

Early-successional habitats comprise 25% of the total capable forest lands in the Analysis Area (Table A-11). Upper Elliott and Upper Squaw subbasins contain the largest acreage's of early-succession forest habitats (Table A-11). The relative proportions of early-succession habitats is highest within Upper Elliott (34%), Upper Squaw (33%), and Mule (32%) subbasins. Dutch subbasin contains the lowest proportion of early-succession habitats (13% and 850 ac.) (Table A-11).

Table A-11: Acres of Forest Habitats Within the Squaw/Elliott/Lake Watershed Analysis Area.

BASIN NAME	EARLY		EARLY-2		MATURE		MATURE-2		LATE		TOTAL
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres
Mule	1,439	26	326	6	1,993	36	1,567	28	285	5	5,610
Kinney	821	13	152	2	2,495	40	37	25	455	7	6,223
Lake	1,117	13	176	2	4,420	52	2,300	27	418	5	8,431
Lower Squaw	1,237	18	179	3	2,181	33	2,340	35	750	11	6,687
Upper Squaw	2,363	22	1,121	11	2,156	20	2,931	27	2,098	20	10,669
Lower Elliott	1,279	15	298	3	3,092	36	2,609	30	1,308	15	8,586
Upper Elliott	2,337	16	2,605	18	2,777	20	4,712	33	1,749	12	14,180
Dutch	546	8	304	5	990	15	2,817	43	1,833	28	6,490
Joe	481	15	121	4	979	31	1,169	37	419	13	3,169
Total Acres	11,620	17	5,282	8	21,083	30	22,745	32	9,315	13	70,045

d) Hardwood and hardwood/conifer forests are uncommon habitats within the Analysis Area. These habitats consist of pure stands of hardwoods, or stands of hardwood and conifer trees. Common hardwood trees in these forests are pacific madrone, canyon live oak, Oregon white oak, California black oak, and golden chinquapin; conifer trees commonly associated with these forests are ponderosa pine, Douglas fir, and incense cedar. Shrubs are also common in these forests, i.e., silktassel, ceanothus, and manzanita species. Canopy closure within this forest habitat type often averages greater than 60%. The age-class distribution of these forests has not been determined.

Hardwood and hardwood/conifer forests provide important wildlife habitats. These forest types are limited in total acres and in their distribution as compared to conifer forests. Hardwood and hardwood/conifer forests contain a high diversity of tree and shrub species which provide a high diversity of habitat niches. Black-tail deer and black bear utilize these forests because of the availability of a diverse food source, as well as for the hiding cover and thermal cover values. Neotropical migratory birds utilize these forests for nesting, foraging, and resting. For example, several species of birds heavily utilize Pacific madrone berries, a common tree species in these forests. The northern spotted owl may also utilize these forest types for foraging. Woodrats are heavily utilized by spotted owls and woodrats are common in these forest habitats. Hardwood and hardwood/conifer forests are generally open enough to allow spotted owls to fly through and have a canopy closure (>60%) which provides the owls protection from aerial predators.

Similar to the ponderosa pine savannah described previously, a hardwood forest type, the oak savannah, was likely more common on the Beaver Creek watershed than are present today. Oak savannahs were probably common on the hotter sites on the watershed, especially sites with shallow soils. However, fire suppression efforts beginning in the early 1900's has created conditions that has mostly eliminated this habitat type within the watershed. Oak savannahs provide important wildlife habitat for black-tail deer, black bear, western tree squirrel, and numerous bird species.

Hardwood forests comprise 7.5% (5,267 acres) of the total forested lands within the watershed. Hardwood forest habitats are most common in Mule (1,183 ac.), Lower Elliott (984 ac.), and Lake (867 ac.) subbasins (Table A-12). Hardwood habitats are least common in Dutch (86 ac.), Joe (138 ac.), and Upper Elliott (123 ac.) subbasins (Table A-12). The age distribution of hardwood forests has not been determined.

e) Shrub lands are a common habitat type in the drier portions of the Analysis Area. Shrub lands occupy greater than 4,200 acres within the Analysis Area (Table A-12). Shrub lands in the Analysis Area generally consist of a mix of shrub species, i.e., green and white leaf manzanita, buckbrush, deer brush, and silktassel. In the more moist sites, conifer trees and hardwood trees can be found in these brushfields. Ponderosa pine, Oregon white oak, California black oak, and Pacific madrone are the most common trees associated with brushfields. Shrub communities are most common in Upper Elliott (1,655 ac.), Upper Squaw (686 ac.), and Lower Elliott (474 ac.) subbasins (Table A-12). The remaining subbasins contain between 200 and 300 acres of shrub lands (Table A-12).

Table A-12: Acres of Non-Conifer Forest Habitats Within the Squaw/Elliott/Lake Watershed Analysis Area.

BASIN NAME	NON-VEG Acres	GRASS/HERB Acres	SHRUB Acres	HARDWOODS Acres	TOTAL Acres
Mule	147	290	291	1,183	1,911
Kinney	72	67	207	701	1,047
Lake	308	66	220	867	1,461
Lower Squaw	48	42	208	663	961
Upper Squaw	231	161	686	522	1,600
Lower Elliott	29	25	474	984	1,512
Upper Elliott	495	366	1,655	123	2,639
Dutch	61	29	287	86	463
Joe	19	29	252	138	438
Total Acres	1,410	1,075	4,280	5,267	12,032

Brushfields provide important habitat for both game and non-game wildlife. Black bear heavily utilize berries produced by shrub species common in brushfields, e.g., whiteleaf manzanita. Black-tail deer utilize brushfields for foraging, hiding, and escape cover. Resident birds such as mountain quail, California quail, wild turkey, and rufus-sided towhee use brushfields for nesting, cover and forage. Neotropical migratory birds also utilize brushfields, e.g., house wren, hummingbirds, bushtit, and plain titmouse.

Brushfields within the Analysis Area if classified into age classes would mostly fit into the mature and older categories. Because of fire suppression efforts since the turn of the century, these brushfields have experienced little to no disturbance. Without fire suppression efforts it is likely that a portion of the brushfields would have burned over the past 100 years and this would have created a mosaic of brushfields in different age-classes. From the standpoint of ecosystem health, the brushfield plant communities are unhealthy in the Beaver Creek watershed because they are almost entirely in mature and older age classes. Early seral stages of brushfields as compared to later stages consist of numerous young shrubs, have a diverse assortment of grasses and forbs, and may have conditions conducive to the establishment of conifers and hardwood trees, i.e., such as ponderosa pine and Oregon white oak. Early seral stages of brushfields provide wildlife habitats not found in the older age classes For example, young brushfields often provide excellent black-tail deer foraging habitat and the diversity and density of herbaceous vegetation provides food sources and nesting opportunities for many bird species, e.g., lesser and American goldfinches, dark-eyed junco, and indigo bunting.

f) Grass/herbaceous habitats are uncommon within the Analysis Area comprising only 1,075 acres (Table A-12). Grass/herbaceous plant communities are typically associated with ridgetops and south facing slopes. These habitats are primarily found in Upper Elliott (366 ac.), Mule (290 ac.) and Upper Squaw (161 ac.) subbasins (Table A-12).

Grasslands are important to a number of wildlife species. Blacktail deer utilize these areas for foraging throughout the year, except when they are snow covered. Many birds utilize grasslands for nesting (dark-eyed junco) and feeding (American and lesser goldfinches). Grasslands is also important habitat for many insect species such as butterflies, flies, beetles, wasps, and bees. These insects play an integral role in pollination of many plant species.

g) Non-vegetated areas are an uncommon habitat type in the Analysis Area, comprising 1,410 acres) (Table A-12). This habitat type is most often found along ridges and mountain tops. Rock outcrops can be lightly vegetated, but most often have no vegetation associated with them. Non-vegetated habitats are most common in Upper Elliott (495 ac.), Lake (308 ac.) and Upper Squaw (231 ac.) subbasins (Table A-12). Rock outcrops provide habitat for bat species (pallid bat), reptiles (fence lizard and western skink), snakes (western rattlesnake), birds (turkey vulture and rock dove), and for salamanders where canopy closure exists over the rock-outcrops.

h) Bridges, Buildings, and Caves provide unique wildlife habitats. Residential buildings and outbuildings provide roosting habitat for many bat species. The Brazilian free-tailed bat and Townsends big-eared bat are two species commonly associated with buildings. The latter bat is listed as a sensitive species by the Forest Service (Region-6). Bats use buildings for maternity roosts and hibernacula, particularly residential buildings which provide relatively stable year-round temperatures. All the residential buildings within the watershed are privately owned. The Forest Service outhouses located at campgrounds are often utilized by bats for roosting sites.

Bridges provide night roosts for bats. Many bat species forage over and along streams and then stop under bridges to consume prey, or to rest. Some bridges also provide day roosts. Cave are found within the Analysis Area. Caves provide environmental conditions (i.e., cool, stable temperatures; high humidity, air flow, and protection form disturbance) essential for some bat species, i.e., Townsends big-eared bat. This bat species uses caves for maternity roosts and day roosts. Caves are also used by other wildlife species such as banana slugs, snails, and insects.

i) Snags and Down Logs can be found in all forested habitats and brushfield habitats discussed above. However, because of the importance of snags and down logs to a very large group of wildlife species this habitat type is discussed separately. Snag and down log habitat throughout for the Analysis Area has not been evaluated, but a general evaluation was done to provide a qualitative description of this special habitat type. Snag habitat is likely good within unmanaged timber stands, including hardwood and hardwood/conifer stands. Snag and down log habitat is good on south slopes where drought and beetles have killed many ponderosa pine and Douglas fir trees during the last ten years of drought. Conversely, snag and down log habitat is poor within all managed forest stands of the forested watershed. Numerous managed stands throughout the Applegate Ranger District have been surveyed for snag habitat and data indicates that snag numbers in these managed stands most often do no meet minimum standards.

j) **Riparian habitats** are located along streams, but also include wetland shrub communities, wet grass/forb meadows, bogs, springs, and seeps. Streamside riparian habitats vary in size from the large riparian zone associated with Applegate River, Elliott Creek, and Squaw Creek, to those found along small streams such as Dutch Creek, Joe Creek, and Pearce Gulch. Intermittent streams also provide riparian habitats particularly during the months of the year when they flow water. These intermittent streams, during an average rainfall year, flow water and provide riparian habitat during the breeding season of many wildlife species.

The continuity of a riparian habitat will affect how it functions as wildlife habitat. A streamside riparian zone that has a continuous forest canopy for its entire length can serve as wildlife travel corridor, on the other hand, if a large portion of the riparian forest is removed, some wildlife species will not be able to travel through the open area. Riparian zones associated with large patches of late-successional forests may serve as nest sites for spotted owl or goshawk nests.

Riparian habitats are some of the most important habitat types found in the Analysis Area. Riparian habitats are utilized heavier than other forest habitats in relation to their abundance. Some wildlife species are restricted to streamside habitats while other species utilize riparian zones to a greater degree than upland habitats. Results of a study of small mammals in riparian habitats versus upland habitats conducted on the Butte Falls Ranger District, Rogue River National Forest, demonstrated the importance of riparian habitats to small mammals. In the study by Mamone (1994) small mammal species diversity was significantly higher species richness was higher, and abundance was significantly greater in riparian zones than within adjacent upland sites. In this study, eleven species were captured in riparian habitat, but only 9 species in upland habitat. Within riparian habitat, 288 individuals were captured, but only 172 individuals were captured in upland habitat. Four species (Richardson's water vole, Arvicola richardsoni; shrew-mole, Neurotrichus gibbsii; vagrant shrew, Sorex vagrans; and broad-footed mole, Scapanus latimanus) were only captured in riparian habitat.

In the same study, Mamone (1994) reported higher plant species richness and density within riparian than in upland sites. Within riparian habitat, thirty-nine plant species were found, but only 30 species were found in upland habitat. In the same study the mean percent cover of grasses/sedges, herbs, and moss were significantly higher and percent cover of bare soil was higher in riparian than in upland habitat.

Within the Analysis Area, there are 382 miles of streams that provide riparian habitats. Upper Elliott (66 mi.), Mule (58 mi.), and Upper Squaw (54 mi.) subbasins have the largest amounts of streams (Table A-20). Class 4 streams, or intermittent streams, are the most abundant streamside riparian habitat within the Analysis Area and accounts for greater than 285 miles. Permanently flowing streams (Class 1, 2, & 3) account for more than 100 miles of streams. These permanently flowing streams provide some of the most important wildlife habitats in the Analysis Area. Additional analysis and discussion of riparian areas (Riparian Reserves) is contained in Appendix A, Riparian Habitat.

k) Wetlands comprise approximately 800 acres within the Analysis Area (Table A-20). These wetlands consist of wet meadows, alder glades, and wet conifer forests. Wetland habitats are mostly distributed at the high elevations in the headwaters of the major streams within the Analysis Area. The highest density of wetlands are within the Upper Elliott (600 acres) and the Upper Squaw (115 acres) subbasins (Table A-20).

Wetlands within the Analysis Area provide habitat for numerous wildlife species. Alder glades provide habitat for neotropical migratory birds, i.e., the little willow flycatcher, furbearers, i.e., American fisher, and game species, i.e., black-tail deer and black bear. The condition of wetlands in the Analysis Area varies depending on the wetland type. Alder and forest type wetlands are generally in good to excellent condition. Conversely, meadow wetlands are generally in fair to poor condition due to many years of moderate to heavy livestock use. Livestock grazing is heavy in some meadow wetlands (range utilization data for 1992-95) and within the small grass/forb wetlands adjacent to springs and seeps at the headwaters of streams (Mike Mathews, 1995). Livestock grazing and trampling degrades meadow wetlands by removing vegetation, trampling vegetation, compacting and displacing soils, and increasing sedimentation into stream channels. Degraded wetlands are not capable of maintaining the functions and processes, such as providing wildlife habitats, associated with healthy wetlands.

l) The Affects of Roads on Wildlife Habitats

Road density within the Analysis Area averages 2.5 miles of road/square mile of land (Table A-13). Road density is greatest at the high elevation subbasins: Upper Squaw (3.8 miles of road/sq. mi.), Upper Elliott (3.5 miles of road/sq. mi.), and Joe (3.2 miles of road/sq. mi.).

Table A-13: Comparison of Road Density by Subbasin

Subwatershed	Area (sq mi)	Road Miles*	Road Density (mi/sq mi)
Upper Elliott Cr	26.2	91.5	3.5
Lower Elliott Cr	14.2	29.1	2.0
Dutch Cr	10.7	15.2	1.4
Joe Cr	5.4	17.4	3.2
Upper Squaw Cr	18.5	71.2	3.8
Lower Squaw Cr	10.9	23.4	2.1
Lake	11.7	17.3	1.5
Kinney Cr	6.7	12.5	1.9
Mule Cr	9.9	10.3	1.0
All	114.2	287.9	2.5

*** Includes only system roads.**

Roads can affect the quality of wildlife habitats, particularly when roads are located in important habitats. Roads in black-tail deer winter range, or within deer fawning habitats can be more impactive, than roads in summer range habitat. Reduction in road densities, or removal/decommissioning of roads in particular locations can improve the quality of wildlife habitats. Priority locations to be considered for improved road system management include streamside riparian zones, wetland habitats, and black-tail deer winter range. The Access and Travel Management process should be used for reviews of roads and wildlife considerations.

Roads within wetlands affect their ability to provide wildlife habitats. Across the Analysis Area, there are 2.31 miles of road within wetland habitat. The highest density of roads in wetlands is within the Upper Elliott (1.5 miles of roads) and Upper Squaw (0.5 miles of roads) subbasins (Table A-20). Further discussion of the affects of roads in riparian areas is contained in Appendix A, Riparian Habitats.

m) Connecting Habitats Within the Analysis Area and With Adjacent Watersheds

An analysis of connecting habitats within the Analysis Area has not been conducted, but is recommended. To maintain a fully functioning forest ecosystem connecting habitats must be maintained between the various forest habitats, between high and low elevation habitats, and within and between subbasins.

2. Wildlife Species

a) Northern Spotted Owl:

The northern spotted owl is Federally listed as a threatened species. Surveys for spotted owls were conducted across the Applegate District during 1981-90. These surveys covered most of the District, but small areas were skipped for a variety of reasons, i.e., difficult access or no management activities planned. Presently, no spotted owl surveys are being conducted, only reproductive monitoring of specific sites are conducted.

Spotted owl nesting, roosting, and foraging habitat (NRF) within the Analysis Area was based on PMR data and has been determined for both private and Federal lands (Table A-14). This analysis is not totally accurate because it does not take into account timber harvest activities that have occurred since 1987 on both Federal (USFS & BLM) and on private lands. The NRF habitat on National Forest lands is located on lands allocated as Adaptive Management Area, Riparian Reserve, and Late-Successional Reserve.

The Analysis Area can be divided into two distinct areas of distribution of NRF habitat. At the lower elevations, the areas north of Elliott Creek, NRF habitat is primarily located along north facing slopes below Elliott Ridge. The south slopes below Elliott Ridge consist primarily of grasslands, brushfields, hardwood forests, and ponderosa pine forests. The areas south of Elliott Creek, (Lower and Upper Elliott, Dutch, and Joe subbasins) primarily consist of north facing slopes that climb to over 6,000 feet in elevation. The aspect and greater precipitation in these areas create better growing conditions. South of Elliott Creek NRF habitat can be found more evenly distributed across the landscape and is not restricted to north slopes.

Spotted Owl Activity Centers

Twenty-eight spotted owl pair activity centers (PAC) are known for the Analysis Area (Table A-14). They are located on lands allocated as Adaptive Management Area, Late-Successional Reserve (LSR), and Riparian Reserves. All activity centers are at least 100-acres in size as directed in the Record of Decision for Amendments to Forest Service and Bureau of Land Mangement Planning Documents Within the Range of the Northern Spotted Owl (ROD) (USDA/USDI, 1994).

Although spotted owls appear to be well distributed across the landscape, they are more commonly found in clusters. These spotted owl pair clusters are in locations where large patches of NRF habitat are available. The north slope of Elliott Ridge is a site where there is a cluster of three spotted owl activity centers. Other spotted owl clusters are located in Pearce Gulch, within the Applegate/Oak Knoll LSR, and within the Mule Creek and Kinney Creek subbasins. Managing spotted owl clusters provides a greater likelihood of maintaining site occupancy and reproductive output of the spotted owl population within the Analysis Area. Clustering owl activity centers and NRF habitat provides the opportunity to establish and manage large patches of habitat. Large patches of NRF habitat provide interior forest conditions which are more likely to support spotted owls than are smaller patches. Small patches of NRF habitat function as edge

Table A-14: Northern Spotted Owl Activity Centers and Associated Acres of Suitable Habitat

PAC #	Habitat Amounts (0.7 mi.)			Habitat Amounts (1.3 mi.)		
	Federal	Private	Total (0.7)	Federal	Private	Total (1.3)
107	244	167	411	460	544	1004
108	724	15	739	1717	185	1902
110	864	0	864	1642	153	1795
111	317	228	545	703	743	1446
114	408	19	427	786	335	1121
115	256	0	256	477	0	477
116	271	42	313	808	935	1743
117	157	0	157	583	22	603
118	368	13	381	933	203	1136
120*	611	0	611	2086	31	2117
128	199	0	199	744	0	744
147	646	119	765	1410	325	1735
158	223	2	225	460	43	503
164*	514	28	542	1099	75	1174
165	369	0	369	1084	33	1117
168*	461	43	504	1328	178	1506
178A*	445	27	472	1481	202	1683
178*	574			1732		
179A*	234	254	488	885	528	1413
179*	181			749		
180A*	680	0	680	1965	74	2039
180*	574			1732		
187*	297	5	302	969	59	1028
188	106	0	106	473	30	503
195	692	0	692	1794	0	1794
196	546	224	770	1026	490	1516
197	167	65	232	529	380	909
199	203	7	210	324	124	448

Activity center numbers with an * indicate these sites are within LSR CA-354. The "A" after an activity center number indicates an alternate nest site. The table displays acres of suitable habitat on both Federal and private land ownership.

habitat and not as interior forest habitat. Edge habitat is not suitable for spotted owls, but it is used by spotted owl prey species (great horned owl) and competitor species (barred owl).

The minimum standards established by the U.S. Fish and Wildlife Service for habitat amounts within 0.7-miles of an activity center is 500 acres and 1336 acres within 1.3-miles (USDI, 1990). These habitat amounts are supposedly adequate to support a pair of spotted owls and prevent abandonment of pair sites. Within this Analysis Area, more than 16 pairs, 57% of all spotted owl pairs are in an incidental take situation because of lack of adequate amounts of NRF habitat within either the 0.7 or 1.3 mile home ranges (Table A-14). Out of the sixteen pairs, 43% (12 pairs) of these owl pairs lack adequate of amounts of habitat within both 0.7 and 1.3 mile home ranges. The remaining four owl pairs are deficient in amounts of habitat within either the 0.7 or 1.3 mile radius.

Timber harvest is primarily responsible for the lack of habitat within the home range of many of these spotted owl pairs. National Forest, BLM, and private timber harvest all combined have removed extensive areas of habitat within this Watershed Analysis Area. Yellowjacket Ridge, Elliott Creek Ridge, Silver Fork/Donomore areas, and Squaw Creek are examples of areas where extensive timber harvest has removed spotted owl nesting, roosting, and foraging habitat.

Reproductive History

During the past several years, spotted owl pairs within the Analysis Area have been monitored to varying degrees for reproduction (Table A-15). Reproductive data for these owl pairs is limited and no firm trends can be established from this data. However, some simple analysis can hi-light some possible areas of concern. Reproductive success ranged from 0-1 young per year. Combined reproductive data for all spotted owl pairs within the Analysis Area results in only 0.56 young per year. This does not appear to be adequate to maintain existing population levels.

Spotted owl reproduction is influenced by many factors including prey availability, weather conditions, and availability of adequate amounts of suitable habitat. The first two factors are beyond the scope of this analysis. However, a comparison of reproductive success with the amount of suitable habitat within owl home ranges, indicates that some affects to reproduction are occurring for spotted owl pairs with low amounts of suitable habitat. Sixteen young were fledged during the six year monitoring period by 10 spotted owl pairs (0.51 young per year) that were deficient of NRF habitat within both the 0.7 and 1.3 mile home ranges. On the other hand, 15 young were fledged during the same monitoring period by 8 spotted owl pairs (1.73 young per year) that had adequate amounts of NRF habitat within both the 0.7 and 1.3 mile home ranges. Although this analysis is not statistically based and only includes a small sample size, these numbers give an indication that adequate amounts of habitat within the home range of spotted owl pairs does positively affect reproductive output. Conversely, lack of suitable habitat negatively affects reproduction of spotted owl pairs.

Table A-15: Spotted Owl Pair Reproductive History

"unk"birds did not respond, or surveys were not conducted.

Owl #	1994	1993	1992	1991	1990	Total
107	unk	0	0	0	0	0
108	0	0	1	0	0	1
110	0	unk	unk	unk	unk	0
111	unk	0	2	0	0	2
114	unk	0	3	0	0	3
115	unk	unk	unk	unk	unk	0
116	unk	unk	0	unk	unk	0
117	2	0	2	0	0	4
118	1	0	1	0	2	4
120	2	unk	unk	unk	2	4
128	unk	unk	0	unk	unk	0
147	0	unk	unk	unk	unk	0
158	unk	unk	unk	unk	0	0
164	0	0	2	unk	0	2
165	2	0	2	unk	0	4
168	0	0	2	0	0	2
178	1	unk	3	unk	0	4
179	1	0	1	2	0	4
180	2	0	0	unk	0	2
187	unk	unk	unk	unk	0	0
188	unk	0	0	0	unk	0
195	unk	unk	unk	unk	unk	0
196	2	0	unk	unk	unk	2
197	unk	unk	unk	0	0	0
199	1	0	unk	unk	unk	1

Critical Habitat

The Endangered Species Act directs the U.S. Fish and Wildlife Service to propose critical habitat for Federally listed wildlife species. Critical habitats are specific areas within the geographical areas occupied by a species at the time of listing on which are found those physical or biological features (1) essential to the conservation of the species; (2) which may require special management considerations or protection; and (3) specific areas outside the area occupied by the species upon a determination that such areas are essential to its conservation. Conservation means the use of all methods and procedures necessary to bring a species to the point at which the protective measures of the act are no longer necessary. Conservation is the process or means of achieving recovery. It is reasonable for the designation of critical habitat areas "essential to the conservation of the species" to consider the habitat needs identified in a recovery plan (USDI, 1992).

Critical habitat (CH) for the spotted owl is located within the Watershed Analysis Area (USDI, 1992a, 1992b). Critical habitat is located along the southeast and southern boundary of the Analysis Area. Analysis of the habitat conditions within critical habitat has not been conducted, but may be necessary if projects are planned within or adjacent to these areas. The kinds of information that are needed for a CH analysis includes the amount of NRF habitat, the number and location of owl pairs, the status of these owl pairs in relation to incidental take guidelines for habitat amounts, and reproductive success for each owl pair. Dispersal conditions within and between CH units is also required for an adequate analysis. This data within this report can be used to conduct a CH analysis, but it will need more in-depth discussions of NRF habitat within CH and dispersal conditions between CH. This analysis is beyond the scope of this report.

Late-Successional Reserves (LSR)

Late-Successional Reserve (#RC-354) is partially located within this Analysis Area on the Applegate District and extends south onto the Oak Knoll District of the Klamath National Forest. A GIS analysis of habitat for this LSR was conducted based on aerial photo interpretation and stand condition mapping interpretation. The results indicate that this LSR is approximately 56,100 acres in size of which 34,957 acres (62%) provides suitable spotted owl habitat. The LSR contains 19 pairs and 4 resident single spotted owl distributed between the two Districts which meets the intent of this LSR for owl pair numbers. Approximately 2,000 acres of private land inholdings occur within the LSR boundaries. The LSR land allocation does not apply to private lands; certain activities (e.g. timber harvesting, road development) on private lands have the potential to affect connectivity of late-successional habitat within LSRs.

Nine spotted owl pair sites are located within the Applegate District portion of this LSR. Of these nine PACs, seven are located within the Squaw/Ellliott/Lake Watershed Analysis Area. Each of these seven owl pairs have more than the minimum amounts of NRF habitat, except for pair site #187. Pair site #187 is deficient in suitable habitat because of timber harvest within the home range. Two parcels of private land adjacent to #187 presently are being logged and no longer provide NRF habitat; timber harvest on Forest Service lands has also removed habitat from within the home range of pair #187. Information on the status of spotted owl pairs within the Oak Knoll portion of this LSR are not available. The Mt. Ashland/Oak Knoll LSR located on both the Ashland and Oak Knoll Districts is approximately 20 miles northeast of LSR #RC-354. An assessment is in progress for this LSR.

An important aspect of a functioning LSR system is to maintain suitable dispersal habitat between LSRs. Because dispersal between this LSR and other adjacent LSRs must occur through the Squaw/Elliott/Lake Watershed Analysis Area, the condition of dispersal habitat throughout the Analysis Area is extremely important. Other LSRs occur to the northwest, north, northeast, and southwest of LSR #RC-354. Dispersal habitat within the Analysis Area is further discussed below.

Dispersal Habitat

Spotted owl dispersal habitat within the Analysis Area was determined through the use of aerial photo interpretation data and GIS. Information on how stands were grouped to estimate dispersal habitat is on file at the District office. The dispersal habitat analysis has some weaknesses, but it does give a good approximation of dispersal conditions within the Analysis Area. The dispersal analysis was in part based on assumptions about the ability of some stand conditions to provide dispersal habitat. These assumptions have not been field verified. The dispersal habitat analysis was conducted in 1990 and is not totally accurate because (1) only Forest Service lands were included in the analysis, BLM and private lands were not included and (2) the dispersal habitat data has not been updated since 1990 and Federal and private lands timber harvest has occurred within the watershed since 1990. The definition of dispersal habitat used for this analysis is that found in the Interagency Scientific Committee report (ISC) (USDA, 1990). The ISC recommends 50% of the Federal lands within each quarter-township should have forest stands that consist of trees averaging 11" dbh or greater and with an average canopy closure of 40% or greater. This is often referred to as the 50-11-40 rule.

The Watershed Analysis Area fully encompasses 17 quarter-townships (QT) and a portion of six additional quarter-townships. These quarter-townships all exceed the ISC recommendations for dispersal habitat, except for QT #31 presently at 39% dispersal habitat. QT #31 is located in an area that primarily supports hardwood forests, brushfields, and grasslands. Timber harvest has not created the existing dispersal habitat conditions in QT #31.

Within the Analysis Area, dispersal habitat between the Mt. Ashland and The Applegate LSRs for the most part is in good condition. However, outside the Analysis Area in adjacent quarter-townships dispersal habitat does not meet recommended levels. The weak links in connecting habitat exists within quarter-townships #15, 16, 31, 35, and 45. Quarter-township #15 and 16 are close to the Mt. Ashland LSR and #35 is close to the Applegate LSR and #45 is immediately adjacent to the Applegate LSR. QT #31 is located between the two LSRs. The poor dispersal conditions of these quarter-townships should not affect the ability of spotted owls to disperse between the two LSRs.

Dispersal habitat is also necessary to connect the Applegate LSR with LSRs located to the north on BLM lands and to the west/northwest on the Siskiyou National Forest. Based on the District's 50-11-40 analysis the only weak areas for this dispersal corridor are within quarter-townships #1, 2, 31, 35, and 45. QT #1 and 2 are located along the north boundary of the Applegate District and have had considerable timber harvest, and/or consist of low elevation pasture lands, brushfields, or hardwood forests.

Spotted Owls in Adjacent Watersheds

Spotted owl populations in watersheds outside this Analysis Area will not be evaluated within this report. Analysis of spotted owl habitat and dispersal conditions have been conducted within Beaver Creek and Palmer Creek watersheds and within the Beaver/Palmer timber sale Biological Assessment (on file at the Applegate District office). Spotted owl habitat and populations have also been analyzed and are presented within the Little Applegate Watershed Analysis Report (on file at the Applegate District office).

Private Lands

Private lands are scattered throughout the Analysis Area. The majority of these lands are owned by larger timber companies, but some are owned by private individuals. There are 11,040 acres of private lands within the Analysis Area, mostly concentrated in Elliott, Squaw, and Lake subbasins. Private land logging has been occurring throughout the District at a fast rate during the past several years. A considerable portion of this logging has occurred within the home range of owl pairs and has removed suitable spotted owl habitat. Several private land logging projects are presently on-going or are proposed within the Analysis Area (Tin Cup, Blue Ledge, and Squaw Peak).

Private lands play an important role in providing suitable habitat for spotted owls within the Analysis Area (Table A-14). NRF habitat and in several areas activity centers are entirely or partially located on private lands. . The role of these private lands in providing dispersal habitat may be as important as providing NRF habitat. Private lands in some

cases can be barriers to dispersal of spotted owls due to juxtaposition on the landscape and because of different management than occurs on Federal lands. Sections of private lands that abut against one another, can be barriers to dispersal if they were all to be logged within the same time frame.

Private land management activities may also influence how the Applegate District manages adjacent lands. For instance, private land logging may remove important dispersal habitat which may place greater importance on adjacent National Forest lands.

b) Peregrine Falcon:

The peregrine falcon is a Federally listed endangered species. Two nest sites are known for the District; the Apple site is immediately adjacent to the Squaw/Elliott/Lake Watershed Analysis Area. The foraging home range for the peregrine falcons at the Apple site extends on to the Analysis Area. Monitoring results indicate that the Apple site is occupied year-round, that is the bird(s) do not migrate to lower elevations during the winter. Reproductive output of the Apple site is poor, with young fledged only once during the past 4 years. Yearly monitoring indicates that the site has been occupied each year by a male peregrine falcon, but a mate has not been observed.

The nest site requirements of the peregrine falcon is very specific, but the foraging requirements are more general. Large vertical cliffs are locations of peregrine falcon nests and birds of all sizes are their primary prey. Peregrine falcons forage across large landscape areas. The home range of the peregrine falcon is a radius of five miles around a nest site. Riparian habitats are preferred foraging habitat because of the high density of birds found in riparian zones.

The Squaw/Elliott/Lake Watershed Analysis Area for the most part does not provide suitable nest sites for peregrine falcons. However, the high elevations of this Analysis Area may provide the cliff habitat required for peregrine falcon nest sites. These potential nest sites have not been identified or surveyed to determine if peregrine falcons are present. On the other hand, the Analysis Area provides excellent foraging habitat due to the density of riparian habitats within the home range of the Apple site. Riparian foraging habitat within the home range of the Apple site and also within the Analysis Area include Applegate Lake, the main stem of Applegate River, and the following streams: Carberry, Middle Fork, Elliott, Squaw, and French Gulch. Numerous smaller streams are also potential foraging habitat.

c) Bald Eagle

The bald eagle is a Federally listed threatened species. A bald eagle management area (BEMA) is located within the Analysis Area (RRNF, 1993). The BEMA surrounds Applegate Lake and extends down along the Applegate River. A draft BEMA plan is in place and this plan provides direction and recommendations for management of activities that could potentially affect occupancy and reproduction at the site. The BEMA consists of a primary management zone (nest grove) and of a secondary management zone. This bald eagle management area is within bald eagle Recovery Zone 23 which includes southern Oregon and a portion of Northern California. This bald eagle site is one of only three sites found on the Rogue River National Forest and the only one known for the Applegate Watershed.

Additional background information concerning the bald eagle pair at Applegate Lake can be found within the BEMA plan. A few important considerations will be discussed further in this document. The bald eagle pair are year-round occupants of Applegate Lake, these birds do not migrate away from the Lake. Habitat use by these birds includes all the major drainage's that feed into Applegate Lake (Middle Fork, Elliott Creek, Carberry Creek, Squaw Creek and Squaw Lakes, and the main stem of the Applegate River down to Cantrall-Buckley Park. Habitat use is concentrated at Applegate Lake during the breeding season (Jan.-Sept.), but expands to the river systems during times of anadromous fish runs, times of feeding nestlings, and during the winter months. Important components of the bald eagle management area are the nest stand, foraging and roosting perches, and courtship sites.

The bald eagle nest stand is approximately 290 acres and consists of lands allocated as Developed Recreation (232 ac.), Foreground Retention (44 ac.), Big Game Winter Range (3 ac.), and Timber Suitable II (12 ac.) (USDA, 1990). The entire BEMA is approximately 8,900 acres (does not include the areas along the Applegate River). Nearly all land allocations within the LRMP (USDA, 1990) are represented within the BEMA, as well as Riparian Reserves and Adaptive Management Area (USDA/USDI, 1994).

Reproductively the bald eagle pair at Applegate lake have been very successful. A total of nine young have been fledged between 1988-95. Young have fledged six of the eight years this site has been monitored. Two young have been fledged three of the six years. This results in a reproductive rate of 1.5 young per year. This reproductive rate is considerably higher than the State 5-year average of 0.95 young per year (Isaacs and Anthony, 1994). Obviously, the Applegate Lake BEMA is an important site for meeting the goals of the Bald Eagle Recovery Plan and for providing young birds to the State bald eagle population. **Continued yearly monitoring of reproduction is recommended.**

Human disturbance is a major factor affecting occupancy of bald eagle sites and reproduction of bald eagles (Stalmaster, 1987). Human encroachment into a nest site may cause abandonment of the site. Human activities and encroachment into a nest site can also cause reproductive failures. Reproductive failure may occur from nest site abandonment, flushing an adult bird from a nest during incubation could cause the eggs to die, or eggs/young could be knocked out of a nest, or a young bird could be frightened out of the nest/nest tree before it had the ability to fly.

Recreation activities can be a major impact to the Bald Eagle pair at Applegate Lake. Recreation opportunities draws many people to Applegate Lake for swimming, boating, fishing, camping, and hunting. Since the completion of Applegate Lake, recreation use has increased and very likely will continue to increase. Every year there is more pressure to develop additional recreation opportunities at Applegate Lake to meet the needs of the additional recreationist. This increase in use will continue as the Rogue Valley population continues to increase. As this growth in use continues and additional developments occur, there is a very real possibility that affects to bald eagle use of the lake will occur. To prevent conflicts, a proactive management approach should be implemented that includes development of a long-range recreation plan for Applegate Lake takes into account the expected increase in recreation needs and the needs of bald eagles.

It should not be under-estimated the aesthetic and recreation values associated with having bald eagles at Applegate Lake. They are appreciated by most recreationist that happen to observe the birds, some recreationist come to Applegate Lake specifically to observe the bald eagles, and the bald eagles are a excellent as subjects for educational and interpretive programs.

Several areas of concern related to recreation and bald eagles include:

1. The present boat speed limit on the lake is 10 mph which limits the kinds of use that occur. If this speed was to be increased to allow water skiing or speed boating, it would very likely affect bald eagle use of Applegate Lake.

2. The existing livestock trail is immediately adjacent to the bald eagle nest tree and use of this trail during the breeding season (Jan. 1- Sept. 30) does affect the bald eagle pair.

3. The locations of dispersed and developed campgrounds, hence the concentration of people in an area, can affect bald eagle use of Applegate Lake and the major tributaries that feed into the Lake.

BEMA Fire Management Plan

A fire management plan for the BEMA was started in 1992-93, but was not completed. This plan was to provide recommendations and action plans in the event of a wildfire within the BEMA. This plan should be completed as soon as possible because the BEMA has a potential for a catastrophic wildfire. The landscape position of the BEMA and summer thunderstorm patterns tend to concentrate lightning caused fires within the BEMA. The concentration of recreation use within the BEMA, especially dispersed recreation sites, increases the potential for a human caused wildfire. Also, the vegetation conditions within the BEMA are such that a wildfire would be hard to control and could sweep through the area very quickly. Finally, the access for fire fighters into the BEMA is extremely difficult and dangerous, so initial attack may be slow, or not available.

Several important aspects of the proposed BEMA fire management plan include: (1) restriction of direct aircraft fly-over of the bald eagle nest site, especially the nest tree; (2) the restricted air space extended out over the lake to the west of the nest stand; (3) helicopter bucket fill-up would occur outside the area that could influence nesting and rearing of young; (4) boats would be used to ferry fire-fighters to access fires within the nest stand; (5) hand tools, pumps and hoses would be the preferred fire fighting techniques within the nest stand; (6) helicopter and retardant drops would be considered in the event of an extremely hazardous situation; and (7) the U.S. Fish & and Wildlife Service would be consulted in the event of a fire within the BEMA that could affect survival of bald eagles, or threatened loss of their habitat.

d) Great Gray Owl:

The great gray owl is not listed as sensitive within Region-6, but is listed as such by Region-5, California. This owl species has been reported within and adjacent to the Analysis Area. Surveys within portions of the Analysis Area have been conducted during 1995, but an active nest site has not been confirmed. The great gray owl is most common in forests adjacent to meadows. Timber harvest, particularly shelterwood harvests, appear to be beneficial to this species (USDA/USDI, 1994).

The great gray owl is a survey and manage species (USDA/USDI, 1994). An interim survey protocol for great gray owl has been developed. The ROD provides Standards and Guidelines for managing known great gray owl nest sites: "a no-harvest buffer of 300 feet around meadows and natural openings and establish 1/4-mile protection zones around known nest sites".

Suitable habitat for this owl species is found across the higher elevations within the Analysis Area, particularly where large openings (natural and created) are adjacent to suitable nesting habitat (mature/late-Successional forest patches). Great Gray owl habitat consists of open areas used for foraging (meadows, clear-cuts) and adjacent conifer stands (late-successional characteristics) for nesting.

e) Northern Goshawk

The northern goshawk is a FWS Candidate Species for Federal listing as a threatened species. The northern goshawk is uncommon within the Squaw/Elliott/Lake Watershed Analysis Area. Six sites are known for the Analysis Area. This species nests in areas with late-Successional habitat characteristics. However, this species forages across a wide range of habitats, but primarily uses closed canopy forests. Surveys for this species within the Analysis Area consists of visits to known sites, or suspect sites in order to find nest trees. However, surveys across the District have not been conducted. All known sites have been found incidentally through the District spotted owl survey program. Standardized survey protocol for this species has just recently been available.

The Rogue River NF LRMP provides specific management guidelines around goshawk nest sites. Goshawk sites will be protected within a 25 acre no-harvest buffer of trees unless other adjacent alternate buffers are available in a logical basis to maintain habitat over time.

f) Neotropical Migratory Birds

This group of wildlife includes all land birds that winter south of the United States-Mexico border and breed in temperate North America. Neotropical migratory birds are a diverse group and include species such as warblers, flycatchers, swallows, hummingbirds, American kestrel and turkey vultures. There is widespread international concern about the future of neotropical migratory birds (Andelman and Stock, 1994).

The Squaw/Elliott/Lake Watershed Analysis Area provides diverse habitats for neotropical migratory birds. Neotropical migratory birds utilize these habitats for nesting, foraging, as stopover sites during migration, and as staging areas in preparation for migration. Habitats found in the Analysis Area and used by neotropical migratory birds include grasslands, shrub lands, hardwood communities, and conifer forests . A diversity of riparian habitats such as wet meadows, alder glades, streamside riparian zones, and lakes provide important habitats for neotropical migratory birds. Non-forested areas such as rock outcrops and cliffs also provide unique habitats. The geography of the Analysis Area provides low elevation to high elevation habitats and provides conditions for summer time thermals (uprising of warm air) that are required by some neotropical migratory birds in order to forage, or to gain the elevations necessary for long-distance migration.

The various species of neotropical migratory birds, and the habitats and seasons of use are not known for the Analysis Area. Low intensity bird surveys have been conducted around Applegate Lake and a neotropical migratory bird monitoring site is located adjacent to the Analysis Area, but besides these two efforts there has been no work conducted on neotropical migratory birds. A sample of neotropical migratory birds that are known to utilize the Analysis Area include little willow flycatcher, American robin, MacGillivray's, Nashville, Wilson's, and yellow, warblers; western tanager, American robin, solitary and warbling vireos, song sparrow, tree swallow, band-tailed pigeon, mourning dove, American kestrel, and turkey vulture. This is by no means a complete list.

Over the past several years, research has been conducted on neotropical migratory birds. Results of these studies has provided some indications that some neotropical migratory bird species populations appear to be declining, and that that some breeding habitats are also at risk (Andelman and Stock, 1994). Several species of concern and the habitats of concern found within the Squaw/Elliott/Lake Watershed Analysis Area are further discussed below. By no means is this a complete list of neotropical migratory bird species that are of concern or present within the Analysis Area; a more through analysis is presented by Andelman and Stock (1994).

Little Willow Flycatcher

This flycatcher is listed as a Federal Candidate Species for listing as threatened and is listed as sensitive by the USFS, Region-5. This species nests in willow habitat. These habitat types are only found in scattered locations within the Analysis Area: Applegate Lake, high mountain meadows such as Silver Fork Basin, and along streamsides such as the upper reaches of Donomore Creek. Willow flycatcher have been observed within and adjacent to the Analysis Area. A survey conducted in 1993 of several potential habitat areas did not locate any willow flycatcher. However, the year of the survey was not an optimal time to conduct the survey. During the survey period called for in the protocol, the willows and alders in the survey areas had not leafed out, so they did not provide suitable willow flycatcher nesting habitat. The little willow flycatcher has been captured at the neotropical migratory bird monitoring station along Carberry Creek immediately adjacent to this Analysis Area.

Livestock grazing has been identified as potentially affecting willow flycatcher habitat and reproduction. Willow flycatcher construct nests in willows within six feet of the ground; livestock grazing within suitable willow flycatcher nesting habitat can dislodge nests out of willow trees, or knock eggs out of a nest. Livestock grazing of willows can also remove or reduce suitable nesting habitat. Additionally, brown-headed cowbirds parasitize willow flycatcher nests and brown-headed cowbirds are often associated with cattle and cattle grazed areas.

Band-Tailed Pigeon

Based on analysis of 10 year and 23 year breeding bird surveys, this species population trends shown significant declines (Andelman and Stock, 1994). Band-tail pigeons are found within the Analysis Area during both the breeding and migration periods. Large numbers of band-tail pigeons stopover within the Analysis Area during their southerly migration. The Analysis Area provides important foraging habitat for this species. Thousands of band-tail pigeons spend weeks on the District feeding on fruit of blue elderberry and Pacific madrone. These stop-over areas allow the birds to build up energy reserves to carry them on the next leg of their migration. Important stop-over sites within the Analysis Area include all the high elevation areas that contain blue elderberry (i.e., Elliott Ridge) and the forests surrounding Applegate Lake.

Although no nesting sites have been located on the District, band-tailed pigeons have been observed within the Analysis Area during the breeding season. No surveys have been conducted to locate nest sites. Nesting habitat for this species is dense pole sized conifer stands. Natural mineral springs are essential components of band-tail pigeon habitat. Mineral springs have not been identified within the Analysis Area, but have not been looked for. Mineral springs if found should be protected because they are essential for band-tail pigeons.

Band-tailed pigeons are an important prey item for peregrine falcons. Peregrine falcons likely prey heavily on the band-tailed pigeons during the times of year when large numbers of pigeons are on the Analysis Area.

Turkey Vulture:

This species population numbers have shown a significant declining trend (Andelman and Stock, 1994). The Analysis Area provides nesting, foraging, and stopover, and staging areas for turkey vultures. Nest sites are often found on cliffs and rock outcrops. Foraging habitat for the most part is the entire Analysis Area. Large numbers of turkey vultures can be found within the Analysis Area during the spring and fall migration when thousands of turkey vultures congregate within the Analysis Area. These birds spend weeks in the area preparing for their southerly migration. The turkey vultures leave when weather conditions create the strong thermals that allows them to gain the elevation necessary to fly over the Siskiyou Crest and the elevation necessary to migrate long distances with the least amount of energy use.

The Analysis Area is also breeding habitat for turkey vultures. The cliffs/rock outcrops within and adjacent to the Analysis Area provides nesting habitat and the rest of the Analysis Area provides foraging habitat. During the breeding season, Applegate Lake and the major ridges surrounding Applegate Lake are major gathering sites for large numbers of turkey vultures.

Although turkey vultures can be generally seen gliding across the entire Analysis Area, they tend to concentrate in greater numbers around Applegate Lake. Reasons for this concentrated use include: (1) the high density of riparian habitats around Applegate Lake may provide good food resources; (2) the presence of several major ridges with their associated large snags provide excellent early morning roost sites; and (3) thermal may develop better in this area because of Applegate Lake.

Morning roosts for turkey vultures are an important component of the habitat of this species. Large snags along major ridges provide these important habitat values:

1. Sunning/Preening sites -

- These large-winged birds must warm their bodies in the early morning before flying long distances and the top of snags along the major ridges are the first places to receive the morning sun.

- Sunning is a method used to control parasites.

- Morning roosts provide safe preening sites; an approaching predator is easily observed.

2. Thermals develop along major ridges before other places on the landscape.

3. The presence of large snag along the major ridges.

- Although snags are found in most forested areas, turkey vultures primarily use snags located along ridges or areas that have the same characteristics as ridge tops. Snags in these landscape positions extend above the forest canopy and are easy for the large winged turkey vulture to fly onto and off. Snags intertwined with live trees are unsafe for use by turkey vultures.

- Snags along ridge tops are easily accessed from all sides because they are not intertwined with canopies of live vegetation and extend far above the ground.

- Large snags along ridges generally have a clumpy distribution, so large numbers of turkey vultures can roost together in close proximity.

- The high landscape position afforded by large snags on major ridges, provide excellent places of observation. From this high landscape position predators can be easily seen and possibly odors of food may be more noticeable.

Andelman and Stock (1994) list neotropical migratory bird habitats within Oregon that are at risk during the next 50 years. These risk assessments were performed by the Oregon Department of Fish and Wildlife. The risks include degradation of habitat quality, and loss of the habitat from conversion to some other uses. For the Squaw/Elliott/Lake Watershed Analysis Area habitats with a high risk of loss are oak woodlands, grasslands, and riparian habitats. Habitats with a moderate rate of loss and/or conversion are wet and dry meadows, freshwater marshes, ponds, and lakes. Additionally, within the Analysis Area, mature and late-successional ponderosa pine communities are at risk.

g) Siskiyou Mountain Salamander:

The Siskiyou Mountain Salamander is a FWS Candidate Species for Federal listing as a threatened species. This salamander species is listed as sensitive by the Forest Service, Region-6 and threatened by the state of California.

The Siskiyou Mountain Salamander has an extremely narrow range and is primarily found on the Applegate RD. The species range extends to the south to the Happy Camp RD, Klamath NF; north on to BLM lands; and small populations may exist east on to the Ashland RD and west to the Siskiyou NF. However, the center of Siskiyou Mountain salamander distribution is within the Squaw/Elliott/Lake Watershed Analysis Area.

A GIS analysis indicates that there are approximately 40,000 acres of potential Siskiyou salamander habitat within the Squaw/Elliott/Lake Watershed Analysis Area. This is nearly 55% of the entire Analysis Area. Potential habitat was defined as areas where suitable landtypes, soil types, and canopy closures intersected. This habitat is distributed throughout the Analysis Area. This potential habitat should be field verified for suitability and for occupancy prior to management activities (USDA/USDI, 1994).

Habitat for this species has been described as "moist, mossy or humus covered talus and rocky outcrops, especially on north-facing slopes with dense overstory canopy" (Appendix J2; p. J2-426). The ROD provides specific Standards and Guidelines for this species habitat (USDA/USDI, 1994). In essence, the guidelines call for protecting all known populations and avoiding disturbance of talus throughout the site. Additionally, a buffer of at least the height of one site-potential tree or 100 feet horizontal distance, whichever is greater, surrounding the site, must be retained around the outer periphery of known sites; overstory trees must not be removed within the boundary of this buffer. The ROD also calls for surveys prior to implementing management activities.

Surveys of specific habitat has occurred at a cursory level across the District and Watershed Analysis Area. Occupied sites are known within the Analysis Area, with most concentrated south of Elliott Creek. A considerable amount of survey work has been conducted during 1995 as part of a Siskiyou Mountain salamander research project.

Surveys for this species are labor intensive and can only be done when environmental conditions are suitable. A study conducted on the Siskiyou National Forest for a related salamander species, the Del norte salamander, found that this species could only be found when temperature and humidity conditions were within a certain range. Survey work for Siskiyou salamander conducted over the last several years on the Applegate Ranger District indicates that this salamander can only be found when environmental conditions are within a very narrow range. Presently, the District has survey protocol for Siskiyou salamander that has been peer reviewed and accepted as adequate to survey for this salamander. The Siskiyou Mountain salamander research study mentioned has been planned and financed by private companies, State agencies and Federal agencies. A list of the participants include Rogue River, Siskiyou, and Klamath National Forests; Pacific Southwest Experiment Station, Redwood Sciences Laboratory;

Medford District, BLM; Timber Products Corporation and Fruit Growers Corporation; and California Fish and Game and Oregon Department of Fish and Wildlife. This research project was designed to learn more about the important components of Siskiyou Mountain salamander habitat, so we can better identify potential habitat and possibly manage salamander habitat. Another important aspect of the study is to determine the range of this species.

h) California Mountain Kingsnake:

The California mountain kingsnake is listed as sensitive by the Forest Service, Region-6. The California mountain kingsnake is found at the lower elevations of the watershed, particularly around Applegate Lake and the riparian zones that connect with the lake. This species is closely associated with talus/rock outcrops and riparian habitats. Surveys for the species and its habitat have not been conducted except at a project specific sites. Surveys for this species are not adequate for locating California mountain kingsnakes and no adequate survey protocol is available. To maintain populations of this species, protecting suitable habitat and habitat of their prey species is the most effective method.

i) Western Pond Turtle:

The western pond turtle is the only turtle species native to this area. This species is listed as sensitive by the Forest Service, Region-6. The FWS considers the western pond turtle a Candidate Species for listing as threatened.

Historically, this species ranged over large areas within the Applegate Valley. However, loss of slow water, aquatic habitats that has occurred since the settling of the Applegate Valley by European settlers, has reduced pond turtle populations to their present levels. Human activities that drain wetlands and remove nesting habitat continued to impact the species. Predation on pond turtles is a problem because young turtles are not surviving to become adults to replace individuals that die. Surveys conducted across southern Oregon indicate the pond turtle population consists primarily of mature individuals and the young and middle age classes are not well represented. This trend across the range of a species can lead to extinction.

Western pond turtles occupy riparian and lacustrine habitats at low to moderate elevations. Riparian habitats with aquatic vegetation and basking sites such as logs and rocks are preferred pond turtle habitat. Nesting sites for pond turtles are often located in upland areas and can be at long distance from their aquatic habitats. Grassy areas with soils soft enough to excavate are preferred nesting habitat; sunny areas within forests may also be used for nest sites. Pond turtles are known to hibernate in forests, under logs.

Although standardized surveys for this species are not available, suitable survey techniques have been developed on the District. As with Siskiyou salamander, pond turtles must be surveyed for when environmental conditions are suitable and animals are active, thus visible. Western pond turtles are found in several locations within the Analysis Area. The sighting locations range from low elevation areas along the Applegate River to high elevation sites which are at the upper elevational range for this species. Suitable habitat for pond turtles is found within the Analysis Area consists of ponds, marshes, and streams of suitable size and characteristics.

In general, Standards and Guidelines in the ROD (USDA/USDI, 1994) and in the Rogue River NF Land & Resource Management Plan (LRMP) (USDA, 1990) provide protection to pond turtles. These Standards and Guidelines call for buffers around wetlands and streams. These buffers will protect part of the pond turtles habitat, but may not protect nesting sites hibernation sites. As mentioned previously, nesting sites and hibernation sites can be some distance from the aquatic habitat and may not be included within a wetland/riparian buffer. Careful planning is necessary when activities occur around active pond turtle sites to insure managing for the entire habitat of pond turtles. Within the Analysis Area livestock grazing of occupied sites may impact pond turtles, there fore livestock should be managed to prevent loss of vegetative cover and trampling of nests, or nesting habitat.

Within the Analysis Area, potential impacts to turtles include predation, motor vehicles, and livestock grazing of riparian/aquatic vegetation within occupied sites. Turtles cross roads to get from aquatic to nesting habitat and during these migrations the turtles often get run-over by motor vehicles. Predation is a serious problem for pond turtles where they share habitats with bullfrogs and large mouth bass, two major predators of young pond turtles. The bullfrog and bass are not native to the Applegate Valley, but have introduced to this area. Bullfrogs can be found in nearly all wetland habitats in the Analysis Area. The large mouth bass is well established in Applegate and Squaw Lakes.

j) Furbearers:

Furbearers includes the American marten, California wolverine, and the Pacific fisher. Habitat for these species is found within the Analysis Area, but only the Pacific fisher has been confirmed for the Applegate District. No recent confirmed sightings of American marten and California wolverine are known for the Applegate District.

A camera survey for furbearers was conducted during 1994-95. During this study, Pacific fisher were confirmed for the District. However, no photos were taken of either wolverine or marten. This camera survey was limited in scope, so negative results are not sufficient to say that these two species are definitely not on the Applegate District. The camera survey was only conducted in several areas, the survey area only included low elevation habitats, and the project had problems with camera malfunctions.

The confirmed Pacific fisher sighting was not within the Squaw/Elliott/Lake Watershed Analysis Area. However, similar types of habitat are present within the Analysis Area as were within the Pacific fisher sighting location, so this furbearer likely is within Squaw/Elliott/Lake Watershed Analysis Area.

k) Bat Species:

All of the bat species found on the Applegate Ranger District are likely to occur in the Analysis Area (Table A-16). Myotis species are the most common group of bats found in the Analysis Area. Myotis species are known primarily as snag dependent, that is, they utilize snags as maternity sites and roost sites. Recent work conducted on the Applegate AMA demonstrates the importance of snags and large down logs as bat roost sites. M. thysanodes and Antrozoas pallidus have been shown to utilize large ponderosa pine and Douglas fir snags as roost sites. These snags are located along ridge tops and extend high above the forest canopy. Additionally, these studies indicate that these bats exhibit site fidelity to particular snags. Loss of snags used by these bats could dislocate an entire colony.

The hoary bat, Lasiurus cinereus and the silver-haired bat Lasionycteris noctivagans are foliage roosting bats. The pallid bat Antrozoas pallidus also uses rock for roost sites. Riparian zones provide the best foraging areas for bats, although the pallid bat seems to forage in upland forests. Buildings are used as hibernaculums in the winter because of the warmth provided and because of the many cavities (crevices) found in buildings. Bridges and caves scattered in the Analysis Area also provide important bat roost sites.

The ROD provides Standards and Guidelines for the management of human-made structures that are used by bats. However, the snag retention guides found in the ROD and the LRMP do not afford adequate protection for natural roosts (snags). There is a high potential for management activities to have major impacts to the breeding populations of bats located within and adjacent to the Analysis Area. Timber salvage, timber harvest, fuel-break construction can be highly impactive to snag habitat and bat populations. These activities should only be implemented with adequate safeguards to insure protection of known bat roosts, potential bat roosts, and may require surveys to determine if specific snags are being used by bats. Only by this proactive approach can we better manage the bat populations within the Analysis Area.

Table A-16: Bat Species Likely to Utilize Habitats within the Squaw/Elliott/Lake Watershed Analysis Area

Tadaarida brasiliensis	Brazilian free-tail bat
Antrozous pallidus	Pallid bat
Lasionycteris noctivagans	Silver-haired bat
Lasiurus cinereus	Hoary bat
Eptesicus fuscus	Big brown bat
Myotis californicus	California brown bat
Myotis evotis	Long-eared brown bat
Myotis volans	Long-legged brown bat
Myotis yumanensis	Yuma brown bat
Myotis lucifugus	Little brown bat
Myotis thysanodes	
Plecotus townsendi	Western big-eared bat

l) Black-tailed; Big Game Winter Range:

The LRMP has portions of the Analysis Area as black-tail deer winter range. However, black-tail deer likely use more areas than identified in the LRMP. All suitable habitats below 3,500-4,000 feet, depending on aspect, are used by black-tail deer during the winter months. Subbasins with the highest amounts of winter range are Lower Squaw, Lower Elliott, Lake, Kinney, and Mule. Summer range habitat for black-tail deer increases to the mountain tops where suitable forage and cover are available.

To mitigate for loss of forage habitat because of inundation of the Applegate Valley that is now Applegate Lake, the U.S. Army Corps of Engineers funded the conversion of a number of brushfields to improve black-tail deer forage areas. These areas are in need of re-treatment to maintain their forage characteristics.

A habitat analysis of big game winter range has not been conducted for the Analysis Area. Based on the authors observations, forage habitat within winter range is a limiting factor for black-tail deer populations. Optimal thermal cover in some areas of the winter range is also probably limiting. Summer range forage/cover has not been evaluated, but it is likely that summer range conditions are not limiting black-tail deer populations. Since summer range is so expansive, it is not expected to limit deer populations. One possible limiting factor for summer range is lack of water, particularly at the low elevations. Lack of water in other wise suitable habitat makes that habitat unusable.

Roads can have a negative impact on black-tail deer and other wildlife species and their habitats. As road densities increase, the effectiveness of the deer habitat decreases. Road densities within black-tail deer winter range may be more of a concern than across the entire deer range. During the winter, black-tail deer are concentrated into relatively small areas and they can be more easily disturbed and displaced during these periods from uncontrolled motor-vehicle use.

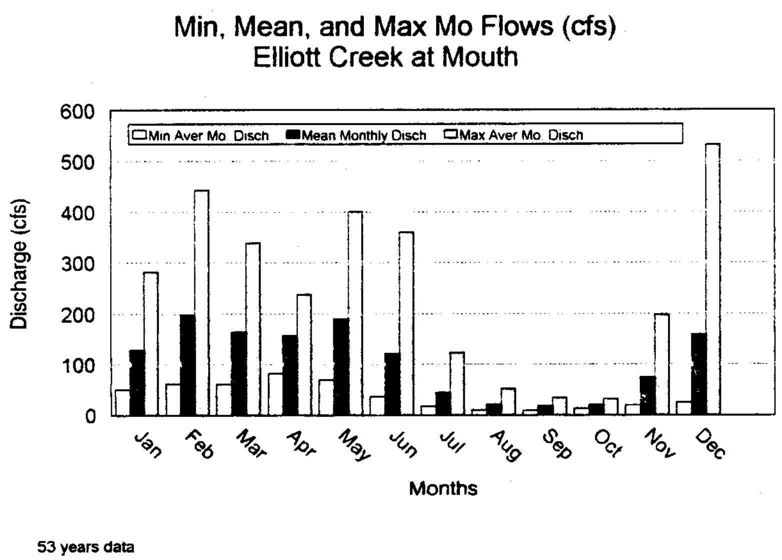
2. AQUATIC SYSTEMS

A. HYDROLOGY AND WATER USES

1. Streamflow Regime

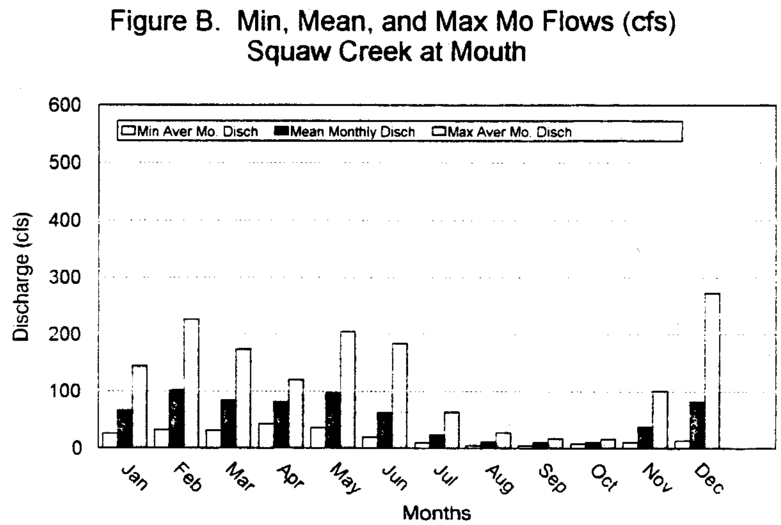
Based on 10 years of stream gage data (1977-87) for Elliott Creek near its mouth (USGS Sta #14361600), the hydrograph in **Figure A-20** displays the **seasonal pattern of runoff** at that site. **Average monthly discharges** (in cubic feet per second or cfs) are displayed. In addition to mean monthly discharges for the period of record, the minimum and maximum average monthly discharges are displayed. It is noted that individual minimum and maximum monthly values may have occurred in different years during the period of record; however, six of the minimum monthly discharges occurred in 1981 while eight of the maximum monthly discharges occurred in 1983. The instantaneous peak flow measured on Elliott was 3980 cfs on December 19,1981, and the instantaneous minimum discharge was 3.9 cfs on September 10, 1980. The instantaneous peak was no doubt much greater during the 1964 and 1974 floods; the minimums were very likely lower during the 1977 and/or 1994 runoff years. Average annual water yield from Elliott Creek basin is about 78,000 acre/feet.

Figure A-20: Monthly Streamflow for Elliott Creek



The hydrograph in Figure A-21 displays the seasonal pattern of natural unaltered flows expected at the mouth of Squaw Creek. It is based on an extrapolation of the data from Elliott Creek (the adjacent subbasin of similar geology). Extrapolated values were adjusted slightly downward since the Squaw Creek drainage receives less overall precipitation (average 35 inches verses 43 inches per year) than Elliott Creek. Even then, the Squaw Creek summer flows may be slightly less than shown in Figure A-21 since a higher proportion on Elliott Creek is above 5000 feet, which suggests delayed surface runoff from snowmelt longer into the summer in that drainage; 43 percent of Elliott Creek drainage is in the snow zone verses 14 percent of Squaw Creek. The winter storage of 1,100 acre-feet in Squaw Lakes does not appreciably influence downstream winter flows. However water is retained to maintain the water level of Lower Squaw Lake during the summer high recreation use period; although water is released for minor downstream private uses and for fish, the amounts of summer flows in lower Squaw Creek is again likely less than the unaltered flows displayed in Figure A-21. Based on size of watershed, the expected instantaneous peak and minimum discharges at the mouth of Squaw Creek are lower than in Elliott Creek. Average annual water yield from Squaw Creek basin is estimated to be 40,000 acre/feet.

Figure A-21: Monthly Streamflow for Squaw Creek



While there are few (Elliott Creek 1977-87) or no streamflow records for subbasins within the Analysis Area, long-term data from the Applegate River gage near Copper (USGS #14362000) and from other nearby gages reveal that the **1974 flood** was the greatest recorded event for most streams in this region. That was estimated to be greater than a 100-year flood. The **1964 flood**, while of lesser magnitude than 1974, also approached the 100-year event, and reportedly was more damaging to property values in some areas of Southwestern Oregon. Other **historic floods (since the arrival of European settlers) occurred in 1853, 1861, 1890, 1927, 1948, and 1955.** Since there is very little human habitation of the Analysis Area, flood damage to building structures has been minor. Roads and drainage crossings are the human improvements that have been most effected by floods.

Flood events have typically occurred during the winter months coinciding with the convergence of extreme conditions involving high-intensity long-duration tropical storms on heavy snowpacks and saturated ground conditions. Subbasins with substantial proportions of their acreage in the transient snow zone (estimated between about 4000-5000 feet elevation) expectedly receive the most pronounced flooding due to the synchronization of rain-on-snow events. Table A-17 displays the proportions of each of the nine subbasins within the Analysis Area that are within the rain-dominated (<4000 feet), transient snow (4000-5000 feet), and snow-dominated (>5000 feet) zones.

Table A-17: Subbasin Distribution of Dominant Forms of Precipitation

Subbasin	Proportional Distribution of Dominant Form of Precipitation (Percent of Watershed Area)		
	Rain Dominated	Transient Zone	Snow Dominated
Upper Elliott Cr	7	23	70
Lower Elliott Cr	76	20	4
Dutch Cr	33	31	36
Joe Cr	46	30	24
Upper Squaw Cr	35	43	22
Lower Squaw Cr	82	18	--
Lake	99	1	--
Kinney Cr	93	7	--
Mule Cr	92	8	--
Total Elliott Watershed*	33	24	43
Total Squaw Wtershed**	53	33	14

* Includes Upper Elliott, Lower Elliott, Dutch, and Joe Cr Subbasins
** Includes Upper and Lower Squaw Creek Subbasins

No effort was made to construct a monthly hydrograph for Kinney and Mule Creeks. The geology of these watersheds, as well as precipitation pattern is significantly different from Elliott Creek so that that data is not useful for extrapolation. However both Kinney and Mule Creeks display annual runoff patterns similar to Elliott and Squaw Creeks except that Mule Creek typically becomes dry by June of most years and remains so until the autumn rains. Kinney Creek summer flows become so low as to be measured in terms of gallons per minute (gpm).

2. Effects of Land Use on Flow Regime

Human processes such as **roading and timber harvest** do not noticeably influence large catastrophic events (e.g. the 1964 and 1974 floods) on main stem rivers such as the at the mouth of Elliott and Squaw Creeks, and the Applegate River; they have a more noticeable effect on the flows of smaller tributary streams. Tributaries with substantial impacts from logging and roading, are likely displaying increases in the high flows which may in turn be accelerating channel-altering processes (scour and deposition) depending on inherent channel resistance.

3. Water Uses/Water Rights:

The primary water uses within the Analysis Area are associated with the Applegate Reservoir, a Corps of Engineer project constructed for flood control and irrigation of the Applegate Valley. It is also heavily used for recreation as a secondary benefit. At capacity, the Reservoir has about 990 surface acres and contains 82,000 acre-feet of water of which 26,000 acre-feet is allocated to downstream irrigation uses (mostly below the Analysis Area). **Flows in the Applegate River below Applegate Dam are regulated by that impoundment** so that the effect has been to alter the hydrograph by moderating historic highs and low flows. Therefore summer flows are greater than historic unaltered flows while winter high flows and peak flows have been generally reduced subject to flood control and projected irrigation needs.

Overall there is very little consumptive use of waters within the 73,000-acre Analysis Area. Consumptive uses are those where water is consumed (and not available for re-use); domestic, irrigation, stockwater, firefighting and road watering are the consumptive uses found in the Squaw/Elliott/Lake Analysis Area. Other uses are for non-consumptive purposes wherein water is used for a beneficial use but is still available for re-use downstream; mining, maintenance of fish habitat, and recreation are existing non-consumptive uses in this Analysis Area. Power generation at Applegate Dam is a possible future use.

Water rights currently being exercised within the Analysis Area are primarily located in Squaw Creek and French Gulch. There are about a dozen rights for fish, irrigation, domestic, mining and stockwater uses in the two miles of Squaw Creek above Squaw Lakes. There are 8-10 rights to water for domestic, stock, fish and irrigation use on lower Squaw Creek near its mouth and at Dividend Bar. There are several rights to water for domestic use and irrigation of gardens on private property in French Gulch. Total consumptive uses in these streams is small. The Forest Service has acquired ownership of three old consumptive use water rights in Lower Squaw Creek, and has transferred those uses to maintenance of lake levels in the lower Squaw Lake during the summer recreation use period. The effects, if any, of these water uses on normal summerflows and fish habitat in Squaw Creek is unknown.

There are only four water rights in the entire Elliott Creek drainage; the total use is only several thousand gallons per day for domestic, wildlife, stockwater, and minor pasture irrigation. The Brushy Creek drainage below Applegate Dam has some mining use of about one cfs, and there are no known uses in Mule and Kinney Creeks.

Other consumptive uses exercised throughout the Analysis Area by the Forest Service include watering of roads for dust abatement and fire fighting. The timing and place of use of this water is variable and depends on timing of such management activities as timber harvest and on incidence of wildfire. There is also some minor developments for wildlife and stockwater use.

The **future trend** in water use that there will be no change from the present. The minor amount of private land that is not industrial forest land is already at or near maximum development under current zoning. Water use on industrial forest and public lands is not expected to change.

4. Channel Modifications

Extreme climatic and flood events may result in the introduction, movement, and/or repositioning of channel substrate. That, and lateral (bank) cutting and scour of riparian vegetation, may result in disruption of the aquatic habitat and dependent biotic communities. The degree of disruption and recovery time is largely influenced by human processes that affect the natural runoff (headwater streams), erosional, and sedimentation processes within a watershed, and that affect the adjacent riparian zone (Riparian Reserves). Since there has not been a major flood event since 1974, and since much of the roading and harvest activity in these subbasins has occurred since then, it is not known to what extent a major flood would contribute to changes in the existing physical habitat owing to the altered sediment regime and the alteration of Riparian Reserves within these subbasins.

5. Trends

The expected **future trend** is that **large flow events** on main stem streams (Lower Squaw and Elliott Creeks) and on relatively undisturbed Dutch and Mule Creeks, will not change noticeably from the past or present. As the Northwest Forest Plan is implemented, it is expected that peaks witnessed in headwater streams of Elliott, Squaw, Kinney, and Joe Creeks, and some Lake facing streams, will slowly decrease to historic levels. This envisions hydrologic recovery of these heavily regenerated drainages, and watershed restoration activities envisioned in the Northwest Forest Plan. Since water use is already minor in the Analysis Area, the future trend for **low flows** is essentially no change from the current. The five miles of Squaw Creek below the Squaw Lakes will likely continue to experience somewhat lower than natural unaltered flows owing to the assumed continued interest in maintaining the water levels in the Lower Squaw Lake during the recreation season. The two miles of Squaw Creek above Squaw Lakes will also likely experience lower flows during summer withdrawals for irrigation.

B. WATER QUALITY (Sediment/Turbidity, Temperature, Heavy Metals)

Pursuant to requirements of the Clean Water Act, the Oregon Department of Environmental Quality (DEQ) completed the Statewide Assessment of Nonpoint Sources of Water Pollution (Oregon DEQ 1988). Although the 1988 DEQ assessment did not identify any impacted beneficial uses in the Oregon portion of the Squaw/Elliott/Lake Watershed Analysis Area (i.e. Squaw Creek, Mule Creek, Kinney Creek and Lake subbasins), it notes that this determination may be because of lack of water quality data at that time. No information has been found as to the State of California's assessment of Elliott Creek. Except for some 1993 USFS stream temperature data for the Applegate River at Copper Creek (below Applegate Dam), some 1993 USFS temperature data for lower Squaw Creek, some 1977-87 USGS and 1994 USFS temperature data for Elliott Creek, and some chemical analyses for Joe Creek, there is no known water quality data for the Analysis Area. Based on this limited data, stream survey findings, and visual observations of high and low flows, it is believed that turbidity and sedimentation are the primary water quality attributes that have been affected by human processes within the Analysis Area; by comparison, water temperatures (Squaw Creek) and toxic metals (Joe Creek) are secondary concerns.

The Oregon DEQ 1988 Assessment identified domestic use, irrigation, stockwater, coldwater fisheries, other aquatic, and aesthetics as impacted beneficial uses in the Applegate River **beginning 10 miles downstream of the Squaw/Elliott/Lake Watershed Analysis Area** near its confluence with the Little Applegate River. This is evidenced by high turbidity, high sediment loads, low dissolved oxygen (DO), high bacteria, elevated nutrient levels, introduction of pesticides, and insufficient stream structure. While the DEQ Assessment did not find water quality and beneficial uses impacted within this Analysis Area, the **cumulative effects** of activities in the Analysis Area and the main stem of the Applegate River and its tributaries below the Analysis Area have resulted in "moderate" impacts to water quality and habitat in the middle and lower Applegate River.

1. Sediment and Turbidity

Since sediment data is not available for Squaw/Elliott/Lake Watershed Analysis Area, sediment delivery is described anecdotally, based on visual observations and on interpretations of fish habitat survey information where it exists. Surveys have been completed for Squaw Creek and Elliott Creek including Silver Fork tributary. Field reconnaissance was completed on all subbasins except for upper Joe Creek.

Being located in areas dominated by soils parented in mica schist of the Condrey Mountain Formation, high turbidity has been regularly observed in Squaw and Elliott Creeks during storm-generated surface runoff. The sediment generated from these sites is largely composed of sand and silt-sized platelike mica particles which remain in suspension similar to fine-textured silts. Much of the finer sediment is transported into Applegate Reservoir and the finest material is discharged from Applegate Reservoir during lake drawdown. Much of the coarser material is observed deposited in the slow water areas (i.e. stream margins and floodplains) of Squaw and Elliott Creeks. Embeddedness of gravels with sediment has been observed in Squaw, Elliott, and lower Dutch Creeks. See the fish habitat section for a discussion of effects of this sediment of fish habitat and populations.

Except for observed turbidity in Kinney and Mule Creeks during some storm events, nothing is known of the sediment regime in these streams. No stream habitat survey has been done for Kinney or Mule Creek. The soils in these watersheds are derived primarily from metavolcanics and metasediments so that the erosion and sediment potential is lower here than from mica schist soils in Elliott and Squaw Creeks. Any sediments originating in Kinney and Mule Creek subbasins ultimately enters the Applegate River below Applegate Dam where the river supports an anadromous fishery.

The human processes most responsible for sedimentation are roading and timber harvest operations (yarding, landings, etc.). **Roads are the primary contributors of sediment to aquatic systems** and the magnitude of input is directly related to overall road density, road proximity to riparian areas, and the inherent erodibility and mass wasting potential of roaded areas (Geomorphology, Road Associated Erosion). Sedimentation from mining and grazing are secondary but the effects of their contribution on aquatic values in this Analysis Area is not known.

Table A-18 displays the extent of roading in the nine subbasins within the Analysis Area. Road densities are high in Upper Elliott, Upper Squaw, and Joe subbasins. They are moderate in Lower Elliott, Lower Squaw, and Kinney subbasins, and are low in Mule, Dutch, and Lake facing stream subbasins. Prior to World War II, road development was mainly associated with mining, access to private lands/ranches, and limited amounts of logging. With the post-World War II boom, road development increased sharply in conjunction with the acceleration of timber harvesting. In the 1970s and 80s, intensive timber harvesting continued to add to road development in the Analysis Area (Appendix F, Historic Human Processes Influencing Current Watershed Conditions).

Table A-18: Comparison of Roading by Subbasins

Subbasin	Area (sq mi)	Road Miles*	Road Density (mi/sq mi)
Upper Elliott Cr	26.2	91.5	3.5
Lower Elliott Cr	14.2	29.1	2.0
Dutch Cr	10.7	15.2	1.4
Joe Cr	5.4	17.4	3.2
Upper Squaw Cr	18.5	71.2	3.8
Lower Squaw Cr	10.9	23.4	2.1
Lake	11.7	17.3	1.5
Kinney Cr	6.7	12.5	1.9
Mule Cr	9.9	10.3	1.0
All	114.2	287.9	2.5

*** Includes only system roads.**

Roading within riparian areas is displayed in Figure A-22. Riparian areas are defined here as Riparian Reserves (Northwest Forest Plan - ROD S&Gs pages B-12 through B-17, C-30 & C-31). While Riparian Reserves do not apply to private lands, the same widths are used here on all ownerships only for analysis purposes.

Road miles within the components of Riparian Reserves associated with streams and wetlands is displayed in Table A-20. (Other components of Riparian Reserves not displayed in the table are associated with lakes, reservoirs, ponds and geologic instability.) From Table A-20, it is apparent that nearly half (almost 28 miles) of all roads located within streamside Riparian Reserves are located adjacent to Class 1 and 2 (fish bearing) streams, which comprise only 12 percent of the total stream miles within the Analysis Area.

Riparian Reserves most impacted by roading are located in Lower Elliott, Upper Squaw, and Lower Squaw subbasins. These subbasins show nearly a one-to-one ratio of road miles to stream miles. While Joe Creek and Mule Creek subbasins display high road mile to stream mile ratios, it is noted that Joe Creek has a minor amount of fishery and that most of the roading in Mule Creek subbasin is actually adjacent to the Applegate River. The high ratio of road miles to stream miles in Kinney Creek is attributed to both roading along the Applegate River and along

Squaw/Elliott/Lake Watershed Analysis Area

Roads Crossing Streamside Riparian Reserves

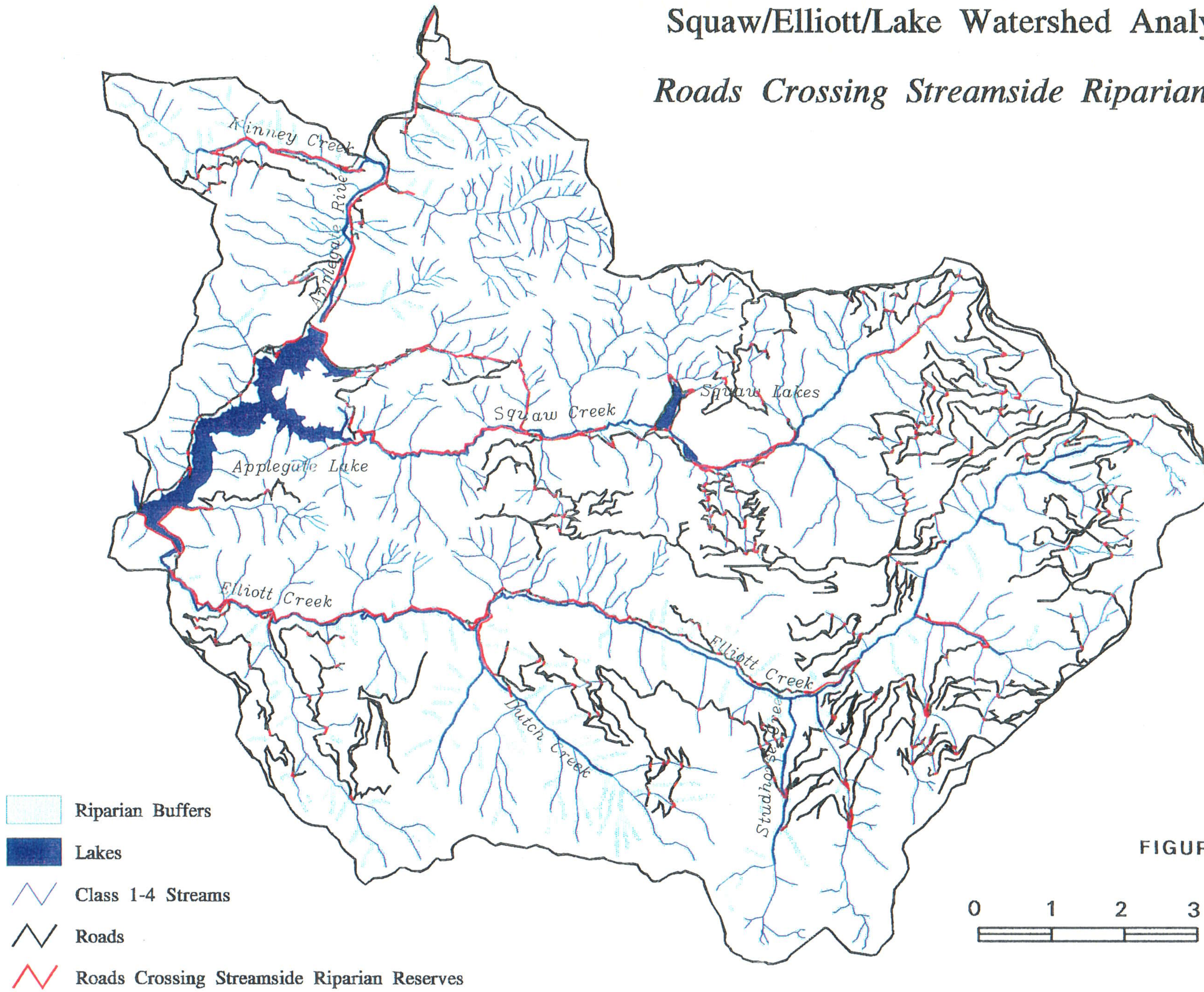


FIGURE A-22

the lowest two miles of Kinney Creek. Roading is low within Riparian Reserves adjacent to fish bearing streams in Dutch, Lake and Upper Elliott subbasins as well as the main stem of Mule Creek.

Roading is not substantial within wetlands. Upper Elliott subbasin has 77 percent of all wetlands in the Analysis Area, and 66 percent (1.5 miles) of the total roading within wetlands.

Roads located in soils and landforms of the Condrey Mountain Formation have very high potential to erode or slide and are the greatest sediment producers in the Analysis Area. This potential and/or active sediment source area includes all of Upper and Lower Elliott, Dutch, and Joe Creek subbasins, and the southern two-thirds of Upper and Lower Squaw subbasins. Further discussion on road associated erosion is contained in Geomorphology, Road Associated Erosion.

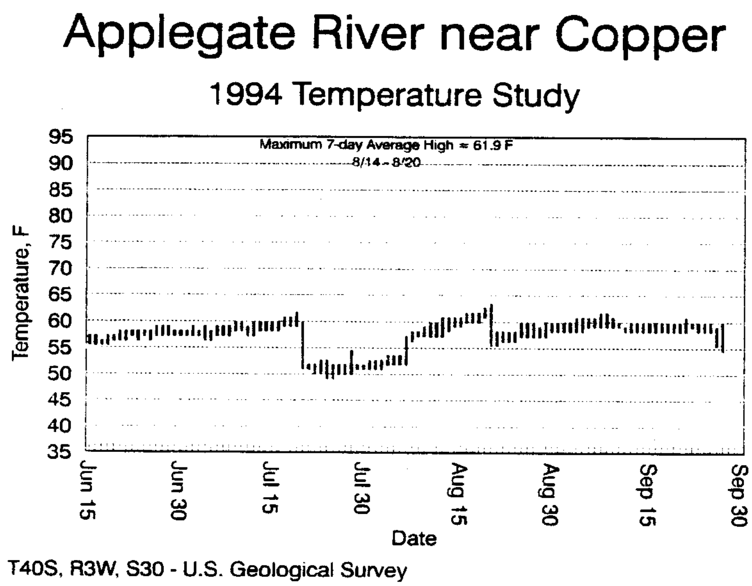
The projected **future trend of roading** in the Analysis Area is largely predicated on implementation of the Northwest Forest Plan. Any new road construction within already roaded areas will likely be minor, particularly within Riparian Reserves. There will likely even be a net decrease of roads in already roaded areas as many of them are decommissioned or restored as part of the restoration strategy in the Northwest Forest Plan. Highest priority for restoration will be in Riparian Reserves, on unstable and high sediment producing sites on the mica schist, and where there are excessive road densities. These areas are mainly in the Upper and Lower Elliott, Upper and Lower Squaw, and Joe subbasins. It is not expected that there will be significant road building in the unroaded portions of Dutch and upper Joe Creek subbasins where they are included in the Applegate-Oak Knoll LSR. The unroaded portions of Mule and Kinney Creeks, and smaller portions of French Gulch and Squaw Creek subbasins, may or may not remain that way subject to review of (future) project proposals under the NEPA (EIS) process.

It is expected that the **future trend** will be a gradual reduction in sediment yield in Squaw Creek, Kinney Creek, lower Dutch Creek, Joe Creek, and Lake facing stream subbasins; this expectation is based on the very limited private land ownership in these subbasins, and the assumption that the Northwest Forest Plan will be implemented on public lands. This Plan emphasizes watershed restoration and hydrologic recovery of recently regenerated areas. Historic rates of sedimentation will not be achieved in these streams although they should be reduced to levels that will sustain healthy populations of resident fish. A smaller reduction of sediment yield is expected in Elliott Creek; this is based on the same assumptions of implementation of the Northwest Forest Plan on public lands, but no change in current direction concerning harvest and roading activities on about 5,000 acres of private lands. Historic sediment loads will not be achieved in Elliott Creek and resident fish populations will likely continue to be affected. Since upper Dutch and Mule Creek subbasins are relatively pristine, sediment yields will not change there.

2. Water Temperatures

Water temperatures in the **main stem Applegate River** are influenced by the operation of water releases from Applegate Dam. Data collected in 1993 (Figure A-23) show that water temperatures below the dam may remain in a narrow (diurnal) range between 60-65 degrees F for a period of up to 1 ½ months from July into August. This is within the "good-fair" range desired by anadromous and other coldwater fish

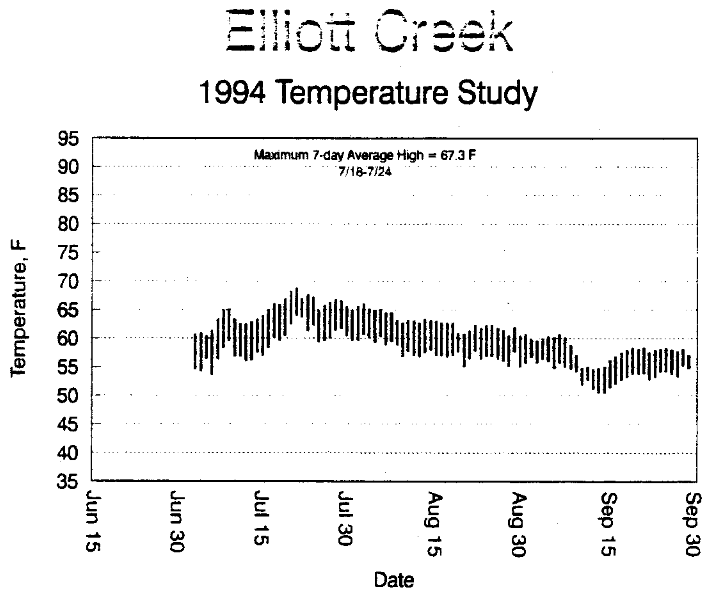
Figure A-23: 1994 Temperature Study for the Applegate River



It is likely that summer water temperatures have been elevated in **Squaw Creek below Squaw Lakes** owing to maintenance of lake levels in Squaw Lakes during the summer recreation season. Temperatures near 70 degrees F were recorded during the July 1993 Level II Stream Survey of this portion of Squaw Creek. The duration and impacts of these temperatures on fish populations is unknown so that it is desirable to perform additional monitoring of temperatures and aquatic fauna. Although there is no data for **Upper Squaw Creek**, there are about a dozen water rights in the two miles of stream above the Squaw Lakes, including irrigation use; the effects this has, if any, on streamflows and stream temperatures is unknown.

Temperature data collected on **Elliott Creek** from 1978-87 shows daily mean temperatures reaching 65 degrees F in late July and early August. Elliott Creek data collected in 1994 (Figure A-24) showed that stream temperatures fluctuated mostly between 60-65 degrees F from around July 1 into August. The maximum 7-day average high for that period was 67.3 degrees but it is noted that 1994 was an exceptional drought year generating extremely low flows. The preliminary conclusion from this data is that lower Elliott Creek summer temperatures generally enter the "good-fair" (61-64 degree F) range desired by cold water fisheries for a duration of about two months.

Figure 24: 1994 Temperature Study for Elliott Creek



T48N, R11W, S17 - Applegate RD, Rogue River NF

The expected future trend is that stream temperatures below Applegate Dam, and Squaw Creek below Squaw Lakes will not change; this assumes the continued operation of water releases from these impoundments for existing beneficial uses. Temperatures in Dutch Creek likewise will remain similar to current conditions; this is because Riparian Reserves are largely intact as pertains to the provision of stream shade and will remain in that condition. With implementation of the Northwest Forest Plan it is expected that there will be a gradual small improvement (decrease) in summer temperatures in Kinney, Joe, Upper and Lower Elliott, and Upper Squaw Creeks owing to recovery of Riparian Reserves on public lands. Temperatures are not a concern in Mule Creek because it typically becomes dry by June and remains that way until the fall rains.

3. Toxic Metals

The three miles of Joe Creek below the entry of mine drainage from the Blue Ledge Mine have very high conductivity and high levels of copper, zinc, and iron. Concentrations are well over the optimum levels recommended for coldwater fisheries. As a consequence, fish and other aquatic organisms are missing in this section of Joe Creek. Limited water quality analyses to date indicates that the addition of toxic metals from Joe Creek has not affected aquatic life in Elliott Creek below their confluence; this is undoubtedly attributed to the large dilution factor of Elliott Creek flows. Monitoring of fish and macroinvertebrates in Elliott Creek is recommended to verify this. Unless concentrations of toxic metals from Joe Creek are impacting Elliott Creek fisheries values, and unless technology to economically correct sources of toxic heavy metals from Blue Ledge Mine drainage becomes available, it is expected that in the **future** lower Joe Creek will remain lost as a fishery.

C. RIPARIAN HABITAT

1. Riparian Reserves

Riparian Reserves are allocated by the ROD primarily to protect and restore the health of aquatic systems and their dependent species. Riparian Reserves will also help to maintain and restore riparian structures and functions, conserve habitat for organisms dependent on the transition zone between riparian and upland areas, improve travel and dispersal corridors for terrestrial animals and plants, and provide for a greater connectivity of late-successional forests. See Appendix A, Terrestrial Wildlife for further discussion on wildlife habitats and riparian areas.

"Riparian Reserves are along all streams, wetlands, ponds, lakes, and unstable or potentially unstable areas where the conservation of aquatic and riparian-dependent terrestrial resources receives primary emphasis." (ROD, p. 7). The following table displays Riparian Reserve Widths identified by the ROD, as applied to the Analysis Area:

Table A-19: Riparian Reserve Widths as Applied to the Analysis Area

Water Body Category	Riparian Reserve Width
Fish-bearing (Class 1 and 2) **Streams, Natural Lakes**	**300 feet** slope distance on both sides of streams (600 feet total, including both sides of the stream) and adjacent to lakes.
Permanently flowing, **non-fish bearing** (Class 3) and seasonally flowing or intermittent, **non-fish bearing**(Class 4) streams, **Wetlands >1 acre, Constructed Ponds and Reservoirs**	**150 feet slope distance,** (300 feet total, including both sides of the stream).
Wetlands <1 acre, unstable or potentially unstable areas.	**The extent of the riparian vegetation and/or unstable or potentially unstable area.**

For this watershed analysis, Riparian Reserve widths were used to analyze the conditions of riparian vegetation both on and off National Forest lands to provide a landscape perspective of the overall condition of riparian corridors. However, the Riparian Reserve land allocation applies only to National Forest and Bureau of Land Management lands. The analysis of specified widths of riparian habitat may be referred to interchangeably throughout this document as Riparian Reserves and riparian areas, both terms imply the same meaning.

a) Hydrologic Features (Streams, Lakes, Reservoirs, Wetlands)

Streams, lakes, reservoirs, and wetlands are displayed in Figure A-25. The miles of streams by stream class and subbasin are displayed in Table A-20; Class 1 and 2 (fish bearing) stream miles are combined. Within the Watershed Analysis Area, 12 percent of streams are fish bearing, 13 percent are Class 3 (non-fish bearing, perennial), and 75 percent are Class 4 (non-fish bearing,

Squaw/Elliott/Lake Watershed Analysis Area

Hydrologic Features

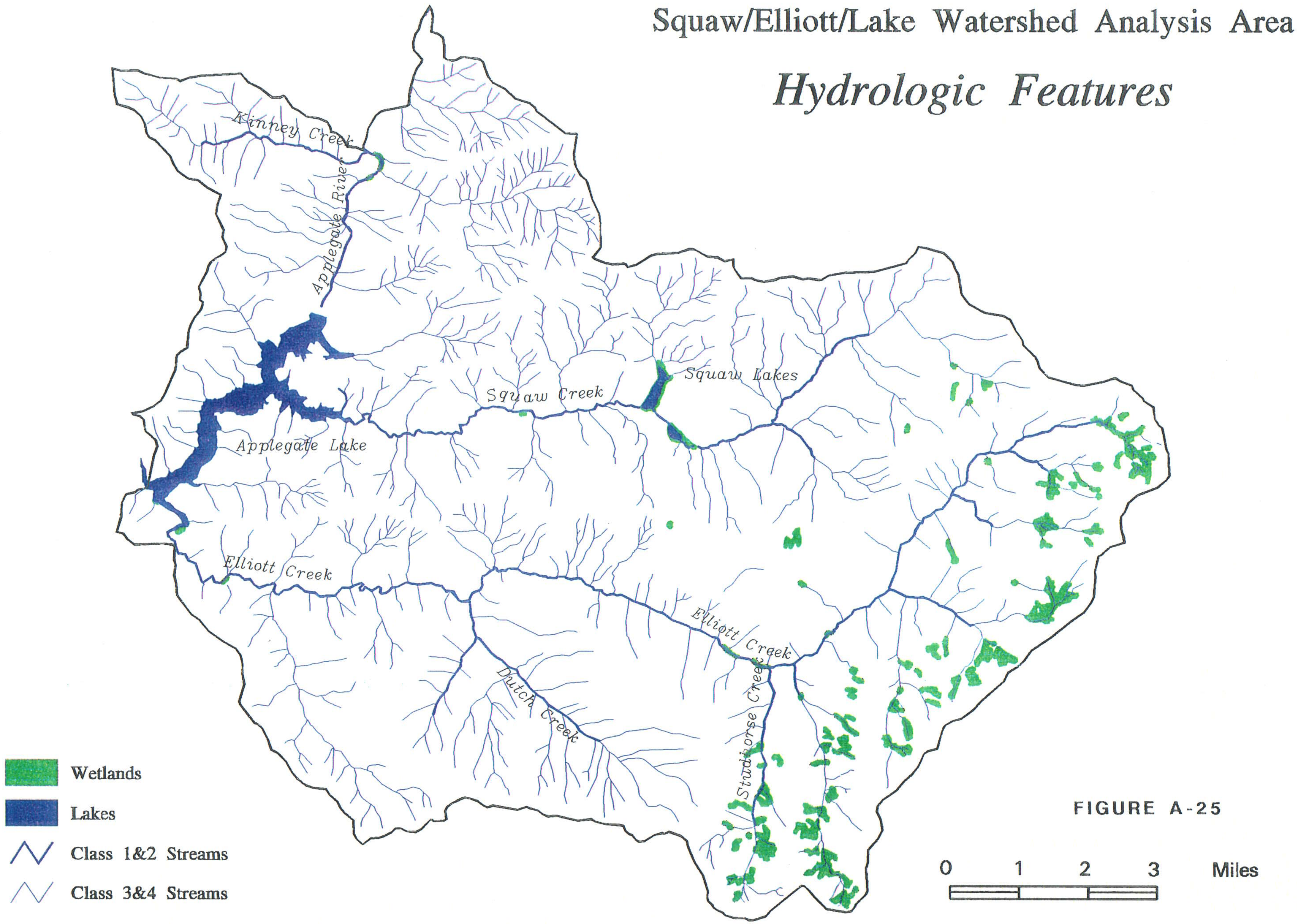


FIGURE A-25

intermittent) streams. Streamside riparian habitats consist of conifer forests, montane hardwood forests, grass/forb meadows, and non-vegetated areas. Conifer forests are the most common vegetation type within streamside riparian zones (Table A-20). Along the alluviated canyons the last appreciable flood occurred about 20 years ago resulting in a distinct class of young riparian trees, typically alders, in the flood zone, e.g., Squaw and Elliott Creeks and Silver Fork of Elliott Creek.

Natural lakes in the Analysis Area include the two Squaw Lakes, Kettle Lake, and Summit Lake. A dam constructed at the outlet of lower Squaw Lake allows for 1,100 acre feet of storage of water above the natural pool, and is available for downstream release during summer months.

The most dominant water body within the Analysis Area is Applegate **Reservoir**, completed in 1980. This reservoir has a maximum capacity of about 82,000 acre feet and has a surface area of about 990 acres when full.

Wetlands comprise approximately 800 acres of the Analysis Area (Table A-20). These wetlands consist of wetland shrub communities, wet grass/forb meadows, alder glades, wet conifer forests, bogs, springs, and seeps. Wetland habitats are mostly distributed at the high elevations (above 5,000 feet) in the headwaters of the major streams within the Analysis Area. The highest concentration of wetlands are within the Upper Elliott (approximately 600 acres) and the Upper Squaw (115 acres) subbasins (Table A-20).

2. The Effects of Human Processes on Riparian Habitat Conditions

The **historic condition** of Riparian Reserves is not known for certain. However, it is generally acknowledged from historical accounts that most of the Riparian Reserves which were not in a "permanent" montane hardwood forest type or a non-forest type (grass, herbaceous, shrub, or barren rockland) possessed late successional characteristics associated with large conifer trees. Many of these Riparian Reserves were believed to have maintained late-successional forest with open parklike conditions due to frequent fires, especially at lower elevations. They provided many of the beneficial attributes of late-successional forest stands for both terrestrial and aquatic habitats and species (e.g. shade, cover, and large wood for channel structure).

The current distribution of late-successional, mid-successional, and early succession forest within riparian areas varies by subbasin. Figures A-26 through A-34 display the distribution (by subbasin) of forested successional stages as well as non-forested habitats.

Squaw/Elliott/Lake Watershed Analysis Area

Streamside Riparian Successional Stages
Upper Elliott Subbasin

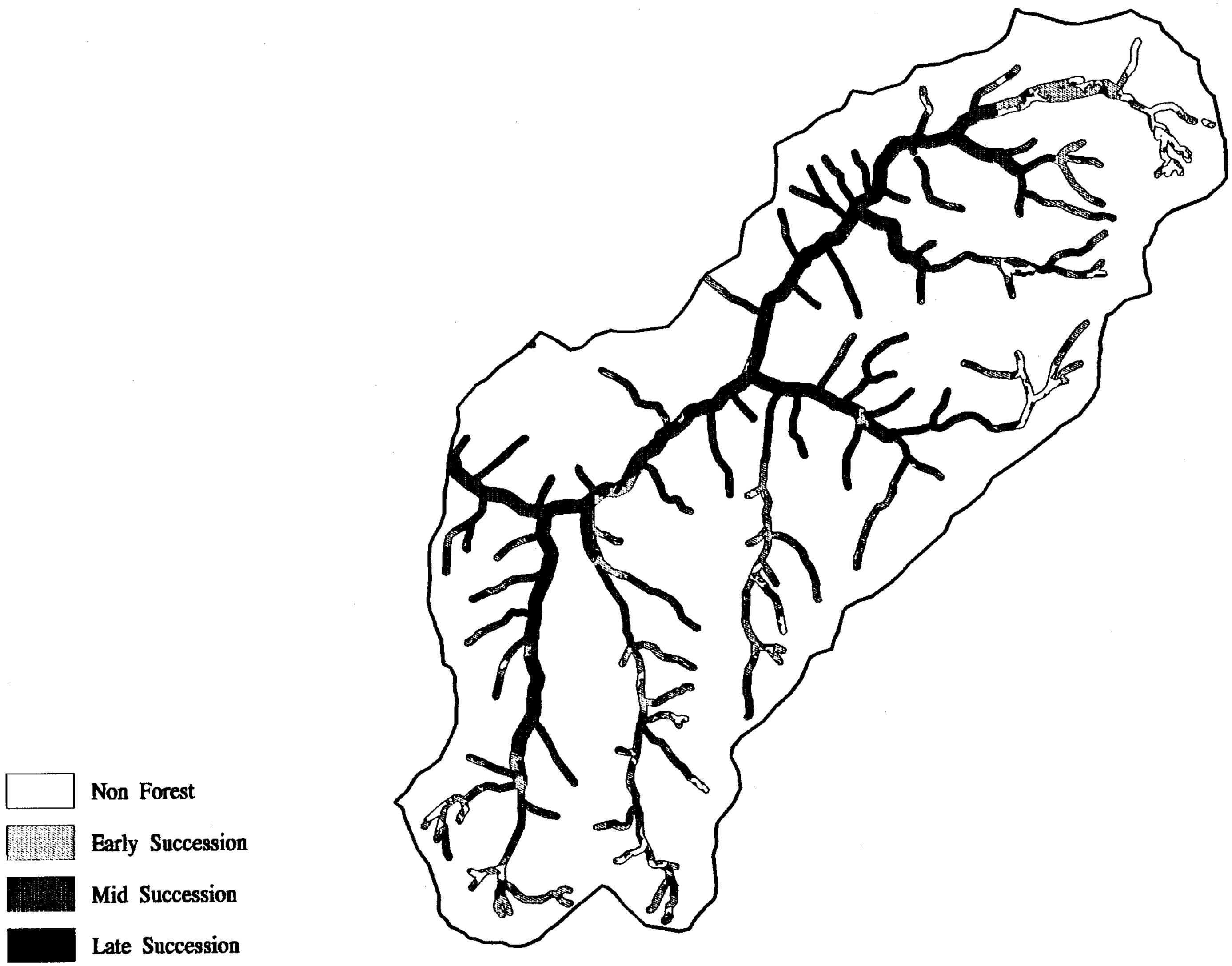


FIGURE A-26

Squaw/Elliott/Lake Watershed Analysis Area

Streamside Riparian Successional Stages
Lower Elliott Subbasin

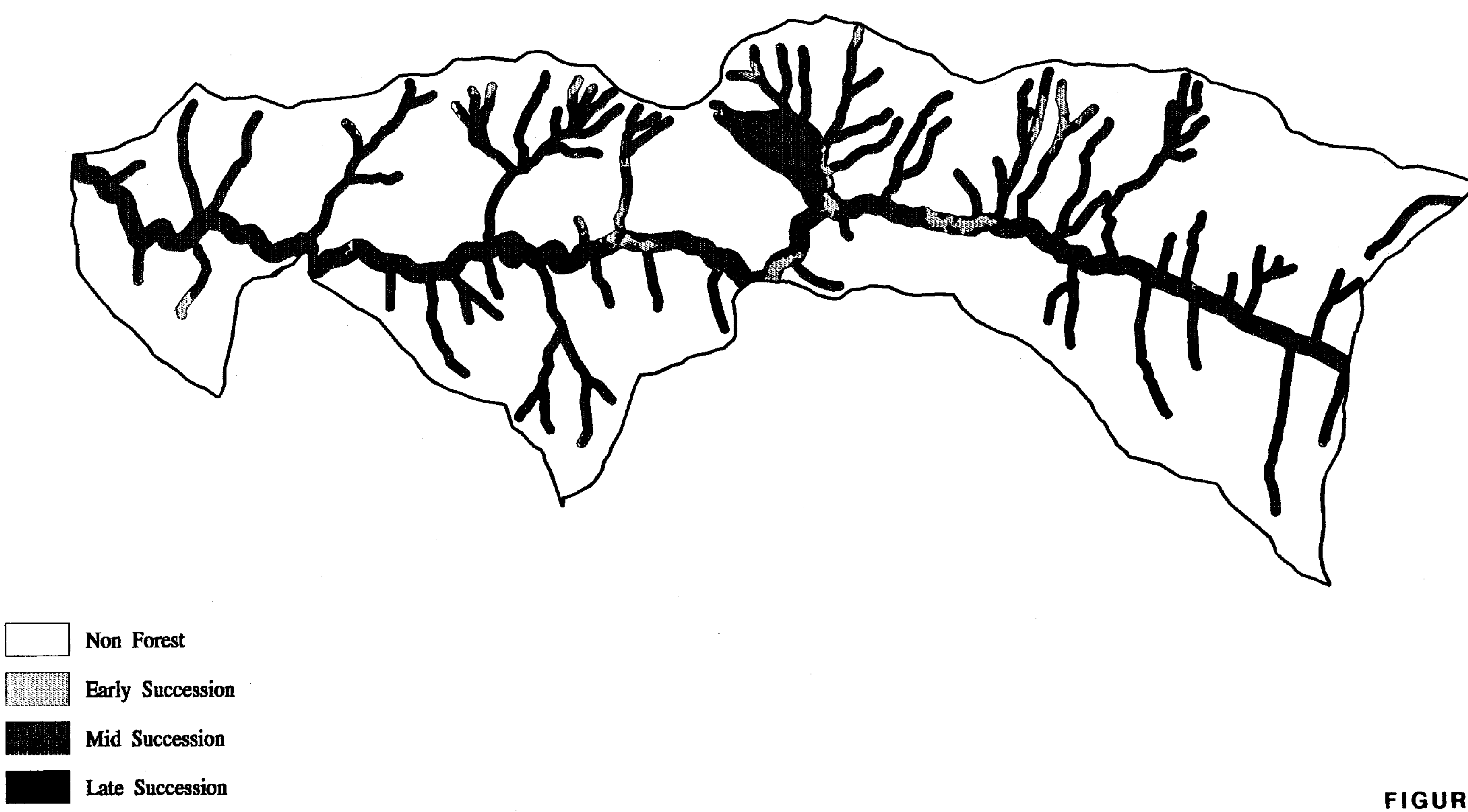


FIGURE A-27

Squaw/Elliott/Lake Watershed Analysis Area

Streamside Riparian Successional Stages
Upper Squaw Subbasin

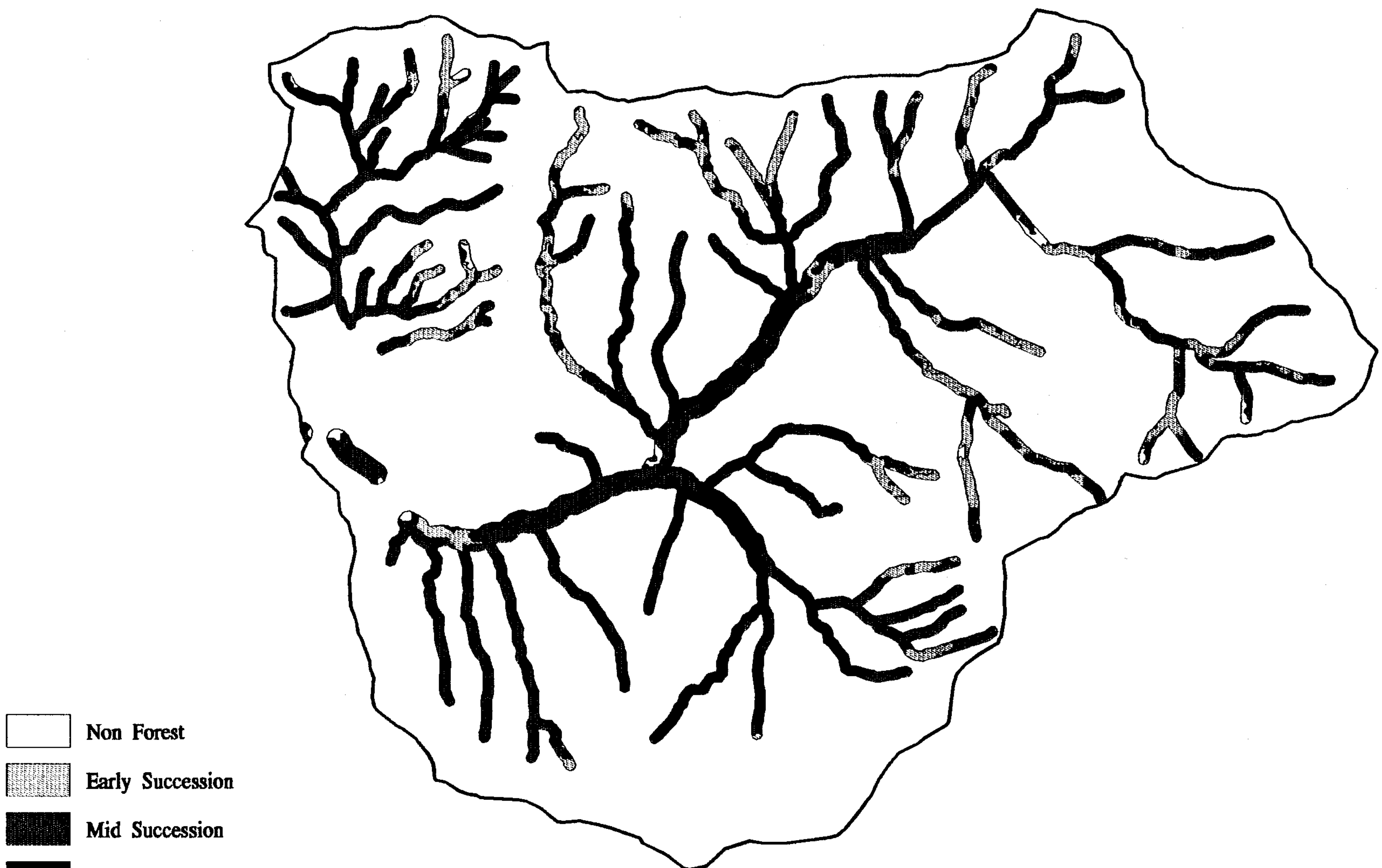


FIGURE A-28

Squaw/Elliott/Lake Watershed Analysis Area

Streamside Riparian Successional Stages
Lower Squaw Subbasin

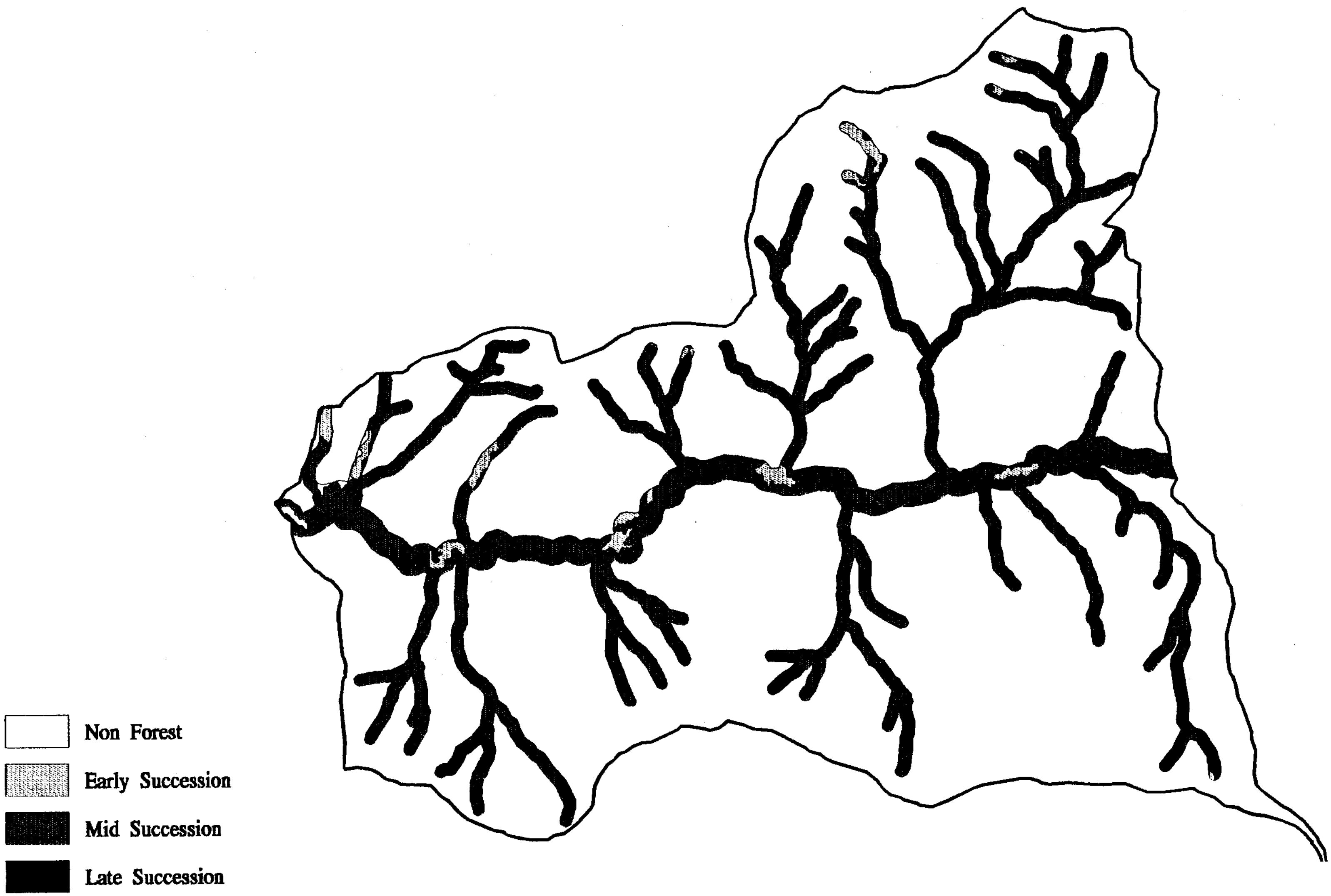


FIGURE A-29

Squaw/Elliott/Lake Watershed Analysis Area

Streamside Riparian Successional Stages
Dutch Subbasin

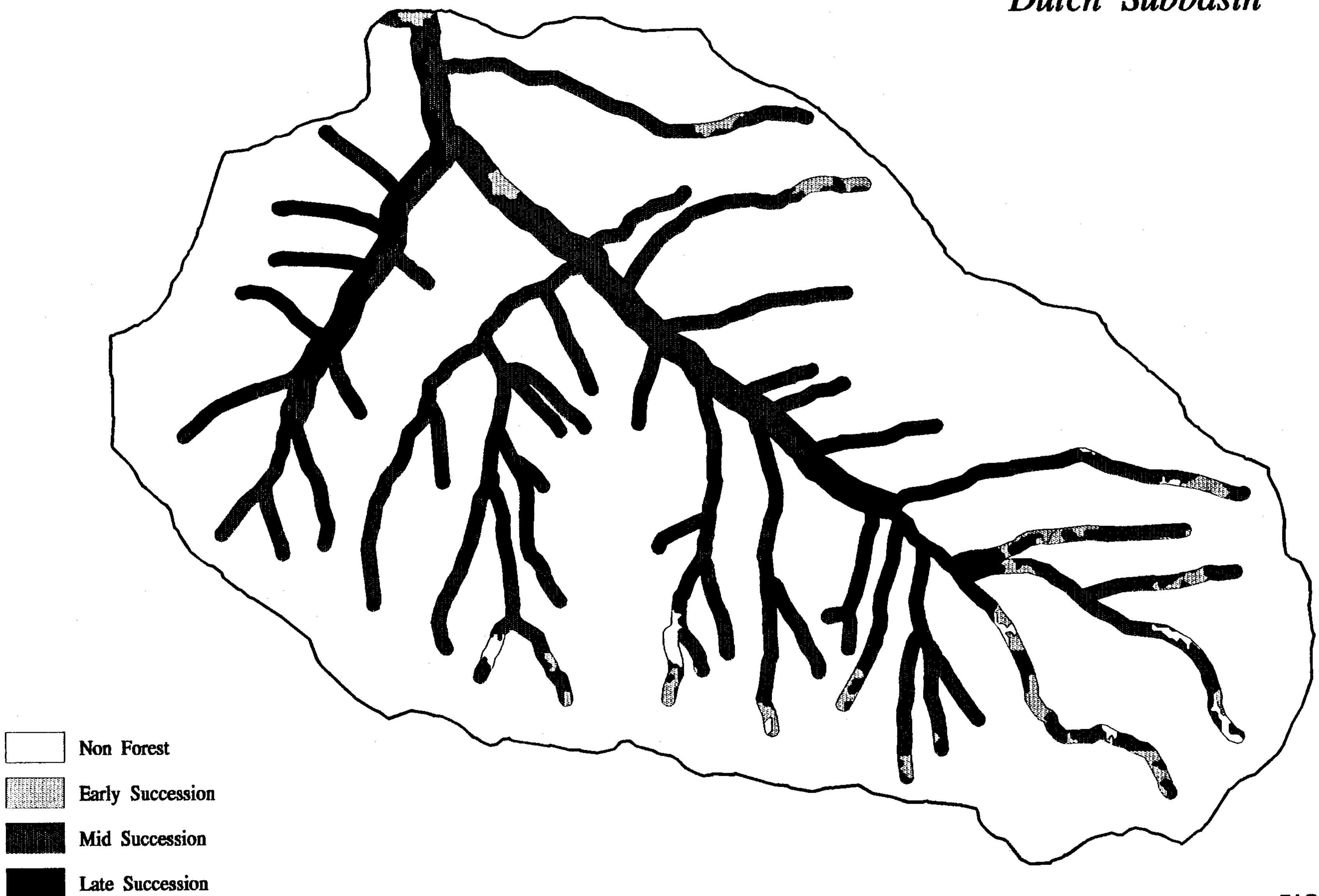


FIGURE A-30

Squaw/Elliott/Lake Watershed Analysis Area

Streamside Riparian Successional Stages
Joe Subbasin

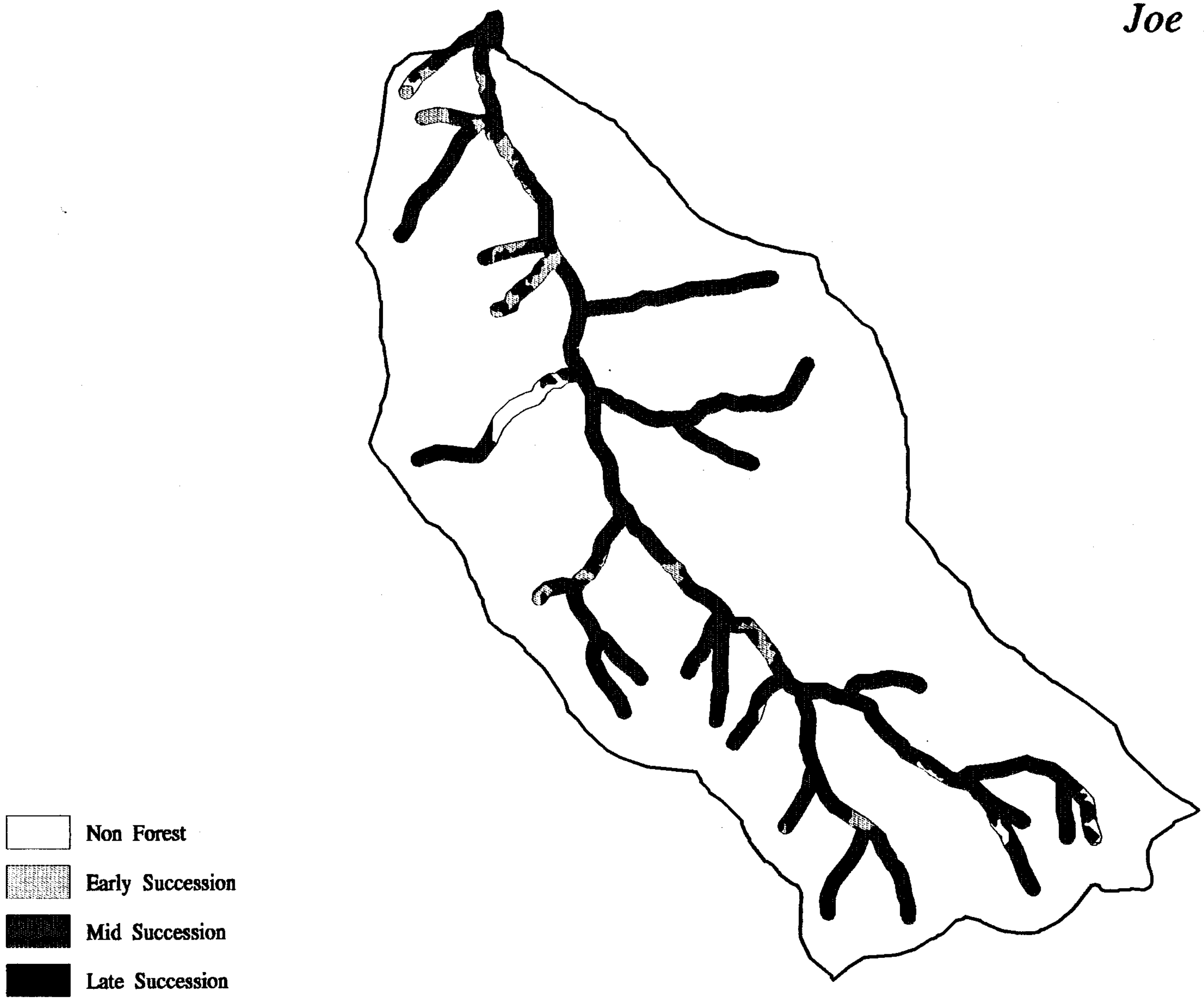


FIGURE A-31

Squaw/Elliott/Lake Watershed Analysis Area

Streamside Riparian Successional Stages
Lake Subbasin

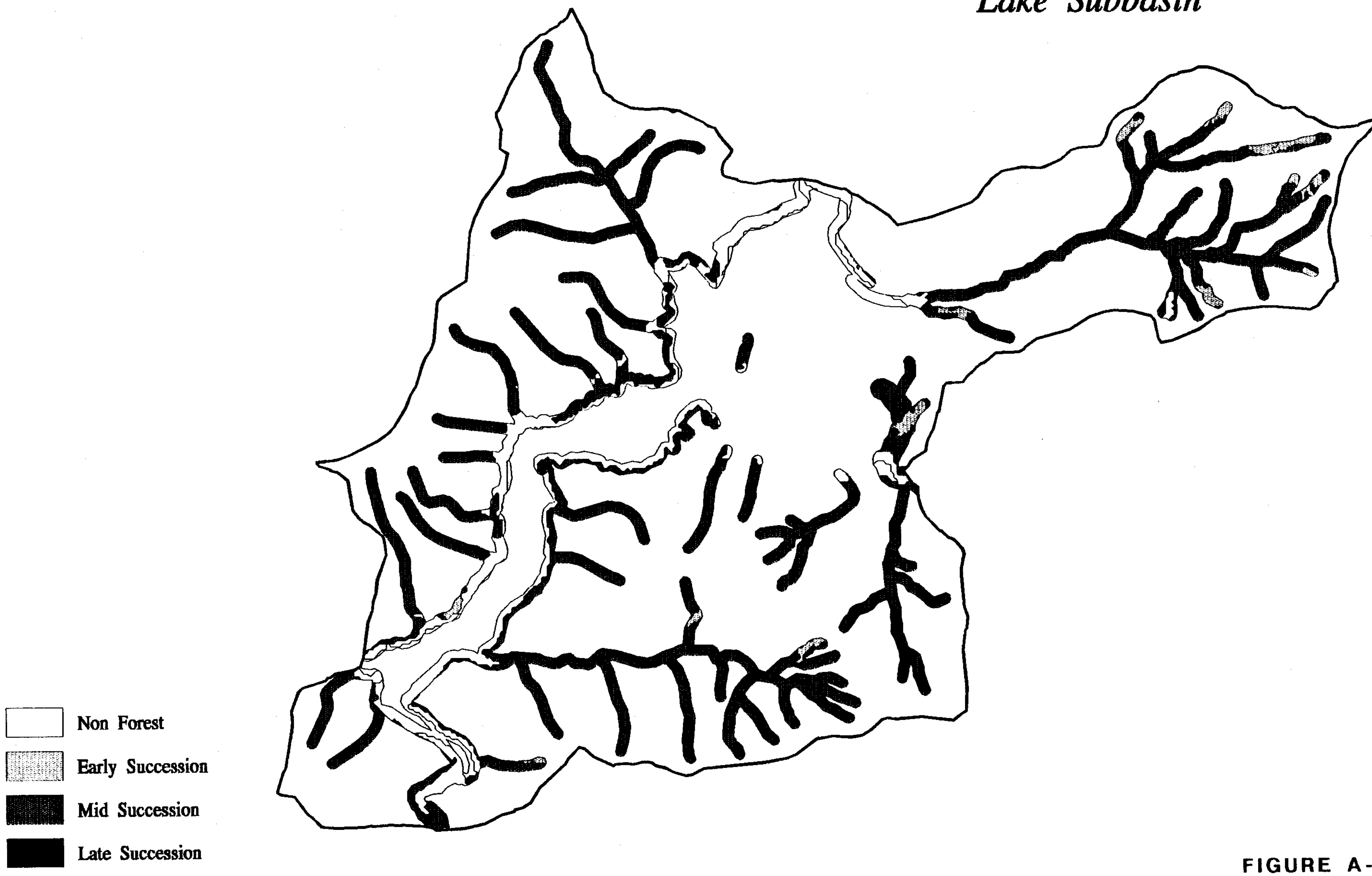


FIGURE A-32

Squaw/Elliott/Lake Watershed Analysis Area

Streamside Riparian Successional Stages
Mule Subbasin

FIGFURE A-33

Squaw/Elliott/Lake Watershed Analysis Area

Streamside Riparian Successional Stages
Kinney Subbasin

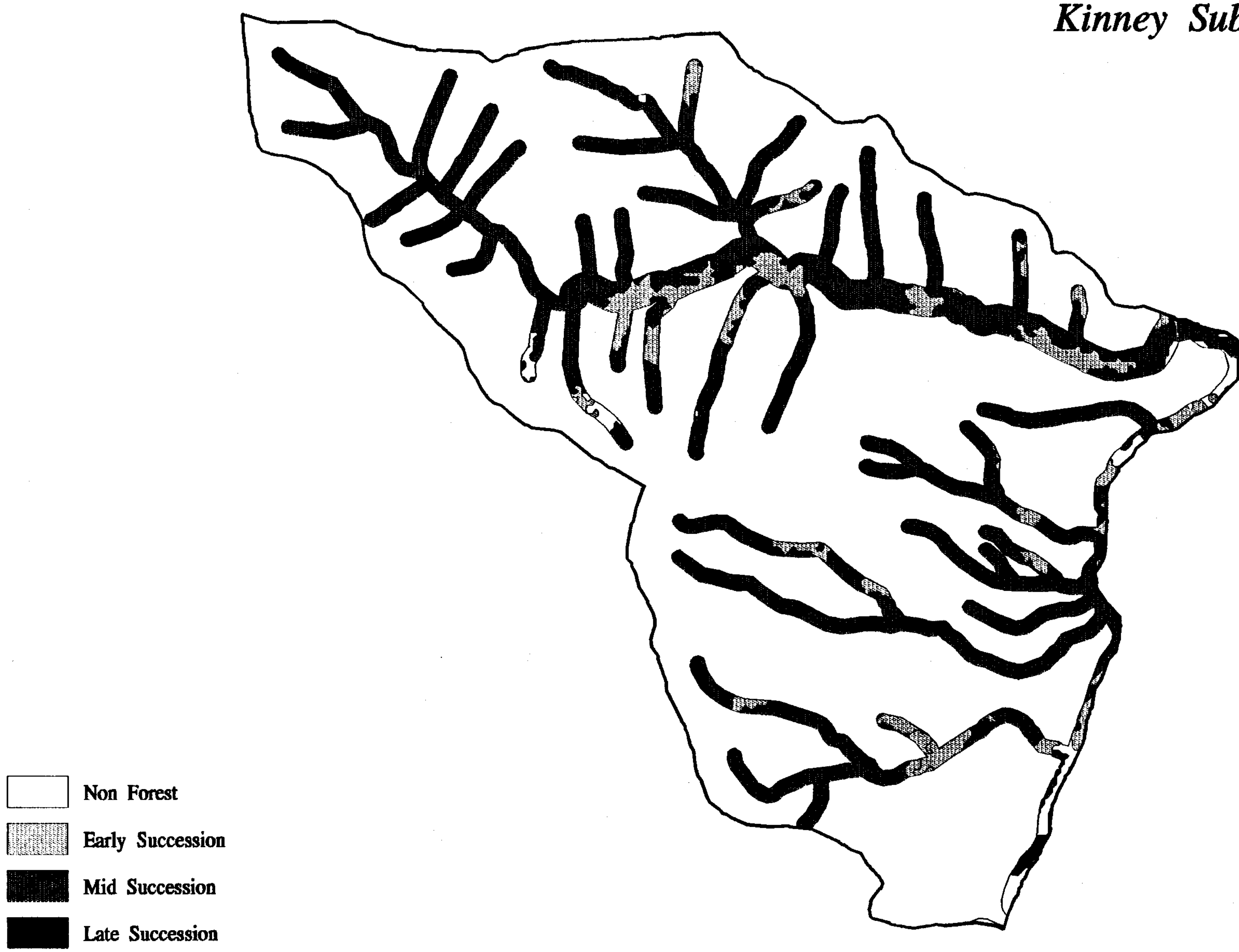


FIGURE A-34

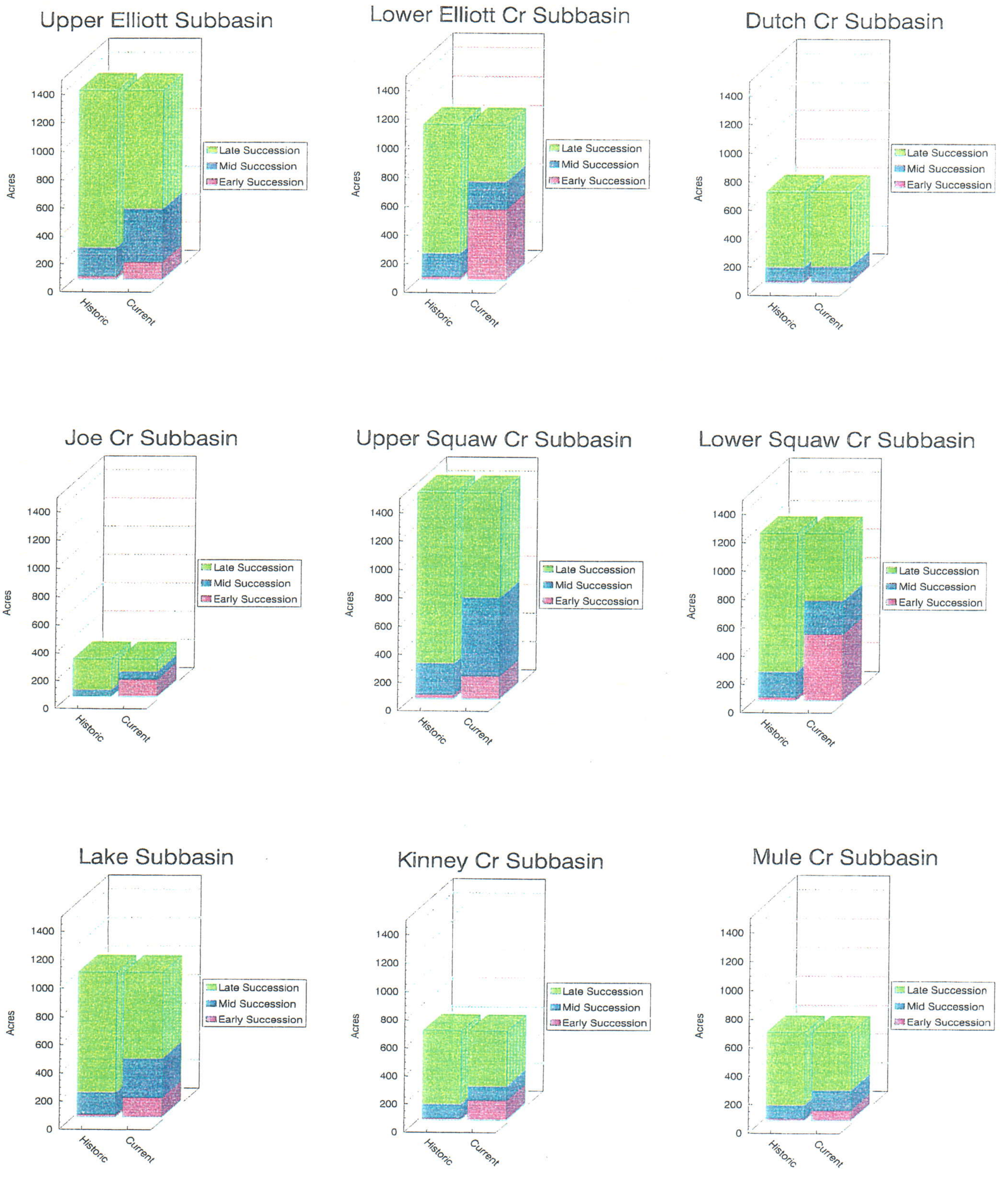
The vegetative composition of Riparian Reserves has changed dramatically from historic (pre-European settlement) times in most of the nine subbasins in Squaw/Elliott/Lake Watershed Analysis Area. The human processes that have affected the majority of this change include timber harvest, road development, and fire exclusion; other processes with lesser impact include mining and grazing.

It is assumed that the current distribution of forest successional stages found in Riparian Reserves within the unentered portions of National Forest lands of the Dutch Creek subbasin approximates historic conditions for all subbasins in the Analysis Area. Based on this assumption, Figure A-35 provides a visual comparison of the estimated historic and current levels of late-successional, mid-successional, and early-successional forest within **streamside Riparian Reserves** (on National Forest lands) by subbasin. **Permanent non-forest and permanent montane hardwood forest within Riparian Reserves are assumed to have remained somewhat constant from historic times and are thus ignored in this comparison.** It is assumed that riparian zones associated with private lands and Riparian Reserves associated with lakes, wetlands, and unstable and potentially unstable areas on National Forest lands, have also experienced a decline in late-successional forest composition.

Dutch Creek, Mule Creek, and Kinney Creek subbasins have a high percentage of their conifer forest Riparian Reserves retained in late-successional forest providing good connectivity of riparian habitat. This is in part due to roadless area designation (see Chapter I, Management Area Direction) which has limited access to these areas. The slight decline in late-successional forest in Dutch Creek Riparian Reserves occurs in the lower portion of the subbasin where timber harvesting and road development has occurred. The decline in Kinney and Mule Creek subbasins is mainly attributed to the permanent conversion of lands adjacent to the Applegate River to agricultural uses. All other subbasins have had varying but substantial reductions in late-successional forest within their Riparian Reserves, due to timber harvesting and road development.

Early-successional forest habitats within riparian areas are most common in Lower Elliott and Lower Squaw subbasins (Table A-21). Within these subbasins early succession forests comprise from 34% to 42% of the riparian habitats. Acres of non-conifer habitats are highest in Mule (58%) and Upper Elliott (31%) subbasins. Non-conifer forest habitats consist of montane hardwood forests, grass/forb meadows, and non-vegetated areas.

Figure A-35: Comparison of Historic and Current Distribution of Forest Successional Stages



The ability of streamside riparian zones to provide riparian and aquatic habitat values is dependent on several factors including forest types, forest age, plant species composition, and plant community distribution along the stream. One important factor that affects riparian habitat is the presence of **roads within the riparian zone**. Roads affect riparian habitat in several ways: (1) removal of riparian vegetation, (2) reduction in size of the riparian zone, (3) reduction in effectiveness of the riparian habitat, (4) harassment to wildlife that utilize riparian habitats, and 5) contribution of a disproportionately large percentage of the overall sediment produced to streams.

Presently, in the Analysis Area there are approximately 56 miles of roads within streamside riparian areas (Table A-20). Roads density within riparian areas is the highest along class 1 and 2 streams. There are an average of 0.6 miles of stream for every mile of riparian area associated with class 1 and 2 streams. The subbasins with the highest road density (miles of road/mile of riparian habitat) are Joe (1.3) Kinney (1.2) Elliott and Lower Squaw (0.9 in each), and Upper Squaw (0.8). Where these high road densities within riparian areas occur, the quality and quantity of riparian habitat has been negatively affected.

Table A-20: Roads in Riparian Reserves Associated With Streams and Wetlands

Subbasins	Miles of Road Within Streamside Riparian Reserves and Wetlands									
	Fish-Bearing (Class 1 & 2 RRs)			Non Fish-Bearing (Class 3 RRs)			Intermittent (Class 4 RRs)			Wet-lands
	Strm Miles	Road Miles	Ratio Rd/St	Strm Miles	Road Miles	Ratio Rd/S	Strm Miles	Road Miles	Ratio Rd/St	Acs*/ RdMi
Upper Elliott	13.6	2.26	0.2	10.5	1.58	0.2	41.9	3.68	0.1	604/
										1.52
Lower Elliott	10.1	8.92	0.9	5.6	0.07	<0.1	31.9	0.79	<0.1	3/
										0.15
Dutch	4.4	0.74	0.2	3.7	0.54	0.1	26.9	0.14	<0.1	0/
										0
Joe	0.1	0.13	1.3	4.1	0.42	0.1	10.2	0.45	<0.1	0/
										0
Upper Squaw	4.8	3.84	0.8	5.6	1.23	0.2	43.7	6.72	0.2	115/
										0.48
Lower Squaw	5.4	5.04	0.9	4.4	1.11	0.2	27.3	1.41	<0.1	1/
										0.08
Lake	0.8	0.19	0.2	4.4	1.97	0.4	39.2	4.99	0.1	57/
										0.08
Kinney	3.1	3.82	1.2	2.9	0.07	<0.1	19.6	0.92	<0.1	2/
										0
Mule	3.7	2.67	0.7	8.9	1.12	0.1	45.0	1.16	<0.10	5/
										0
All	46.0	27.61	0.6	50.1	8.11	0.2	285.7	20.26	0.10	787/
										2.31/
Str Miles by Class as % of Total Str Mi.	**12%**			**13%**			**75%**			**N/A**

*** There are additional acres of wetlands not included here. Those typically exist as narrow strips of alder, willow, and other wetland indicator species located immediately adjacent to streams within streamside Riparian Reserves.**

Except for Lower Elliott Creek, **mining** has not significantly impacted riparian areas. Residential development has altered riparian areas on private lands adjacent to Upper and Lower Squaw Creeks, Lower Elliot Creek and the Applegate River below Applegate Reservoir.

Table A-21 summarizes the current acreages in various successional stages within streamside Riparian Reserves by ownership within each subbasin. It is noted that riparian zones located on **private ownership** are a small component of the total acreages for all subbasins except for Upper and Lower Elliott. A large proportion of the Class 1 and 2 (fish bearing) streams (and riparian zones) are located on private land in Elliott Creek. The riparian zone acreage listed as private ownership for Kinney and Mule Creek subbasins is associated with the Applegate River. All of Kinney Creek and all except the mouth of Mule Creek are located on National Forest lands.

Table A-21: Streamside Riparian Areas
Acres in Various Successional Stages by Ownership and Subbasin

Subbasin	ACRES BY SUCCESSIONAL STAGES BY OWNERSHIP								Streamside Riparian Acres
	Late Forest		Mid Forest		Early Forest		Non-Forest		
	USFS	Other*	USFS	Other*	USFS	Other*	USFS	Other*	
Upper Elliott Cr	840	113	373	6	129	11	604	406	2,482
Lower Elliott Cr	395	49	188	5	494	96	118	428	1,773
Dutch Cr	529	15	100	2	13	3	98	144	904
Joe Cr	94	8	53	0	126	1	25	58	365
Upper Squaw Cr	744	28	549	16	166	45	187	265	2,000
Lower Squaw Cr	476	18	233	2	472	34	211	194	1,640
Lake	612	139	276	8	138	147	146	316	1,782
Kinney Cr	397	12	100	5	138	13	212	14	891
Mule Cr	411	46	137	16	73	81	871	132	1,767
All	4498	428	2009	60	1749	431	2472	1957	

*Private Land and Bureau of Land Management

Livestock grazing is heavy in some meadow wetlands (range utilization data for 1992-95) and within the small grass/forb wetlands adjacent to springs and seeps at the headwaters of streams (see Hydrologic Assessment by Mike Mathews). Livestock grazing and trampling degrades meadow wetlands by removing vegetation, trampling vegetation, compacting and displacing soils, and increasing sedimentation into stream channels.

3. Trends

The expected **trends** for Riparian Reserves is that for those areas capable of attaining late-successional forest will approach the historic distribution in all subbasins except those with significant private land ownership (Upper and Lower Elliott Creek, parts of Squaw Creek and adjacent to the Applegate River below the Dam). This conclusion is predicated on the assumptions that the Aquatic Conservation Strategy incorporated in the ROD is implemented on public lands, and that current management practices on private lands will continue under current State and County regulations. The time frame expected to attain historic distribution of late-successional characteristics on public lands is 50 to 80 years for those Riparian Reserves currently in mid-forest succession. Those in early-successional stages will require a greater amount of time.

D. Overall Watershed Condition

An overall current watershed condition rating was obtained for the nine subbasins in the Squaw/Elliott/Lake Watershed Analysis Area by using a process for determining risk of cumulative watershed effects (CWE) from multiple activities. An "overall condition rating" is obtained by combining a "watershed risk rating" and a "channel condition rating" which are developed from an analysis of various physical parameters for each subbasin. The watershed risk rating is an integrated index of the current degree of human activity (processes) within a subbasin, and the consequent potential to contribute adverse impacts to aquatic resources. The two processes evaluated to determine the watershed risk rating are road density and proportion of watershed area with regenerated areas with less than 30 years recovery. The channel condition rating is an index of current channel and fish habitat conditions and is based on indicators believed to limit fish populations. The two conditions (out of four choices) used to determine the channel condition rating are temperature and embeddedness. The variables and rating procedures are described in detail in the document "Determining the Risk of Cumulative Watershed Effects Resulting from Multiple Activities" (US Forest Service - February 1993).

Table A-22 summarizes data and information used to derive current watershed risk and condition ratings and the overall condition rating for each subbasin.

Table A-22: Current Watershed Condition

Subbasin	Watershed Risk Rating: Road Density (mi/sq mi)	Watershed Risk Rating: % Wtrshd in Stands <30 yrs	Watershed Risk Rating: Risk Rating	Channel Condition Rating: Temperature	Channel Condition Rating: Embeddedness	Channel Condition Rating: Rating	Overall Condition Rating
Upper Elliott	3.5	15	High	Good	Good	Good	Poor
Lower Elliott	2.0	38	High	Fair	Poor	Poor	Poor
Dutch	1.4	11	Low	Good	Good	Good	Good
Joe	3.2	23	High	Fair	Fair	Fair	Poor
Upper Squaw	3.8	23	High	Good	Fair	Fair	Poor
Lower Squaw	2.1	4	Low	Poor	Fair	Poor	Poor
Lake	1.5	1	Low	Fair	Fair	Fair	Fair
Kinney	1.9	9	Mod	Fair	Fair	Fair	Fair
Mule	1.0	1	Low	----*	Fair	Fair	Fair

*Mule Creek becomes dry by June in most years so that summer temperature is not a factor.

The Upper Elliott, Lower Elliott, Upper Squaw, Lower Squaw and Joe subbasins are rated "poor." These subbasins have a relatively high probability of incurring additional risks to fish habitat and populations based on existing conditions and potential effects from new projects within those subbasins. While additional project activity may not appear to individually adversely affect fish habitat/populations, they may present additional risk when viewed cumulatively with other (existing and proposed) impacts, and depending on their position within the subbasin relative to sensitive areas. Human processes most likely to provide greater risk are those that create removal of vegetation and additional compaction, such as timber harvest and road building, especially when they occur on sensitive sites such as Riparian Reserves. Watershed restoration should receive emphasis in these subbasins. Any new proposal should at a minimum concurrently include restoration to the extent that it negates or reduces additional risk. Restoration should focus on sensitive areas, e.g. in Riparian Reserves and areas of high erosion/sediment potential; it should also focus on reducing road densities and compacted areas such as skid trails and landings.

The Lake, Kinney, and Mule subbasins are rated in "fair" condition. While not severely impacted, care must be taken in planning new projects so that these subbasins are not moved into the "high-risk/poor" category. Restoration is desirable in these subbasins to at least negate impacts from new activities that have potential to degrade overall watershed conditions.

Only Dutch Creek subbasin is rated in "good" condition. New activities are generally admissible here without concurrent restoration activities to the extent that they do not result in a decline of the overall watershed condition rating to a "fair or poor". This assumes implementation of standard and guidelines included in the ROD as well as the Forest Plan.

E. FISH SPECIES DISTRIBUTION & AQUATIC HABITAT

Fish populations in the analysis reside in 36.8 miles of streams (lotic systems) and three lakes (lentic systems). Both habitat types are discussed followed by fish - warmwater and coldwater (anadromous & resident fish) species and distribution -.

1. Streams (Lotic Systems)

a) Fish Habitat

Fish Habitat is described in terms of 1) influences of physical and human processes, 2) coarse wood, 3) pools, 4) substrate, 5) riparian zones and 6) trends.

a1) Historically (pre-European) - influences of physical processes

The canyon stream water temperatures in the Analysis Area were cool, riparian areas were comprised of mature conifer forests, large wood material in the stream channel was abundant as well as replacement wood in the riparian areas. The geomorphology of canyon stream types combined with an abundance of coarse wood provided complex aquatic habitat types. Sediment delivery to streams occurred as a result of landslides and erosions. Streams were in a stable condition and able to adjust to fluctuations in stream flow and sediment loads. Instream and floodplain connectivity was good. As a result of high quality riparian and aquatic habitat, there was an abundance of winter and summer steelhead, coho salmon (low gradient areas), resident rainbow and cutthroat trout, sculpins, lamprey and macroinvertebrates.

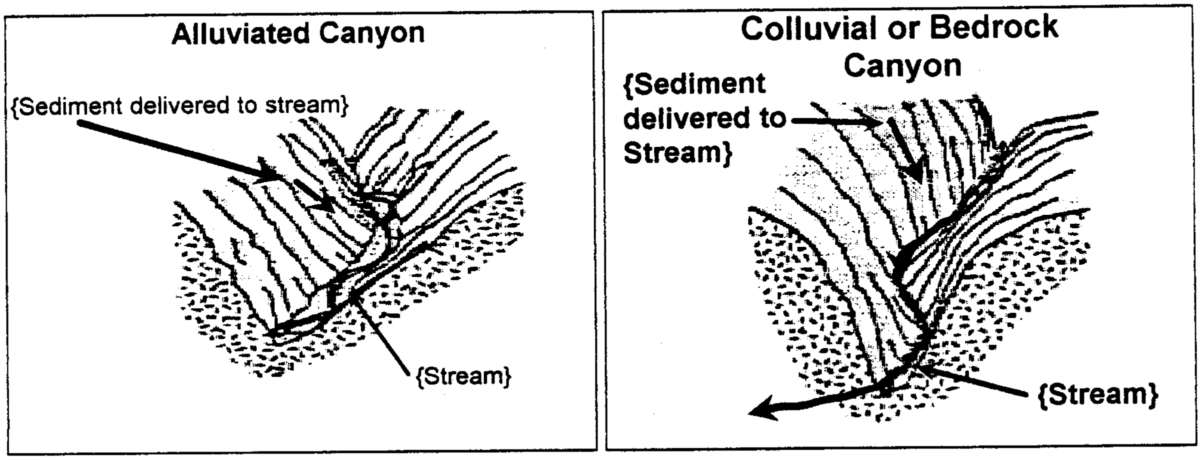
a2) Currently (post-European) - influences of physical and human processes

The basins are generally rugged, mountainous terrain, with peaks over 7,000 feet in elevation. The topography and geology are conducive to rapid runoff and erosion. Fishing pressure is low, provided mostly by local people.

Three canyon stream types dominate the Analysis Area: **alluviated, colluvial and bedrock canyons**. Canyon diagrams below (Figure A-36) depict habitat in areas where streams have not been influenced by human activities.

Channel morphology has ***not*** changed significantly in these areas where streams have ***not*** been influenced by forest management, mining, agriculture, and rural development. Streams are stable, adjusting to fluctuations in stream flows and sediment loads. These areas are mainly in Dutch Creek, Right Fork of Squaw Creek and Ward's Fork. Stream temperatures are cool resulting in a good resident cutthroat and/or rainbow trout population. Presence of large wood and mature canopy cover and floodplain connectivity creates a high quality salmonid habitat in these areas.

Figure A-36
Influences of Physical Process
Alluviated, Colluvial and Bedrock Canyon Streams Diagram



Colluvial and bedrock canyons have steep gradient of 4% and greater are classified as Rosgen A stream type; greater than 10% gradient (usually in the headwaters) and classified as Rosgen AA stream type. These stream types have a low width to depth ratio, bedrock and/or boulder streambed, and the ability to transport sediment and wood downstream. The colluvial and/or bedrock canyons are throughout the Analysis Area alternating with alluviated canyons. Canyon streams are often topographically shaded and are important for water quality production and large wood supply e.g. upper Silver Fork of Elliott Creek, Dutch Creek, and upper Elliott Creek. *Colluvial and/or bedrock* canyons are present throughout the Analysis Area.

Alluviated canyons represented often have "flats" (Reeves, et al.), with floodplains and terraces, and are classified as Rosgen C stream type. Alluviated canyons historically offered productive segments of the stream systems; complex habitat of braided and side channels, wood and deep scour pools. *Alluviated canyons* are the dominate canyon type from the mouth of Squaw Creek to 3.8 river mile upstream. Colluvial and bedrock canyons with *inclusions of alluviated canyons* are present in Upper Squaw and Right Fork of Squaw Creeks and throughout Elliott Creek.

In few places where the upper tributaries broadened , e.g., Silver Fork of Elliott Creek the geomorphology changes to *slope bound valley and alluvial valley* stream types.

Human Influences on Channel Morphology

Forest management (commercial timber harvest and road construction), agriculture (livestock grazing and water diversions for domestic use), mining and rural residential development are the greatest human influences on riparian and aquatic habitats of the canyon streams.

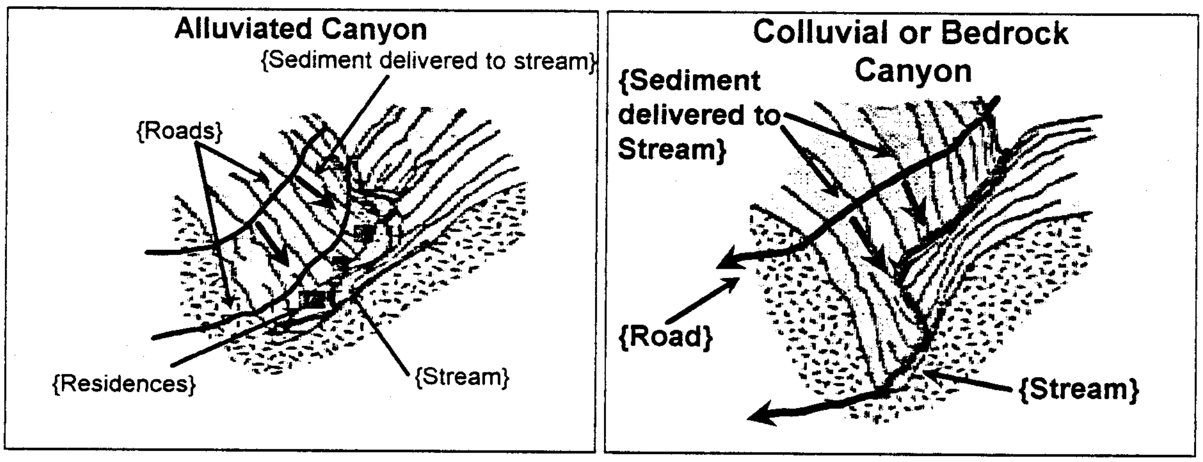
The flat areas associated with the alluviated canyon stream segments were some of the first affected by roading, mining and timber harvest. In these sections, wood has been removed from instream eliminating the necessary ingredient for complex habitat: pools, hiding cover, bank stability, and the sorting of spawning gravels. The removal of wood has also contributed to channel widening. In part due to easy accessibility, large trees have been harvested in the riparian zone, reducing stream shading and allowing solar radiation to warm water temperatures.

Both Squaw and Elliott Creek watersheds have a history of extensive placer mining and timber practices that seriously degraded instream habitat conditions.

Alluviated canyon stream segments have been confined by roads disconnecting the stream from the floodplain. Remnant roads meander back and forth across Squaw Creek, Mule Creek and Ward's Fork of Elliott Creek.

Canyon diagrams below depict habitat in areas where streams have been influenced by forest management, agriculture, and rural development; channel morphology has changed significantly.

Figure A-37
Influences of Physical and Human Process
Alluviated, Colluvial and Bedrock Canyon Streams Diagram



Roads currently parallel many streams, occupying floodplains and inhibiting riparian forest growth potential on Squaw and Elliott Creeks and their tributaries. The road drainage patterns affect stream channels through timing and distribution of water flows, disconnects the floodplain from the stream and increases the amount of sediment transported to streams (see Geology Processes and Flow Regime for more discussions).

Subbasins where intensive timber harvesting, road construction, and mining has occurred, stream channels have generally become entrenched, accelerating bank erosion, increasing channel slope, reducing the meander pattern to an essentially straight, channelized stream, and increasing the width/depth ratio, e.g., Squaw Creek, Elliott Creek. These adjustments in channel geometry will continue to occur as the stream seeks a new state of equilibrium. The channel geometry adjustments, as described above, affect the quality of fish habitat. These effects include a reduction in quality and quantity of pools, spawning gravel, and the nutrient and food supply. There is a correlation between stream width and solar heating of water in stream channels. Both Squaw and Elliott Creeks have a history of extensive placer mining and timber practices that seriously degraded instream habitat conditions.

Coarse Woody Debris

Coarse woody debris in the canyon stream types of the Analysis Area has a range of 2 to 37 pieces of wood per mile (see Table A-23 for historic and current conditions). Dutch and Silver Fork Creeks have a high amount of wood per mile due to their location in an unroaded area; limited management activities occur here. Past timber management activities and stream clean out have removed wood from Squaw and Elliott Creeks and their tributaries. See Findings: Fish Species Distribution and Aquatic Habitat, Figure 17 for a graph displaying a comparison of coarse wood by stream segment/reach.

Pools per mile

Pools per mile are below the expected range of conditions (see Figure 16 "Comparison of Observed and Expected Pools per mile" and Table A-23 for historic and current conditions) due to habitat degradation (Squaw, Elliott, Silver Fork of Elliott Creek, lower two miles of Dutch Creek, and Joe Creek. Low number of pools were recorded where coarse wood has been reduced or eliminated. There is considerable literature documenting the importance of pools to salmonid fish production. Present pool frequency is also related to fine and coarse sediment influencing stream morphology, straightening of channels, removal of large conifer wood pieces in the channel and removal of a mature riparian component for future large wood recruitment.

The pools in the Watershed Analysis Area are short step pools or pocket pools. Some of the pools may not have been accounted for during the stream survey. As instructed in the Region 6 stream survey Forest Service manual, any pool with a length less than the stream width was not reported. This exclusion of "pocket pools and step pools" may cause the total pool percentage to be slightly underestimated. See Findings: Fish Species Distribution and Aquatic Habitat, Figure 16 for a graph displaying a comparison of observed and expected pools per mile. Table A-23 below displays pools per mile data and other habitat conditions.

Table A-23

Historic and Current Conditions (Estimated)

for Aquatic Processes and Functions

N/A = Not applicable

	Squaw Creek		Elliott Creek		Silver Fork of Elliott Creek		Dutch Creek (unroaded area)	
Parameters	*Historic*	*Current*	*Historic*	*Current*	*Historic*	*Current*	*Historic*	*Current*
Large Woody Material (wood per mile) (dimensions 24" dbh X 50")	>40	6	>40	2	>40	37	>40	>25
Pools per mile*	108	<6	64	<13	180	9	50	<27
Pool/Riffle/Glide/S.Channel		12/78/8/2		18/74/6/2		7/91/1/1		24/74/1/1
Side Channel/mile	High	Low	Fair	Low	Low	Low	N/A	N/A
Rosgen Classification (Dominate/Subdominate)	B/C/A	B/F/A	B/C/A	B/F/A	B/C	B/F	A/AA/B	A/AA/B
Stream Temp. (summer)	<58 F	>70 F	<58 F	>67F		52	<58 F	<58 F
Spawning Gravels	Good	Poor	Good	Poor	Good	Fair	Fair	Fair
Fisheries (relative density):								
Steelhead	High	None	High	None	Medium	None	High	None
Coho Salmon	High	None	Medium	None	None	None	Medium	None
Rainbow Trout	High	**Low	High	Low	High	Medium	High	Medium
Cutthroat Trout*	High	Low	High	Medium	High	Medium	High	Medium
Macroinvertebrates (relative density); Positive indicator groups****	Good	Poor	Good	Poor	Good	Fair/Poor	Good	Good
Slope (percent gradient) per stream reach		3/3/6		3/4/5/8/8		5/5/4		4/19
Total miles surveyed		5 (1993)		10.2 (1995)		4.2 (1992)		3.4 (1995)
Riparian Canopy	90%	60%	90%	70%	90%	75%	90%	90%
Riparian Component (%)****	60/40	90/10	60/40	90/10	60/40	80/20	60/40	50/50

*** Expected range of pools per mile based on pool frequency of 3 bankful widths (2-4% slope - Rosgen B stream type) and 2.5 bankful widths (>4% slope - Rosgen A stream type).**

**** Rainbow/cutthroat hybrid**

***** Historic sea-run cutthroat trout extirpated - resident cutthroat trout inhabit present habitat.**

****** Positive indicator groups or taxa in a healthy stream system are highly intolerant taxa which are particularly sensitive to high summer temperatures or impairment due to habitat quality limitations (sedimentation, high winter scour, opening of the riparian canopy, reduction of channel depth).**

******* Hardwood/Conifer (sapling/pole condition) : Conifer (mature trees condition).**

Stream Substrate

Stream substrate (cobbles and gravels) are generally embedded with fine and coarse sediment throughout most of the stream system in the Analysis Area. Embeddedness is defined when silt/sand sediment surrounds cobble/gravel substrate by 35% or greater. However, the higher elevation, steeper gradient streams located above road systems and timber harvest activities are likely to resemble historic levels of stream embeddedness, e.g., Dutch Creek, Silver Fork of Elliott Creek, Right Fork of Squaw Creek, Mule Creek and Elliott Creek above T48N, R10W, Sec 27. Mica schist Condrey Mountain Formation is ubiquitous throughout Squaw and Elliott watersheds and is a highly erodible rock type (Appendix A, Geology and Geomorphology). Spawning gravels are embedded in the mica schist and visually noticeable in the lower alluviated canyons in the lower reaches, e.g. Squaw, Elliott Creek, and lower two miles of Dutch Creek.

Riparian Reserves -

See RIPARIAN HABITAT for discussion on Riparian Reserve Habitat.

Water Quality (temperature, turbidity, water chemistry)

See WATER QUALITY section for detailed discussion.

Trends

Alluvial, bedrock and colluvial canyons under federal ownership are now protected by guidelines of the Northwest Forest Plan (March, 1994). The riparian component will recover under the Aquatic Conservation Strategy of the Northwest Forest Plan. Providing there is little or no stream cleanout, riparian forests will grow to maturity resulting in an increased delivery of large wood material to streams.

If current grazing patterns are maintained, headwater riparian areas will remain in a degraded condition in areas such as upper Silver Fork and upper Squaw Creek, plant species diversity will not improve, stream temperatures will remain elevated during the summer season, and localized areas that have downcut streambanks will remain entrenched.

Due to highly erodible geology (micha schist), timber harvest (landings and skid roads), roads, and mining have exacerbated sediment input to lower Elliott Creek. Data collected from Wolman pebble counts illustrates the lack of variation in substrate size throughout the lower reach of the mainstem (Wolman, 1955). This condition will continue to contribute to low quality and frequency of pool habitat and embedded spawning gravels.

Stream valleys (e.g., upper Silver Fork of Elliott Creek) and mainstem canyon segments (e.g., Squaw and Elliott Creeks) will continue to be entrenched and loss of floodplain connectivity will affect overall channel complexity and survival of fish. Bank degradation and channelization of stream will continue to downcut the stream channel, simplifying the aquatic habitat. Roads will continue to contribute sediment. This trend will continue until recovery of riparian forests reinstates floodplain/stream connections and functions.

Nonfederal ownership managed for timber production will improve slightly with revised state forestry guidelines within riparian zones. Large conifer component in riparian areas will remain rare; little or no protection for riparian areas in rural residential uses. Locally mining activities will contribute to degradation the riparian zone and water quality.

b) Fish populations (anadromous and resident)

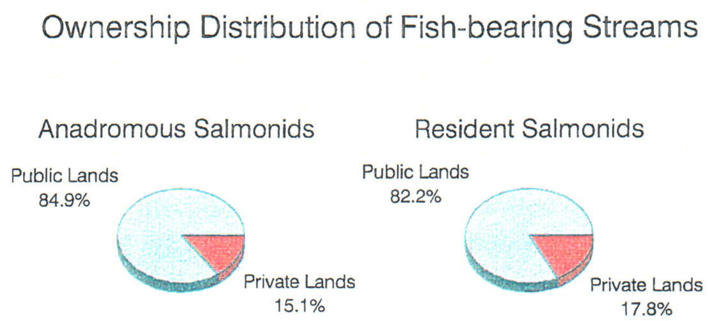
See Findings (Fish Species Distribution and Aquatic Habitats) for:

Anadromous fish streams in the Rogue River Basin (Figure 14).

Historic and Current Fish Distribution map (Figures 12 and 13).

Public land accounts for the greater portion of fish bearing streams (Figure A-38) in the Analysis Area.

Figure A-38



b1) Anadromous Species Distribution - Mule Creek, Applegate River, and Kinney Creek

Approximately 3 miles of anadromous fish stream are present in the Analysis Area representing less than 1% of approximately 1,400 miles of anadromous fish streams located throughout the entire Rogue River basin. The Analysis Area contains two anadromous streams, Mule Creek (.3 miles) and segment of the Applegate River (2.8 miles). Kinney Creek which has the potential of anadromous habitat is blocked by a waterfall located near the confluence of the Applegate River.

These streams are the farthest upstream spawning tributaries for migrating anadromous salmonid on the Applegate River.

Spawning takes place in the Applegate River stream segment of the Analysis Area approximately 2.8 miles, .3 miles of stream in Mule Creek if adequate flows are present and up to 50 feet in Kinney Creek. A 10 foot falls is encountered 50 feet from the confluence of Applegate River on Kinney Creek, preventing anadromous fish passage.

As flow diminishes and stream temperatures increase during late spring, most of the young fry in Mule Creek migrate downstream into the mainstem Applegate River. During field reconnaissance in 1968 (Hoover) and 1995, Kinney Creek had adequate flow to support young fry during the summer months but no fish were found. During 1982 a small population of trout was found (Connell).

Steelhead and resident trout utilize these streams during the winter and spring season to spawn. Oregon Department of Fish and Wildlife estimate that 30 spawning steelhead utilize Mule Creek (ODFW, 1991).

Applegate Dam acts as a barrier to fall chinook, coho salmon, pacific lamprey and up and down migration of steelhead trout. It also blocks the migration behavior of resident juvenile and adult cutthroat and rainbow trout.

Water quality (water temperature and suspended solids) below Applegate Dam is not directly effected by Elliott and Squaw Creeks. Water quantity and temperature released from the dam is regulated by the Corps of Engineers. The net affect is lower peaks in floods and higher flows in the summer with cooler than historic stream temperatures in the summer months in the upper river. The favorable cooler stream water temperatures below the dam (50-60 degrees Fahrenheit) and stream flow altered from historical levels has changed the aquatic biotic and fish assemblages. The reservoir also acts as a depository for sediment from the streams above the dam, reducing the amount of suspended solids into the Applegate River system downstream.

National Marine Fisheries Service (NMFS) has proposed for listing, the Klamath Mountains Province steelhead as Threatened under the Endangered Species Act in the March 16, 1995 Federal Register. An evolutionary significant unit (ESU) was delineated from Cape Blanco to the Klamath River. It was proposed for listing in March 1995 as threatened under the Endangered Species Act (ESA).

Coho salmon recently were proposed for listing under the Endangered Species Act as Threatened. They are currently listed as a depressed stock in the Rogue River basin by the Oregon Department of Fish and Wildlife.

b2) Resident Fish Species Distribution - Squaw & Elliott Creeks and tributaries

Resident fish bearing streams currently in the Watershed Analysis Area total about 36.8 miles. Fish populations above the Applegate Dam are resident and unable to migrate to the ocean and return to spawn. Elliott and Squaw Creeks, tributary to the Applegate River, tributary to the Rogue River, runs westward into the Siskiyou Mountains, Rogue River National Forest, near California's' northern border.

Trout population should flourish in these areas due to no competition from the anadromous fish. However, this trend is inhibited by habitat degradation. Down cutting and channel simplification has decreased side channel habitat in the alluviated canyon segments. Side channel habitat would be expected to be found when inclusions of alluviated canyons appear in Squaw or Elliott Creeks. Where habitat degradation has not occurred as a result of human activities (mainly in Dutch Creek, Right Fork of Squaw Creek and Ward's Fork), good resident cutthroat and/or rainbow trout populations exist.

The principal tributaries of Elliott Creek are Joe Creek, Dutch Creek, and Ward's Fork located in California, and Silver Fork in Oregon. Elliott Creek subwatershed contains a moderate population of 20.4 miles of resident rainbow and cutthroat trout fish habitat. Isolated populations of wild cutthroat trout were found in the headwater streams and above the confluence of Studhorse on Elliott Creek. Elliott Creek is being considered for Wild Trout designation by the California Department of Fish and Game (CDFG). Wild Trout designated streams are given a closer scrutiny by the CDFG in regards to management activities (e.g., timber harvest, streamside alterations, and fishing regulations). It is unlikely that Elliott Creek will be designated as a Wild Trout stream. This stream does not contain plentiful large trout (18-22" in length) required for the designation. Elliott Creek has the potential to meet these criteria but it is presently not functioning as a healthy trout stream.

There are no records of fish planted in Elliott Creek. A 330 foot cascade barrier exists upstream of Alex Creek. Identical trout populations above and below the cascade barrier existed. The size range and mean length were similar, as was the number of fish per mile, CDFG, 1992. Trout over three years of age were not present according to the CDFG study. It is possible that the mature fish are limited in numbers.

The principal tributaries of Squaw Creek are Upper Squaw Creek and Right Fork. Squaw Creek watershed is located within the Oregon border. Squaw Creek subwatershed contains a moderate population 5.9 miles of rainbow/cutthroat hybrid below Squaw Lakes and 4.4 miles of cutthroat trout habitat above Squaw Lakes (see Table A-24 for actual stream miles) during a FS 1995 fish survey. Water withdrawal affects (fluctuations) from Squaw Lakes on fish populations and other aquatic organisms in Squaw Creek (below the lake) are unknown.

Both streams contain pacific lamprey and reticulate sculpin; fish distribution is unknown for these populations.

Fish distribution miles in the Analysis Area are listed for each stream in Table A-24. Historic and current salmonid fish distribution are displayed on the Historic and Current Salmonid Distribution maps (Figure 12 and 13) Findings: Fish Species Distribution and Aquatic Habitat.

General life history of resident trout in the Applegate watershed is depicted in the Applegate River Watershed Assessment, Life History of Applegate River Salmonids - Resident Trout, Table 05, page VI-41.

See Streams (anadromous) section for effects of Elliott and Squaw Creeks water quality on anadromous fish populations below the Applegate Dam.

Table A-24 lists historic and current miles of fish habitat.

Table A-24

Historic and Current Miles of Anadromous and Resident Fish Habitat *in the Squaw/Elliott/Lake Watershed Analysis Area (Verified=v, Estimated=e)*								
	Coho Salmon		Steelhead		Rainbow Trout		Cutthroat Trout	
Stream	Historic	Current	Historic	Current	Historic	Current	Historic	Current
(listed in stream order)	(Miles of Stream) *Rainbow/cutthroat hybrid							
Applegate River	2.8	2.8	2.8	2.8	2.8	2.8	2.8	0
Kinney Creek	0	0	0	0	0	v 0	0	v 0
Mule Creek	e 0.6	0	e 0.6	e 0.3	e 2.5	v 0.1	e 2.5	v 0
French Gulch	e 0.9	0	e 1.1	0	e 1.1	v 0.4	e 1.1	v 0
Squaw Creek	e 2.5	0	e 5.9	0	e 5.9	v 5.9*	e 5.9	v *
Upper Squaw	0	0	0	0	0	v 0	e 3.2	v 3.2
Right Fork	0	0	0	0	0	v 0	e 1.2	v 1.2
Manzanita Crk	0	0	e 0.4	0	e 0.4	v 0.1	e 0.4	v 0
Elliott Creek	e 6.3	0	e 10.4	0	e 10.4	v10.4	e 10.4	e4.7
Joe Creek	e 0.6	0	e 3.5	0	e 3.5	e 0	e 3.5	e 1.2
Dutch Creek	e 1.2	0	e 1.8	0	e 1.8	v 1.8	e 1.8	v 0
Studhorse Crk	0	0	e 0.3	0	e 0.3	v 0	e 0.3	v 0.3
Alex Creek	0	0	e 0.2	0	e 0.2	v 0	e 0.2	v 0.2
Silver Fork	0	0	e 3.6	0	e 3.6	v 3.6	e 3.6	v3.6
Ward's Fork	0	0	e 1.4	0	e 1.4	v 0	e 1.4	v 1.4
Dog Fork	0	0	e 0.8	0	e 0.8	e 0	e 0.8	e 0.8
TOTAL MILES	14.9	2.8	32.8	3.1	34.7	25.1	39.1	16.6

A-25 lists stream mile location within the Rogue River Basin.

Table A-25

River Mile Index		
Rogue River mile: 94.8	**Applegate River (River Miles)**	**Tributary**
Kinney Creek	43.1	
Mule Creek	43.5	
French Gulch	46.3	
Squaw Creek	47.5	
Upper Squaw Creek		8.6
Right Fork		8.6
Manzanita Creek	49.6	
Elliott Creek	51.4	
Joe Creek		1.7
Dutch Creek		4.7
Studhorse Creek		9.5
Alex Creek		9.9
Silver Fork		11.8
Ward's Fork		11.8
Dog Fork		0.4

See Lakes (lentic systems) for affect of nonnative warm water fish populations on salmonids.

See Hydrology and Geology sections for more information about historic and current conditions of Squaw and Elliott Creeks.

2. Lakes (Lentic Systems)

a) Habitat; Applegate and Squaw Lakes

Applegate Lake contains 988 surface acres, 225 feet deep (83 feet average) and has a volume of 82,000 acre-feet of useable water. **Lower Squaw Lake** contains 46 surface acres, 121 feet deep (54 feet average), and has a volume of 2,500 acre-feet. Unknown surface acres and acres-feet data for **upper Squaw Lake**. All of these lakes contain a two-tier fisheries (cold and warmwater fish populations); providing a popular destination for recreation fishing.

Both lakes are below their production potential because of lack of complex habitat in the shoal areas where warm and cold water fish forage. Habitat is lacking mainly due to fluctuation in the water levels of the lakes, making it difficult for vegetation such as willow to become established. The complete effects that water withdrawals (fluctuation of water level) and lack of habitat complexity is having on local fish populations in Applegate and Squaw Lakes is unknown. Fish enhancement (brush rows and willow planting) in Squaw Arm of Applegate Lake has been ongoing since 19901. Partners include: Oregon Department of Fish and Wildlife, various private citizens, partners and the Forest Service.

b) **Fish Species Present; Applegate and Squaw Lakes**

Numerous fish introductions by private individuals and the Oregon Department of Fish and Wildlife (ODFW) have occurred with warm and coldwater fish species in all three lakes. These fish were introduced in Applegate Lake soon after the development of Applegate Dam (1980) and in Squaw Lakes as early as the 1930's when a portion of Squaw Lakes was under private ownership.

Applegate Lake contains coldwater (salmonids) fish species - rainbow and some cutthroat trout and warmwater fish species - large mouth and small mouth bass, black crappie, blue gill, yellow perch, brown bullhead, and Klamath small scale suckers. Surplus steelhead brood stock captured in the collection facility below the Applegate Dam and surplus juvenile steelhead trout and coho and spring chinook salmon from the Lost Creek Hatchery are placed in Applegate Lake to supplement the fisheries. The lake appears to be adequately seeded with young of the year bass from past survey observations. Trophy-sized rainbow trout, small and large mouth bass and black crappie are the most sought after fish in this two tier fisheries.

Squaw Lakes contain coldwater (salmonid) fish species - cutthroat trout and warmwater fish species - large mouth bass, bluegill, black crappie and yellow perch. ODFW has periodically stocked lower Squaw Lake with cutthroat trout; most recent stocking was in 1992. Fish surveys conducted since then have shown no representation of these planted cutthroat populations. It is unknown if local fish populations, e.g., bass are preying on the cutthroat trout fingerlings before they reach maturity. ODFW presently states that a good cutthroat trout population exists from natural production and that further stocking is not needed. ODFW records and anecdotal information are on file at the Ashland Ranger District.

Nonnative fish population of Squaw Lakes and Applegate Lake can affect native stocks by mixing with wild stocks in streams. Non-native species often prey on juvenile salmonids, e.g., bass. Effects of nonnative salmonids spawning with populations of native trout in the tributaries are not known.

Kettle and Summit Lakes are shallow small ponds which are converting to meadows. No fish occupy these water bodies.

3. Fish Populations

Management of fish populations is the responsibility of the Oregon Department of Fish and Wildlife (ODFW) and California Department of Fish and Game (CDFG). ODFW draft management plan, May, 1993, for resident wild trout objectives are summarized: maintain the genetic diversity and abundance of native trout populations in the running waters of the Rogue

River basin; minimize the impacts of hatchery rainbow on the production and genetic integrity of native trout and wild and anadromous salmonids.

Streams accessible to anadromous salmonids are not stocked with trout to protect native salmon and steelhead stocks. Stocking of Applegate Lake with hatchery trout, surplus steelhead from below the dam, etc. by ODFW may affect native fish populations above the reservoir in Elliott Creek and Squaw Creek. No known stocking by CDFG within Elliott Creek.

4. Macroinvertebrates (Aquatic Insects)

Silver Fork of Elliott Creek (above FSR 2250 in meadow) was analyzed for macroinvertebrates during 1994. The meadow represents a rare and unusual habitat type in the Siskiyou/Klamath Mountains. The invertebrate community at the site had many common western montane taxa which are cold adapted and intolerant taxa. The site was lacking a rare and unusual alpine/subalpine associated taxa. In the absence of pregrazing baseline data, the larger and more protected of these springs may provide a glimpse of what the invertebrate community was like in this valley before grazing impacts. Without baseline or further comparative survey data, it is impossible to assess what has been lost. Heavy grazing does not seem to be the most appropriate use in a watershed that may represent a truly unique ecosystem for this region (Wissman, 1992).

Macroinvertebrate samplings were collected on Squaw and Elliott Creeks; data are being analyzed by the contractor and is unavailable during this analysis. It is expected that sediment tolerant taxa will be well represented in the sample taken from Squaw Creek; fine mica schist sediment is ubiquitous in the substrate. No other site was analyzed for macroinvertebrates in the Analysis Area.

3. SOCIO-ECONOMICS

A. ADAPTIVE MA AGEMENT AREA AND THE COMMUNITY

The Applegate Watershed, of which the Watershed Analysis Area is a part of, is allocated to Adaptive Management Area by the ROD. One objective of Adaptive Management Areas is to allow opportunities for agencies, communities, and citizens to work together in developing innovative management approaches to ecosystem management. "Innovative approaches include social learning and adaptation, which depend upon local communities having sufficient political capacity, economic resources, and technical expertise to be full participants in ecosystem management". (ROD, p. D-4)

1. The Applegate Partnership

In response to the political gridlock generated from the controversy over the northern spotted owl and old-growth forests of the Pacific Northwest, the Applegate Partnership was formed in 1992 as a proactive community based group seeking to break the barriers between environmentalists, industry, and agencies in the area of forest management and ecosystem health. Their philosophy is to achieve sustainable natural resources through principles that promote ecosystem health and diversity. The vision statement of the Partnership reads:

> "The Applegate Partnership is a community-based project involving industry, conservation groups, natural resource agencies, and residents cooperation to encourage and facilitate the use of natural resource principles that promote ecosystem health and diversity.
>
> Through community involvement and education, this partnership supports management of all land within the watershed in a manner that sustains natural resources and that will, in turn, contribute to economic and community stability within the Applegate Valley."

The Applegate Partnership provided a concept later captured as an objective of the ROD land allocation Adaptive Management.

2. The Applegate Valley Community

A social assessment of the Applegate Valley community was completed by the Rogue Institute for Ecology and Economy in May 1994 titled "Words Into Action: A Community Assessment of the Applegate Valley." The objectives of the community assessment were:

- Help the Partnership understand how the community works so it can anticipate community concerns and improve management decisions.

- Improve community participation in planning and implementing forest management in order to gain the support of the community.

- Create jobs, a diversified economy, and community improvements consistent with ecosystem management.

In summary the assessment identified that the middle 1970s brought about dramatic changes to the Applegate Valley. Land was broken into smaller parcels; agriculture operations began to require outside income; a host of newcomers brought population influx and a land boom; the alternative community began to settle in the valley; the local economic base declined; commuting became a lifestyle; and people began locking their doors.

Economic and demographic data related to Jackson and Josephine Counties reflected current changes in the Applegate. The counties' population grew by 10.5 and 6.4% respectively between 1980 and 1990. The occupational structure is changing: employment related to logging and woods products manufacturing has declined steadily, while trade and services employment registered sizable increases, accounting for 90% of the growth in nonmanufacturing jobs in the two counties (Oregon Employment Division 1992). These trends are expected to continue through the year 2000.

The Applegate Valley itself is estimated to have 12,650 people, based on disaggregated census data. Valley residents identify with particular geographic area. The research conducted with the assessment discovered five neighborhood units within the Applegate Watershed: Upper Applegate, Applegate, Williams, Murphy, and Wilderville.

The Squaw/Elliott/Lake Watershed Analysis Area is associated with the Upper Applegate neighborhood. The reader is referred to "Words into Action: A Community Assessment of the Applegate Valley" for a more detailed account of the Applegate Valley Community.

2. The Rogue Valley

The Rogue River National Forest, Land and Resource Management Plan, Final Environmental Impact Statement, Chapter III, Affected Environment, provides an overview of the social and economic environment of the Rogue Valley.

B. RECREATION

Two developed recreation areas exist within the Analysis Area, the Applegate Lake complex and the Squaw Lakes Recreation area. These areas combined draw up to 150,000 people annually. The majority of use in the area is limited to day use. This area is primarily snow free year round, which allows for use throughout the year. Since the Applegate Dam was constructed in the late 1970's, there has been a steady increase in recreational use in the area.

1. Developed Recreation

With a 10 mph speed limit, **Applegate Lake** lends itself to family oriented day use activities such as, swimming, fishing, and picnicking. The **Applegate Lake Complex** consists of Swayne View Point, Hartish Park, Watkins, Carberry, and French Gulch Campgrounds; three boat in camps (Tipsu Tyee, Latagawa Cove and Harr Point); Seattle Bar trailhead and picnic area; Stringtown Camp and trailhead; and three boat ramps located at Hartish, Copper, and French Gulch (low water ramp). Use of the Applegate Lake area seems to have a direct relation to the water level of the lake, when the lake is full there is heavier use of the area.

Camping facilities at Applegate Lake were not developed with RV Camping in mind. The existing tent type campgrounds do not provide the services which are in demand to the changing and aging recreationist.

Camping sites at Tipsu Tyee, Latagawa Cove, and Harr Point provide a unique experience for the adventurer. Accessible only by boat or hiking trail, these sites combine peaceful surroundings and a lake shore camping experience with rustic facilities such as tables, fire-rings and outhouses.

Squaw Lakes Recreation Area provides semi-primitive camping in a non-motorized setting. The Campground at **Squaw Lake** is by reservation only and is at 85% capacity from Memorial Day to Labor Day with 100% capacity every weekend.

A management plan developed at the time the dam was constructed does not take into account issues encountered today when trying to manage for human use and protection of resources; the plan is out-of-date considering todays issues.

An inventory facilities at developed recreation sites has been completed in relation to bringing existing facilities into compliance with Americans With Disabilities Act (ADA). An assessment of the inventory and subsequent proposal of needs has not yet been completed.

Planned Developed Recreation Sites include Squaw Peak Lookout Recreation and Harlow Cabin Recreation Rental on Elliott Creek. The Squaw Peak Lookout site would be developed as an overnight rental with a limited season of use. Harlow Cabin would also be developed as an overnight rental and would be more suitable for larger groups.

2. Other Recreational Uses

Dispersed recreational uses in the area include camping, mountain biking, hiking, hunting, and to a smaller extent, stream fishing (lake fishing has a larger draw to the area). Dispersed camping is limited to several short spurs roads along Squaw Creek and Elliott Creek roads and can be attributed to mining activities, hunting, and to simple weekend getaways.

There are approximately 34 miles of maintained combination use recreation trails in the Analysis Area. Mt. Biking has had a dramatic increase in the last five years and the existing facilities are likely inadequate to accommodate the existing levels of use or the predicted increase in mountain bike use as well as other trail use activities. There is an opportunity to use existing roads to develop a larger system of trails.

3. Nuisance Activities

These activities are not necessarily classified as recreation, but are generally associated with public use in an area. As the demand on recreational facilities increases and community dynamics change, there is a corresponding need to increase the level of law enforcement. There have been historic incidences of vandalism and public harassment in the area.

C. ISSUES ASSOCIATED WITH ACCESS & TRAVEL MANAGEMENT

Access and Travel Management is the movement of people and products to and through our National Forests involving access through roads, trails, airways, and waterways. It connects many different multiple uses and is associated with fire management, recreation, as well as with the management of many other natural resources such as wildlife, fisheries, watershed, timber, and range. As we continue to invite more people to use and enjoy our National Forests, it is our responsibility to provide for their use and safety.

As information was compiled for this Watershed Analysis, several issues surfaced relating to Access and Travel Management.

1. Increased Access/Increased Fire Risk

Increased human activity and residential development can be related to increase or a potential for increase in human-caused fires. The majority of human-caused fires within the analysis area occurred in the lower 1/3 elevation, primarily along road corridors, residential locations, and places of frequent outdoor recreation. The Applegate Lake Area has the highest human-caused fire occurrence on the Forest.

With the continued increase in recreational use and development in the rural/wildland interface area, there is a concern, from a fire management standpoint, for increased fire risk.

2. Coordination of Multiple User Recreation Opportunities

Conflict among recreational user groups such as hikers, mountain bikers, and horse groups periodically arise in areas receiving heavy recreational use. The "Multi User Coalition" (based in Medford) has been instrumental in resolving user group conflicts. As their name implies, the "Multi User Coalition" is comprised of a variety of recreational user groups; their goal is to bring the concept of multiple use of trail systems into reality.

Recently, they have worked in partnership with the Forest Service to resolve conflicts between motorcycle, horseback riding and hiker uses on the Elliott Ridge trail system. They worked with the Forest Service to upgrade recreation facilities (e.g. campsites, hitchrails, loading ramps, fire rings, etc.) at Seattle bar and Stringtown. Because this group represents such a variety of user interests, they provide a good source for information and public involvement in Forest Service recreation planning.

A need to coordinate recreation use with livestock trails may also exist.

3. Integration of Recreational Uses and Wildlife

With increased recreational use expected in the Applegate Lake area, there is a concern for integrating human uses and access with Threatened, Endangered and Sensitive species management. Of immediate concern is Bald Eagle nest stands and existing trail use activities. As new trail systems are identified or existing trail uses modified, the needs of many other species will need to be considered as well. In managing to reduce conflicts for one species there is a potential for creating conflicts for other species, care will have to be taken in considering the needs of all species. As we strive to plan for long-term recreation use, other situations similar to this will likely present interesting challenges in providing public access for recreational as well as other uses in the Analysis Area, and may result in limited access to certain areas.

4. Other Considerations

A re-occurring theme throughout the analysis of resources is the effects of high road densities on wildlife habitat, sediment production and slope stability, aquatic and riparian habitats, and to a smaller extent flow regime. More information is contained in Terrestrial and Aquatic Systems.

5. Access and Travel Management Process

The Rogue River National Forest published an Access and Travel Management Process Guide in 1994, to be used by managers, interdisciplinary teams, and other teams and individuals involved in planning and decision making related to the implementation of Forest activities. It is designed to assist in the overall integration of resource management needs and concerns while implementing Access and Travel Management. More information on the status of Access and Travel Management on the Rogue River National Forest is contained in Appendix C.

D. OTHER LAND USES

1. Grazing

The Watershed Analysis encompasses 3 separate grazing allotments, however, only portions of the total allotments fall within the Watershed Analysis Boundary. Grazing allotment boundaries are on file at the Applegate Ranger District. The following is a summary of current allotment information:

Allotment	Season of Use	Permitted #s of Livestock
Beaver/Silver	April 1 - October 31	368
Upper Big Applegate	April 1 - October 31	141
Elliott Creek	June 1 - October 31	100

Records of livestock use and distribution are available for review in the Range Analysis Files at the Applegate Ranger District.

Changes in permitted numbers of livestock and seasons of use could change over the next 3 years due to the updating of Allotment Management Plans (AMP). Environmental analysis is being completed for the updates of AMPs. An Environmental Assessment for Beaver/Silver AMP was released for public comment on September 11, 1995. Environmental Assessments for the Elliott Creek and Upper Big Applegate AMPs are estimated to be released for public comment by the end of 1995 or early 1996.

Issues associated with these grazing allotments include:

Trespass of Cattle from grazing allotments located south of the Siskiyou Crest on the Klamath National Forest. This has been an ongoing problem since Forest Service Boundaries were established. Efforts to reduce the problem include increased communications between the Rogue River and Klamath National Forests, documentation of trespass occurrences, and tactics in preventing cattle from drifting over the Crest.

Impacts to high elevation meadows and wetlands: Silver Fork Basin, Tamarack Meadows, Donomore Meadows, and Lily Mountain are heavily utilized for grazing which is leading to riparian resource impacts. As part of the Allotment Management Plan update, a rest rotation grazing plan is being considered as an alternative to protect riparian and meadow resources while allowing grazing use of the area.

Riparian Reserves: The removal of livestock structures from all Riparian Reserves will bring allotments into compliance with the Aquatic Conservation Strategy.

2. Mining: See Geology and Geomorphology.

3. Water Uses: See Hydrology and Water Uses.

GLOSSARY OF TERMS

Accelerated erosion: erosion at a rate greater than normal for a site on the land surface or in drainageways.

Accretion: the process , driven by plate tectonics, whereby the continental margin grows by addition of ocean crust and sediments at a subduction zone. (FEMAT)

Aggradation: the geologic process by which stream beds, floodplains and the bottoms of other water bodies are raised in elevation by the deposition of material eroded and transported by water from other areas.

Airshed: A geographic area that shares the same air mass due to topography, meteorology, and climate.

Aerial fuel: All burnable material more than six feet above the ground. This includes the upper portions of trees, large shrubs, snags, and all the foliage and woody tissue on them.

Alluvial: originated through the transport by and deposition from running water.FEMAT

Alluvial stream: a stream whose boundary is composed of appreciable quantities of the sediments transported by the flow and which generally changes its bed forms as the rate of flow changes.

Alluvium: stream-deposited debris.

Armoring: the formation of a resistant layer of relatively large particles by erosion of the finer particles.

Bankfull stage: the discharge which just fills a stream to its banks.

Bedload: material moving on or near the stream bed by rolling and sliding with brief excursions into the flow three or four diameters above the bed.

Bed material: the sediment mixture of which the stream bed is composed.

Boulder: fluvial sediment particles larger than 256 mm.

Braided river: a wide and shallow river channel where flow passes through a number of small interlaced channels separated by bars or shoals.

Cirque: a deep steep-walled half-bowl-like recess or hollow, variously described as horseshoe- or crescent-shaped or semi circular in plan, situated high on the side of a mountain and commonly at the head of a glacial valley.

Channel: a natural or artificial waterway that periodically or continuously contains moving water, or which forms a connecting link between two bodies of water.

Climax: The final stages of a vegetation succession through seral stages to the most stable, moisture and shade- loving association the site can support.

Cobbles: fluvial sediment particles 64 to 256 mm.

Crown fire: A fire that advances from top to top of trees or shrubs more or less independent of the surface fire.

Degradation: the geologic process by which streambeds, floodplains and the bottoms of other water bodies are lowered in elevation by the removal of material by water.

Ecosystem: a community of plants, animals, other living organisms, and the nonliving factors of their environment, whose interactions result in an exchange of materials and energy between the living and nonliving components of the system.

Erodability: the erosion potential.

Fire climax: a plant association, forest type, or covertype held at a seral stage by periodic fires, therefore differing from the true climax community; e.g., a Douglas-fir forest in the western hemlock zone.

Fire cycle: The average stand age of a forest whose age distinction fits a mathematical distribution (negative exponential or Weibull).

Fire danger: Resultant of both constant and variable factors—weather, terrain, fuel, and risk—that affect the inception, spread, and difficulty of control.

Fire environment: The physical and biological conditions at the micro-site level that influences fire behavior and its affects.

Fire event: (fire occurrence, fire incident): a single fire or series of fires within an area at a particular time.

Fire frequency: a general term referring to the recurrence of fire in a given area over time.

Fire hazard: A fuel complex defined by kind, arrangement, volume, condition, and location that forms a special threat of ignition.

Fire hazard reduction: Any vegetation treatment that reduces threat of ignition, spread of fire, and its resistance to control. This may involve removal, burning, rearranging, burying, or modification such as crushing or chipping.

Fire interval: (fire-free interval or fire-return interval): The number of years between two successive fire events in a given area.

Fire risk: The chance of various potential ignition sources causing a fire, threatening valuable resources, property and life.

Fire rotation: Fire rotation (natural fire rotation): the length of time necessary for an area the size of the study area to burn.

Fish-bearing stream: any stream that contains any type of anadromous or inland fish population.

Floodplain: the relatively flat valley floor formed by floods which extends to the valley walls.

Fuel type: An identifiable association of fuel elements of distinctive species, form size, arrangement, or other characteristics that will cause a predictable rate of fire spread and difficulty of control under specific weather.

Geomorphology: the science that treats the general configuration of the earth's surface; specific to the study of the classification, description, nature, origin, and development of landforms and their relationships to underlying structures, and the history of geologic changes as recorded by these surface features.

Graded stream: a stream in which a steady state has been reached such that, over a period of time the discharge and load entering the system are balanced by the discharge and load leaving the system.

Granitic: any light-colored, coarse-grained rock formed at considerable depth by crystallization of molten rock.FEMAT

Gravel: fluvial sediment particles between 2.0 and 64 mm in size.

Ground fire: Fire limited to the mantle of organic material, such as duff or peat, that accumulates on top of the mineral soil. Characterized by glowing combustion and little smoke.

Ground fuel: All combustible materials below the surface litter, including duff, tree roots, punky wood, peat, and sawdust, that normally support a glowing combustion without flame.

Hydraulic geometry: describes the way stream channel properties such as bankfull width, mean depth, mean velocity and cross sectional area change with streamflow.

Hyporheic zone: the interface forming the boundary between groundwater and channel water in streams, important in the storage of dissolved gases and nutrients.

Intermittent stream: a stream channel which shows channel scour or deposition in a definable channel.

Jurassic: the second period of the Mesozoic Era, thought to have covered the span of time between 190 and 135 million years ago; also, the corresponding system of rocks.

Ladder fuels: Provide verticle fuel continuity between strata as between surface fuels and crowns.

Mass movement: the downslope movement of earth caused by gravity. Includes but is not limited to landslides, rock falls, debris avalanches, and creep. It does not, however include surface erosion by running water. It may be caused by natural erosional processes, or by natural disturbances (e.g., earthquakes or fire events) or human disturbances (e.g., mining or road construction).FEMAT

Mean fire return interval: arithmetic average of all fire intervals in a given area over a given time period.

Meander: one of a series of sinuous curves, bends or loops produced in the flood plain of a mature stream.

Metasedimentary: a sediment or sedimentary rock that shows evidence of having been subjected to metamorphism.

Metavolcanics: a term for volcanic rocks that show evidence of having been subjected to metamorphism.

Melange: a mappable body of rock that includes fragments and blocks of all sizes, both exotic and native,embedded in a fragmented and generally sheared matrix.

Paleozoic: an era of geologic time, from the end of the precambrian to the beginning of the Mesozoic, or from about 570 to about 225 million years ago. Also, the sequence of rocks deposited during the Paleozoic.

Perennial stream: streams which essentially flow year-round.

Physiographic province: a geographic area having a similar set of biophysical characteristics and processes due to effects of climate and geology which result in patterns of soils and broad-scale plant communities. Habitat patterns, wildlife distributions, and historical land sue patterns may differ significantly from those of adjacent provinces. (FEMAT)

Plate tectonics: a theory of global tectonics in which the lithosphere is divided into a number of plates whose pattern of horizontal movement is that of torsionally rigid bodies that interact with one another at their boundaries, causing seismic and tectonic activity along these boundaries.

Pluton: a coarse grained igneous intrusion and composed of the granitic family of rocks.
Plutonic rock: a rock formed at considerable depth by crystallization of magma and/or by chemical alteration. It is characteristically medium- to coarse-grained, of granitoid texture.

Range of natural variation: Natural processes of succession as influenced by natural disturbance mechanisms. Considers the range of conditions environmentally that would naturally occur through succession. For the eastern portion of interior southwest Oregon, before effective organized fire suppression, a major disturbance mechanism influencing succession and vegetative conditions (live or dead) was fire.

Residence time: of fire passage: The time that the flaming front during fire passage occupies an area. Usually the greater the loading of dead and downed debris, the longer the residence time of fire propagation, combustion and waning, given relative moisture conditions.

Riparian reserves: designated riparian areas found outside Late-Successional Reserves.FEMAT

Sand size: fluvial sediment particles 0.062 to 2.0 mm in size.
Sediment: particles derived from rocks or biological materials that are or have been transported by water.

Sediment discharge: the mass or volume of sediment passing a stream cross section in a unit of time.

Seral stages: The series of relatively transitory plant communities that develop during ecological succession from bare ground to the climax stage.

Sere: A sequence of plant communities that successionally occupy and replace one another in a particular enviornment over time.

Shear stress: force required to erode particles from a streambank.

Sheet erosion: the more or less uniform removal of soil from an area by raindrop splash and overland flow, without the development of water channels exceeding 300 mm in depth.

Snag: A standing dead tree or standing portion from which at least the leaves or foliage and smaller branches have fallen. Often a stub if less than 20 feet tall.

Stand maintenance fire: Fire because of the moisture conditions, atmospheric conditions vegetative type, density, arrangement and topographic conditions results in perpetuation of a certain type of plant community. Usually on a landscape basis. Vegetation can be categorized and described as evaders, resisters, avoiders, invaders, adapters in how vegetation will respond to fire. Determinants are mainly reproductive, physiological, and tolerance adaptations as how they respond to fire.

Stand replacement fire: A fire because of its intensity relative to the type of fuel (live or dead) that is burning; and the area that the fire covers and the type of overstory burned, results in the death of the dominant overstory. Replacement takes place consequently.

Streambank erosion: the removal of bank material by flowing water.

Stream discharge: the quantity of flow passing through a stream cross section in a unit of time.

Subduction: the process of one lithospheric plate descending beneath another.

Subduction zone: A long, narrow belt in which subduction takes place, eg along the Peru-Chile trench, where the Pacific plate descends beneath the South American plate.

Succession: The gradual supplanting of one community of plants by another, the sequence of communities being termed a sere and each stage seral or successional.

Surface erosion: a group of processes whereby soil materials are removed by running water, waves and currents, moving ice, or wind. (FEMAT)

Surface fire: Fire that burns surface fuels, such as litter, other loose debris of the forest floor, and small vegetation.

Suspended sediment load: the weight of suspended particles continuously supported by the water.

Terrain: a tract or region of the earth's surface considered as a physical feature, an ecological environment, or a site of some planned activity of man (e.g. an engineering location).

Terrane: a term applied to a rock or group of rocks and to the area in which they crop out.

Thalweg: the line connecting the lowest or deepest points along a stream bed, valley or reservoir, whether underwater or not.

Ultramafic: dark colored igneous rocks composed of minerals which are enriched in iron and magnesium. (see serpentinite/peridotite)FEMAT

Uplift: a structurally high area in the earth's crust, produced by positive movements that raise or upthrust the rocks.FEMAT

Unconsolidated deposits: sediments that are loosely arranged, with particles that are not cemented together. Includes alluvial, glacial, volcanic and landslide deposits.FEMAT

Unstable and potentially unstable lands: the unstable land component of the riparian reserves includes lands which are prone to mass failure under natural conditions(unroaded, unharvested), and where human activities such as road construction and timber harvest are likely to increase landslide distribution in time and space, to the point where this change is likely to modify natural geomorphic and hydrologic processes (such as the delivery of sediment and wood to channels), which will in turn effect aquatic ecosystems including streams, springs, seeps, wetlands, and marshes.

The following types of land are included: 1) active landslide and those which exhibit sound evidence of movement in the past 400 years; 2) inner gorges; 3) those lands identified as unstable by a geologic investigations, using the criteria stated above (includes lands already classified by the Forest Service as unsuited for programmed timber harvest due to irreversible soil loss, and by the BLM as unsuitable fragile lands). Highly erodible lands (i.e., lands prone to sheet and rill erosion) are not included in this definition.FEMAT

Vegetation zone: A land area with a single overstory dominant as the primary climax dominant. Occasionally zones are named after major seral species. Other associates exist in the zone.

Watershed (catchment): all lands enclosed by a continuous hydrologic- surface drainage divide and lying upslope from a specified point on a stream.

Watershed analysis: A systemic procedure for characterizing watershed and ecological processes to meet specific management and social objectives. Watershed analysis provides a basis for ecosystem management planning that is applied to watersheds of approximately 20 to 200 square miles.FEMAT

Water table: the static level of groundwater below which it is held in intergranular pores of soil or rock at pressures greater than atmospheric.

Wetlands: areas that are inundated by surface water or groundwater with a frequency sufficient to support, and under normal circumstances do or would support, a prevalence of vegetative or aquatic life that require saturated or seasonally saturated soil conditions for growth and reproduction(Executive Order 11990). Wetlands generally include, but are not limited to, swamps, marshes, bogs, and similar areas.FEMAT

DEFINITIONS OF THE EIGHT MAJOR, INTERRELATED CHANNEL VARIABLES:

1. **width:** the distance across the wetted channel during high or low flows.
2. **depth:** the vertical distance between the water surface and a specified point on the streambed.
3. **velocity:** the speed at which water moves downstream.
4. **discharge:** the quantity of flow passing through a cross section in a unit of time.
5. **channel slope:** difference in water surface elevation per unit of stream length.
6. **roughness of channel materials:** a quantitative description of the variables in the stream channel that impede the flow of water.
7. **sediment load:** the mass of the sediment per a measured volume of water-sediment mix.
8. **sediment size:** the size of particles carried by the stream.

LITERATURE CITED

Andelman, S. J. and A. Stock. 1994. *Management, Research and Monitoring Priorities for the Conservation of Neotropical Migratory Landbirds that Breed in Oregon.* Washington Natural Heritage Program. Washington Department of Natural Resources. Olympia, Washington.

Atzet, Thomas and Dave Wheeler. 1982. *Historical and Ecological Perspectives on Fire Activity in the Klamath Geological Province of the Rogue River and Siskiyou National Forests*, USDA Forest Service, Pacific Northwest Region, Portland Oregon.

Atzet, Thomas. 1994. From a personal discussion concerning the fire return interval for the forest/urban interface in the upper Applegate Valley.

Badura, G., Jan, P., 1977. *Soil Resource Inventory For the Rogue River National Forest.* U.S. Forest Service, Pacific Northwest Region, 239 pp.

Baldwin, E.M., 1981. *Geology of Oregon*, 3rd. Edition. Kendall/Hunt Publishing, Dubuque, Iowa, 170p.

Bedrossian, T.L., 1983. *Watershed Mapping in Northern California.* California Geology, June 1983, pp. 140-147.

Blair, W.N., Wong, A., Moring, B.C., Barnard, J.B., Page, N.J., Gray, F., 1981. *Reconnaissance Geologic Map of Parts of the Gold Hill, Ruch, Medford, and Talent 15' Quadrangles*, Southwestern Oregon, United States Geological Survey, Open-File Report 81-1076.

BLM. 1993. *Wildlife Species of the Applegate Adaptive Management Area.*

CDFD, 1992, Elliott Creek, Siskiyou County *Population Estimate Report.* California Department of Fish and Game., Yreka, California.

Connell, Mark. 1980. USDA - Forest Service, *Stream Survey of Anadromous and Native Fisheries on the Applegate Ranger District.* Rogue River National Forest, Applegate Ranger District, Ruch, Oregon.

Donato, M.M., Coleman, R.G., Kays, M.A., 1980. *Geology of the Condrey Mountain Schist, Northern Klamath Mountains, California and Oregon.* Oregon Geology, Vol. 42, No. 7, pp. 125-128.

Everest, F.H. 1993. USDA-Forest Service, Region 6, *Columbia River Basins Forests, Anadromous Fish Habitat Desired Future Conditions*, draft working copy.

Frissell, Christopher A. 1086. *Classification of Stream Habitat and Watershed Systems in South Coastal Oregon and an Assessment of Land Use Impacts.* Oregon Department of Fish and Wildlife.

Froehlich, Aulerich and Curtis, 1981. *Designing Skid Trail Systems to Reduce Soil Impacts from Tractive Logging Machines.* OSU Forest Research Laboratory, Research Paper 44.

Froehlich, Robbins, Miles and Lyons, 1983. *Monitoring Recovery of Compacted Skid Trails in Central Idaho.* Special Report for Payette NF.

Fustish, Chuck, 1991. *Draft Rogue River Basin Fisheries Management Plan.* Oregon Department of Fish and Wildlife, Central Point, Oregon.

Gallino,G. 1994. *Personal Communication on Low Flows.* Portland, Oregon: U.S. Department of the Interior, U.S. Geological Survey.

Harr, R.D. 1975. *Forest Practices and Streamflow in Western Oregon.* Corvallis, Oregon: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. Paper Presented at the Symposium on Watershed Management, Logan, Utah, August 11-13, 1975.

Harr, R.D. 1976. *Hydrology of Small Forest Streams in Western Oregon.* General Technical Report PNW-55. Portland, Oregon: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station.

Harr, R.D.; Fredriksen, R.L.; Rothacher, J. 1979. *Changes in Streamflow Following Timber Harvest in Southwestern Oregon.* Research Paper PNW-249. Portland, Oregon: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station.

Hoover, Jay. 1969. USDA - Forest Service, *Stream Habitat Management Plan Applegate River and Tributaries.* USDA Forest Service. Applegate Ranger District, Ruch, Oregon.

Isaacs, F. B., and R. G. Anthony. 1994. *Bald Eagle Nest Locations and History of Use in Oregon 1971 through 1994.* Oreg. Coop. Wildl. Res. Unit, Oreg. State Univ., Corvallis. 16 pp, 5 tables, 1 figure, 1 appendix.

Maser, Chris, et al., eds. 1988. *From the Forest to the Seas: A Story of Fallen Trees.* General Technical Report PNW-GTR-229. Portland, Oregon.

McCrimmon, Lisa and Thomas Atzet. 1992. *Distribution of Large Woody Material on the Rogue River National Forest.*

Meehan, W.R. 1991. *Influences of Forest and Rangeland Management on Salmonid Fishes and their Habitats*: 9-10, 444-445.

Mortimer, N., Coleman, R.G., 1985. *A Neogene Structural Dome in the Klamath Mountains*, California and Oregon. Geology, Vol. 13, pp. 253-256.

Nickelson, Thomas, et al. 1992. *Status of Anadromous Salmonids in Oregon Coastal Basins.* Oregon Department of Fish and Wildlife, research and development section.

Oregon Department of Environmental Quality. 1988. *Oregon Statewide Assessment of Nonpoint Sources of Water Pollution.* Portland, Oregon: Department of Environmental Quality (DEQ).

ODFW records, various fish survey and stocking records are on file at the Meford District Office.

Orr, E.L., Orr, W.N., Baldwin, E.M., 1992. *Geology of Oregon*, 4th. Edition. Kendall/Hunt Publishing, Dubuque, Iowa, 254p.

Reiser, D.W. and T.C. Bjornn. 1979. *Habitat Requirements of Anadromous Salmonids.* USDA Forest Service General Technical Report PNW-96.

Riggs, H.C. 1972. *Low-Flow Investigations.* U.S. Geological Survey Techniques of Water-Resources Investigations, Book 4, Chapter B1.

RRNF, Applegate Ranger District. 1993. *Draft Site Management Plan for the Applegate Reservoir Bald Eagle Management Area.* Jacksonville, Oregon.

Rosgen, Dave. 1994. *Applied Fluvial Geomorphology.* Unpublished course manual Wildland Hydrology Consultants. Pagosa Springs, Colorado.

Rothacher, J. 1973. *Does Harvest in West Slope Douglas-fir Increase Peak Flow in Small Forest Watersheds?* Research Paper PNW-163. Portland, Oregon: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station.

Schuster, R.L., Krizek, R.J., editors, 1978. *Landslides-Analysis and Control.* Transportation Research Board, National Academy of Sciences, Washington D.C., Special Report 176, 234 pp.

Stalmaster, M. 1987. *The Bald Eagle.* Universe Books, 381 Park Avenue South, New York, N.Y., 227 pp.

Taras, M.J.; Greenberg, A.E.; Hoak,R.D.; Rand, M.C. (Editors). 1971. *Standard Methods for the Examination of Water and Wastewater*, 13th Edition. Washington, D.C.: American Public Health Association; American Water Works Association; Water Pollution Control Federation.

Thomas, J. W., C. Maser, and J. E. Rodiek. 1979. *Wildlife Habitats in Managed Forests: The Blue Mountains of Oregon and Washington*, (J. W. Thomas, ed.). U.S. Department of Agriculture, Forest Service, Agriculture Handbook No. 553.

U.S. Department of Commerce. *Precipitation Data.* U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service Office, Medford, Oregon.

USDA 1993. *Determining the Risk of Cumulative Watershed Effects Resulting from Mulriple Activities*, Endangered Species Act, Section 7. U.S. Department of Agriculture, Forest Service, Pacific Northwest Region.

USDA, U.S. Department of Commerce; U.S. Department of the Interior; EPA. 1993. *Forest Ecosystem Management: An Ecological, Economic, and Social Assessment* - Report of the Forest Ecosystem Management Assessment Team (FEMAT).

USDA/Forest Service, 1990. *Final Environmental Impact Statement, Land and Resource Management Plan*, Rogue River National Forest, Medford, Oregon.

USDA/Forest Service. 1990. *A Conservation Strategy for the Northern Spotted Owl: Report of the Interagency Scientific Committee to Address the Conservation of the Northern Spotted Owl.* Portland, Oregon.

USDA/USDI, Forest Service and BLM. 1994. *Final Supplemental Environmental Impact Statement on the Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl.* Portland, Oregon.

USDA/Forest Service, USDI/Bureau of Land Management, 1994. *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl* and *Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl.*

USDA/Forest Service, 1994. *Slope Stability Reference Guide for National Forests in the United States.* Washington D.C., EM-7170-13, Vol. 1-3, August 1994.

USDA. Forest Service. 1995. *Stream Survey of Squaw Creek.* Rogue River National Forest, Applegate Ranger District, Ruch, Oregon.

USDA/Forest Service. 1995 *Stream Inventory Handbook Level I & II.* Pacific Northwest Region Six.

USDI *Compilations of Records of Surface Waters of the United States through September 1950.* Part 14 Pacific Slope Basins in Oregon and Lower Columbia River Basins. U.S. Geological Survey WSP-1318.

USDI, Fish and Wildlife Service. 1992a. *Endangered and Threatened Wildlife and Plants: Determination of Critical Habitat for the Northern Spotted Owl*; final rule. U.S. Department of the Interior, Fish and Wildlife Service. Portland, Oregon. 41 pp.

USDI, Fish and Wildlife Service. 1992b. *Draft Recovery Plan for the Northern Spotted Owl*. U.S. Department of Interior, Fish and Wildlife Service. Portland, Oregon. 662 pp.

USDI *Statistical Summaries of Streamflow Data in Oregon*: Volume 2 -- Annual Low and High Flow, and Instantaneous Peak Flow. U.S. Geological Survey Open-File Report 93-63.

Vaughn, Harry. 1976. *Blue Ledge Mine, Siskiyou County, California*. California Department of Fish and Game, Yreka, California.

Water Rights Files. U.S. Department of Agriculture, Forest Service, Rogue River National Forest.

Wert, S. and Thomas B. 1981. *Effects of Skid Roads on Diameter, Height and Volume Growth in Douglas-Fir*. Soil Science Society of America. Journal Volume 45, No. 3, May-June.
Wisseman, Bob. 1992. *Benthic Invertebrate Biomonitoring*, Rogue River National Forest, unpublished synthesis report. Aquatic Biology Associates. Corvallis, OR.

APPENDIX B

ISSUES & KEY QUESTIONS

Key Questions

Squaw/Elliott/Lake Watershed Analysis

CLIMATE

Identification of the atmospheric/climate regimes under which the ecosystems of the Squaw, Elliott, and Lakes Watershed Analysis Area have developed is important to this analysis. Attributes to be discussed in this analysis include periods of flood and drought, storm patterns in the winter and summer, occurrence of severe lightning and wind storms, rain on snow events, etc.

Key Question:

1. What is the historical pattern of floods and droughts?
2. What are the winter/summer storm patterns of southwest Oregon, eastern Siskiyous?

1. TERRESTRIAL SYSTEM

GEOLOGY AND GEOMORPHOLOGY

1) What is the origin of geology found in the analysis area?

2) What are the major rock types present?

3) What are the characteristics (strength, erosivity, etc.) of the rocks?

4) Are there geologic structures that influence geomorphology, groundwater, springs, minerals, transportation, slope stability?

5) Are there economic deposits of metallic or nonmetallic ore?

6) What is the patent status of locatable mineral deposits?

7) What are the locations, status and quality of rock sources?

8) Are there any regions that are notably lacking rock sources?

9) Are there any mining or quarry sites in need of reclamation or remediation?

Soils and Slope Stability

1) What are the general soils types and characteristics associated with each of the major rock types? (SRI and JCSS)

2) Where are the areas that have been mapped in detail for soils?

3) Where are the areas that have been mapped in detail for slope stability?

4) What are the major types of slope instability and what are the management concerns/guidance for activities?

5) What factors are involved with the initiation of slope failures?

6) Are there any recreation or transportation facilities threatened by slope instability?

7) What hillslope processes (past and current) influence geomorphology?

8) Can the terrane be characterized using the Landscape approach used for LAWA?

9) What soils are major sources of sediment delivered to waterways?

10) When is sediment delivered, and is the amount of concern?

11) Where and what types of restoration activities can be implemented?

12) What types of management strategies are employed for unstable, potentially unstable or erodible terrane?

Roads

1) Where are the system roads located in relation to Riparian Reserves.

2) What are the characteristics of roads (surfacing, maint. level, age, grade) adjacent to various stream classes?

3) Where are the locations of high density and/or poorly functioning non-system roads?

4) What is the status of Access and Travel Management studies?

TERRESTRIAL VEGETATION, SITE PRODUCTIVITY AND BOTANICAL RESOURCES

The diversity of the vegetative component of an area, both species composition and structure, provide diverse habitats for a wide variety of plant and animal species. The ability of the analysis area to provide and maintain vegetative diversity is dependent on soil productivity and site capabilities. The parameters to be analyzed include plant associations, soil types, amount of coarse woody debris (CWD), and soil chemistry and biology as measured by compaction and loss of duff layers.

1. What is the current and potential vegetation for the Watershed Analysis Area.
2. Where and what kinds of special vegetation habitats occur within the Analysis Area?
3. What Plant species of concern (TE&S and noxious) exist in the Analysis Area?
4. What is the current distribution of successional stages, and how does this compare to natural range of variability (fire exclusion).
5. What is the current condition of late-successional stands? What processes affect the condition of these stands.
6. What is the general health of vegetation components (including hardwood and brush species) within the Analysis Area? What is the risk of catastrophic losses of vegetation to insect, disease, or fire.
7. What is the site productivity in the Analysis Area?
8. What are the historic and current levels of Coarse Woody Debris in the Analysis Area
9. What activities affect soil biology, fertility, and mechanics and where do these activities occur? Percentage of the Analysis Area?

FIRE REGIME

The analysis of the role of fire in the ecosystem is extremely important in southwest Oregon, considering the unique climate and vegetative conditions which influence fire management in this area. For a discussion of fire's influence on resources, fire risk is defined as the chance of various potential ignition sources (lightning, human caused, etc.) causing a fire, threatening valuable resources, property, and life. The chance of a fire starting is determined by hazards present. Fire hazard is a fuel complex defined by kind, arrangement, volume, condition, and location that forms a special threat of ignition, spread, and difficulty of suppression. Attributes that will be addressed and analyzed for fire processes, functions, and conditions will be fuel type and patterns, fire occurrence, fire intensities, fire sizes, fire timing, and fuel modeling (slope and aspect), resource values at risk, and fire risk.

Key Questions:

1. What is the current fire regime?
2. What has been the effect of fire suppression on increased vegetative competition and fire hazard? What are the effects of dying vegetation on fire potential?
3. What is the historic fire occurrence and the timing of historic events? What were the patterns of native burning in the Watershed Analysis area? What areas were burned, when and for what purposes?
4. What was the scope of stand replacing fires under the historical regime?
5. How does increased human activity in the rural interface increase fire risk in the area.
6. How is the reintroduction of prescribed burning affecting fire hazard levels as related to vegetative competition, structures, dead and down woody material, and sediment production.
7. How does air quality differ from historical regimes and current suppression regimes?
8. What is the current air quality condition?
9. How will achieving a more historic regime for fire affect particulate requirements? (Disturbance regime step)
10. What is the potential particulate emission with the current situation? How would a large stand replacing fire affect particulate requirements.
11. What is the current fire regimes effect on sediment and stream flow as compared to the historical fire regime? (Disturbance regime, historical range of variability, and general trends steps).

TERRESTRIAL WILDLIFE

I. How do conditions in the watershed affect viability of species that occur within it?

A. Siskiyou Mountain Salamander: This species has a broad scale management strategy described in the Northwest Forest Plan, however, because their entire range is nearly all within this Watershed Analysis Area further viability analysis is warranted.

1. What is the historic and current distribution of the species and its habitat in the watershed?
2. How does the watershed related to the habitat and population viability of the species over the entire range?

B. ROD species requiring finer scale attention and Threatened or Endangered animal species.

1. What locally rare and endemic species from ROD Table C-3 are located in the watershed; where are they; and what are appropriate steps for management of their sites?
2. What is the existing distribution of northern spotted owls and their habitat in the Analysis Area, the condition of dispersal habitat, the likelihood of incidental take occurring, and the likely affect on Critical Habitat Units (affect of what?)
3. What is the status of Peregrine Falcon (endangered) and Bald Eagle (Threatened) sites within the Analsis Area and how do these sites contribute to the recovery needs of these species?

C. Species which were outside the scope of the FSEIS and which are deemed to be at risk.

1. What species comprise this category, and what is the basis for concluding that viability of the species is at risk?
2. What are the activities or trends in population or habitat that place the species at risk:
3. What is the role of this watershed in the maintenance of the species' population?

II. What are the conditions of the terrestrial ecosystem in the watershed, and how do they influence ecological diversity and maintenance of process such as nutrient cycling, succession, and wildlife habitats?

A. Ecosystem issues that were adequately resolved in the FSEIS, but require additional consideration if land allocation changes are altered. These issues include: Distribution of LSRs; diversity of forest types included in reserves; distribution and size of riparian reserves; and, connectivity of LSRs.

1. What is the condition of Riparian Reserve habitat.
2. What is the condition of LSR habitat.

B. Ecosystem issues for which finer scale attention was deemed necessary in the ROD.

1. What are the contributions of special habitats (as identified in the ROD) to biodiversity and ecological function in the WAA? (i.e. rock outcrops, seeps, springs, bogs, fens, cliffs, talus, caves, and ponds <1 acre).
2. Are there specific areas of late-successional forest outside reserve boundaries that serve an important function not currently being served by LSRs? (e.g., optimal thermal cover in big game winter range, areas needed to meet 15% of the watershed to be in LS conditions).
3. What are the roles of fire and what are the risks of fire in the Watershed Analysis Area and how do they affect wildlife habitats?

C. What are the ecosystem issues related to abundance and ecological diversity, processes functions, and connectivity of ecosystems?

1. What are the ecological consequences of the array and landscape pattern of plant communities and seral stages in the watershed as they related to ecological processes and biological diversity?
2. What non-forested communities occur within the Watershed Analysis Area and what is their status (i.e. abundance, integrity of processes and functions, and connectivity)?

3. What are the ecological roles of natural and human-caused disturbances other than fire within the watershed?
4. What ecological roles do non-federal lands play within the Analysis Area?

III. What is the range of possible contributions of the watershed to social and economic demands for wildlife species and ecosystem productivity?

A. How would the watershed contribute to social, tribal/cultural and economic demands for animal species?

1. what are the species for which there are tribal, social, or economic goals and what is the current condition of these species relative to these goals?

2. What are management goals for each species? What is the potential to accomplish the management goal for the species?

2. AQUATIC SYSTEMS

STREAM FLOW REGIME

Attributes that need to be analyzed are 1 to 2 year storm events (bank full), flood events, and low flows. Bankful storm events have been determined to be the long term channel forming and maintenance event.

Key Questions:

What is the character, timing and distribution of runoff within the major subwatersheds? (Include flood events and drought-related low flows) Have human processes affected natural runoff patterns, and if so, how much? (Mike)

Have low flows, bankful, or flood events affected instream values (e.g. fish, aquatic habitat) or human improvements, and if so, how much? (Mike and Su?)

What is the extent of water use within subwatersheds? Have water withdrawals or impoundments affected instream beneficial uses, and if so, where, how, and to what extent? (Mike)

WATER QUALITY AND AQUATIC HABITAT:

Which water quality attributes (sediment, turbidity, temperatures, dissolved oxygen, nutrients, heavy metals, other) have been influenced by human processes?

Where and how is water quality and/or aquatic habitat degradation manifested (e.g. sediment deposition in pools, turbidity, embeddedness, high temperatures, algal blooms) and what is the magnitude of degradation? Has this affected instream beneficial uses (e.g. macroinvertebrate populations, fish populations, etc.) and if so, to what extent?

What are the primary mechanisms contributing sediment to stream systems and lakes/reservoirs, and where do these processes occur.

What are the general and/or specific sources (e.g. road sediment sources, overgrazed sites, mines, water withdrawals, etc.) of water quality degradation from human processes?

What are the effects of sediment on channel morphology and aquatic habitat? What are the effects of sedimentation on impoundments (Squaw Lakes and Applegate Reservoir)?

What future trends can we expect in sediment production, and how do they compare to historic rates? Where are future rates of sediment production likely to be higher than historic rates?

STREAMSIDE AREAS (RIPARIAN RESERVES):

What is the distribution of Riparian Reserves?

To what extent have human processes changed historic (pre-European settlement) vegetative patterns within streamside areas (Riparian Reserves)? To what extent have timber harvest, roads, mining, grazing, etc. contributed to this change?

To what extent do Riparian Reserves currently possess late successional characteristics which provide adequate canopy cover for stream shade, sources of coarse woody debris (CWD), wildlife cover, etc?

Is the current vegetative structure of Riparian Reserves adequate for sustaining a diversity of species? How do these areas function in providing habitat connectivity and transition habitat for upland species?

WATERSHED CONDITION:

What are the cumulative effects of human processes within major subwatersheds as evidenced by channel condition? Which activities contribute most to these impacts and to what extent?

VIABILITY OF FISH POPULATIONS

Age, distribution and size of fish populations including anadromous coho salmon, summer and winter steelhead, resident cutthroat and rainbow trout. Ohter attributes to be analyzed are water temperature, riparian vegetation, coarse woody debris, pools per mile, width to depth ratio, pool to riffle ratio, habitat connectivity, embeddedness, water quality requirements, spawning gravel, and populations of macroinvertebrates.

Key Questions:

1. What are the historic and current populations and distribution of fish?
2. What fish species are recognized at risk in the watershed analysis area?
3. What fish species are recognized as at risk (e.g., threatened, endangered or sensitive) in the Bear Creek watershed?
4. What role does (or should) the watershed play in providing for conservation or recovery of these species?
5. How have altered physical processes impacted aquatic organism? (What is the current fish habitat conditions for the watershed (coarse woody debris, pool/riffle ratio, width/depth ratio, canopy cover, stream temperature, embeddedness)?)
6. Is habitat connectivity needed to have a viable populations of fish?
7. Does an adequate and diverse population of macroinvertebrates (insects) exist?

SOCIAL/ECONOMIC

The Watershed Analysis Area has a wide range of recreational use as well as rural residential areas interfaced with with forest wildland. Social and economical issues to be addressed include: Adaptive Management Area, rural/wildland interface, developed recreation sites, Access and Travel Management, and cultural uses and historic sites. Analysis of these issues is important in understanding how the Watershed Analysis Area is influenced, and how actions within the Analysis Area affect the local community.

Adaptive Management Area

Tier to AMA Social/Economic Assessment

Other Land Uses

1. What grazing allotments occur within the Analysis Area?
2. What type of active mining occurs within the Analysis Area?
3. What Developed Recreation Sites exist within the Analysis Area?
4. What Types of Recreation currently take place within the Anaylsis Area?
5. Are there any know conflicts between user groups?
6 Are there Co-ordinated group efforts to resolve conflicts?
7. What Recreation demands of the public are currently not being met within the Anaylsis Area?
8. What are the current Recreational Trends within the Anaylsis Area?
9. What conflicts currently exsist between T&E Species and Forest users.

Rural/Wildland Interface

1. What challenges exist in managing for high fire risk with increasing expansion of rural residential areas.
2. What are the administrative closures restricting human activities on National Forest Land? (CFR 36, part B, Forest Supervisor signatures)
3. What illegal or nuisance activities are of concern in the Watershed Analysis Area?
4. Does the social political atmosphere of the local community support reintroduction of fire for hazard reduction.
5. What are the Visual Quality Objectives for the Watershed Analysis Area?

Access and Travel Management and Dispersed Recreational Use

1. What types of dispersed recreational use occur in the Analysis Area?
2. What uses in the watershed analysis area need to be considered when analyzing access and travel management plans and road maintenance schedules?

Cultural Uses

1. What native american attributes exist in the analysis area (subsistance collecting, spiritual areas, prehistoric sites)

It must be remembered that many of these issues overlap with each other. Even though specific issues were highlighted as addressing certain elements, one must remember that there are interactions occurring amongst all the elements. All of these issues will be tracked through the entire analysis and interactions, functions, processes, and conditions may be discussed beyond those highlighted in this issues package.

APPENDIX C

GEOLOGY AND GEOMORPHOLOGY

Characteristics of Landslides
Landscape Subdivions

Characteristics of Landslides

1.0 Introduction

Physical and chemical weathering of rocks at and near the surface of the Earth produces rock fragments and soil accumulations. Climate and geomorphology influence the amount and distribution of these weathering products. Soil and rock deposits are usually stable in gently sloping terrain. However, steep slopes in mountainous terrain such as exists in the Squaw/Elliott watershed are subject to aggressive processes of erosion and mass wasting.

Mass wasting is a natural process that wears away mountainous slopes and delivers fine and coarse sediment to waterways. Productivity of forest soils can be affected by mass wasting through chaotic disruption or entire loss of the soil profile.

Mass wasting includes all processes by which soil and rock materials are dislodged and transported downslope under the direct application of gravitational stresses. It includes slow displacement such as creep and earthflows, as well as rapid movements including rockfall and debris slides.

In contrast, erosion is the mechanical wearing away of the land by removal of soil and rock fragments via running water, wind, or ice.

2.0 Natural Processes

2.1 Earthflows

Figure C-1 is a diagrammatic sketch of an earthflow. It reveals that the head of an earthlow slide forms a steep, crescent-shaped scarp. The toe of the failure commonly consists of lobate, gently sloping, hummocky deposits. The base of the sheared soil mass is usually more or less parallel with the surface slope. Hence, the geomorphic expression of earthflow terrain is that of steep, amphitheater headwalls situated above relatively flat, undulating deposits. This pattern is often repeated from ridgetop to streamside.

Earthflow terrain is characteristically poorly drained; with seeps, springs or ponds as common occurrences. Dendritic drainage patterns, found on other terrain, are often altered by earthflow activity.

Sediment yield to surface waters is almost exclusively limited to periods of movement in which the earthflow toe may impinge upon nearby streams. Since earthflows are slow-moving features which normally require large storm events to initiate them, once the precipitation and floodwaters cease, so does the main contribution to sediment loading of streams. However, since the soils are poorly drained, slow creep of the earthflow may continue for an extended period of time. Additional sediment may be produced upon earthflow reactivation or resulting from associated gullying or sheet erosion of barren soils.

Earthflows may yield from none up to a few thousand cubic yards of soil and rock to waterways. The volume depends upon the landslide size, soil water content and proximity to surface streams. Schist soil particles are generally silt-sized, tend to stay suspended in drainage waters for extended periods of time, and color streams and rivers metallic graphite gray. Deposition of suspended sediment begins as stream velocity and gradient lessen. Much of the fine-grained sediments produced in the watershed from earthflows is likely to be carried in suspension out of the watershed and deposited into Applegate Lake. Bedload contributions of coarse-grained sediment requires large storm flows to carry them out of the watershed.

An earthflow can result in such a chaotic rearrangement of the soil mass as to destroy the existing vegetation. However, in many instances the long-term impact on soil productivity from earthflows is relatively minor. This is because much of the soil mass within the earthflow, even though it has moved downslope, remains on the slope. Often the soil mass is fairly thick and is able to maintain a sufficient profile in which to support vegetation. Earthflows may cause significant distortion to remaining confers growth, especially if the earthflow periodically reactivates. For example, earthflows in the Squaw Lakes region reveal signs of repeated earthflow reactivation resulting in distortion (bent, bowed, leaning) of many old growth conifers.

2.2 Debris Slides

Debris slides and debris flows are characterized by mass movement of soil and weathered rock along a planar soil/bedrock interface. The failed materials do not have any appreciable cohesive strength. These types of landslides usually have a disturbance pattern that is at least ten times longer than their width. The soil and weathered rock mantle is usually relatively thin (typically less than five feet). In most cases debris slides remove the soil mantle down to a firm, planar bedrock surface that parallels the slope surface. Figure C-2 shows diagrammatic sketches of a debris slide and a debris flow.

Debris slides move at speeds which vary from slow to rapid, depending upon slope steepness and water content. Debris flows, as the name implies, have a higher water content and tend to move very rapidly. A debris slide can transition into a debris flow/torrent, particularly if the debris slide enters a tributary drainage and picks up more sediment through scouring. However, debris flows do not include storm and snowmelt flood waters that are laden with woody debris and sediment. Debris slides/flows initiate on hillslopes, while floods are generated in waterways.

In contrast to earthflows that consist of fine-grained cohesive soil particles, debris slides are composed of coarse-grained, non-cohesive soil and rock fragments. Sediment entering waterways are likely to be dominated by sand-to-cobble sized material. These sediments are usually deposited as bedload to streams. Silt and clay sized sediment from debris slides that enter waterways during storms may enter the Applegate Reservoir in floodwaters, unless there is a rapid reduction in storm flow or creek velocity and materials settle out.

Sediment yield to waterways resulting from debris slides/flows can be immediate, particularly from those which are initiated on steep slopes directly adjacent to live streams. The sediment load often is delivered as a "slug" of soil, weathered rock, vegetative debris and water. Once a debris flow enters the stream system they commonly continue to severely erode the stream bed and banks. Debris flows can become increasingly destructive as their volume and scouring power increase with travel distance.

3.0 Susceptibility

3.1 Earthflows

Factors conducive to earthflow formation/movement include: thick soil deposits in sloping terrain; soils with low shear strength; prolonged periods of precipitation preceding a high intensity rainfall event; poor soil drainage; and lack of deeply rooted vegetation.

3.2 Debris Slides

Debris slides are unlikely to initiate on slope angles significantly less than about 60 percent (31 degrees). This is because frictional forces resisting slope movement are usually sufficient. However, for terrain steeper than about 70 percent (35 degrees) slope, the noncohesive soils require the addition of cohesive strength to maintain slope stability. Cohesion may be available from contributions of vegetative root strength (particularly conifers) or capillary tension from soil moisture provided to soils that are only partially saturated. Cohesive strength derived from capillary tension is completely lost once soils become saturated.

Much of the Rattlesnake Creek terrane is composed of cohesionless soils which are prone to debris sliding. This is particularly true of the steep slopes of the granitic and amphibolite rock types.

Hillslope swales (linear depression that do not flow surface water) are common sites of debris slide initiation. These sites can be the location of repeated slope failures because the depressions in soil mantle/bedrock become accumulation zones for colluvial soil and rock that migrates downslope. Groundwater is also concentrated into these swales as it flows towards surface stream channels. If the deposits do not drain surface and subsurface water flow efficiently enough, water pressure between soil particles may be sufficient to reduce frictional resistance to the point where debris slides are initiated. This cycle of debris slide initiation and reoccurrence in hillslope swales may continue over a significant time span, depending upon the rate of colluvial infilling of the debris slide hollow and return frequency of precipitation needed to trigger failure.

4.0 Resiliency

4.1 Earthflows

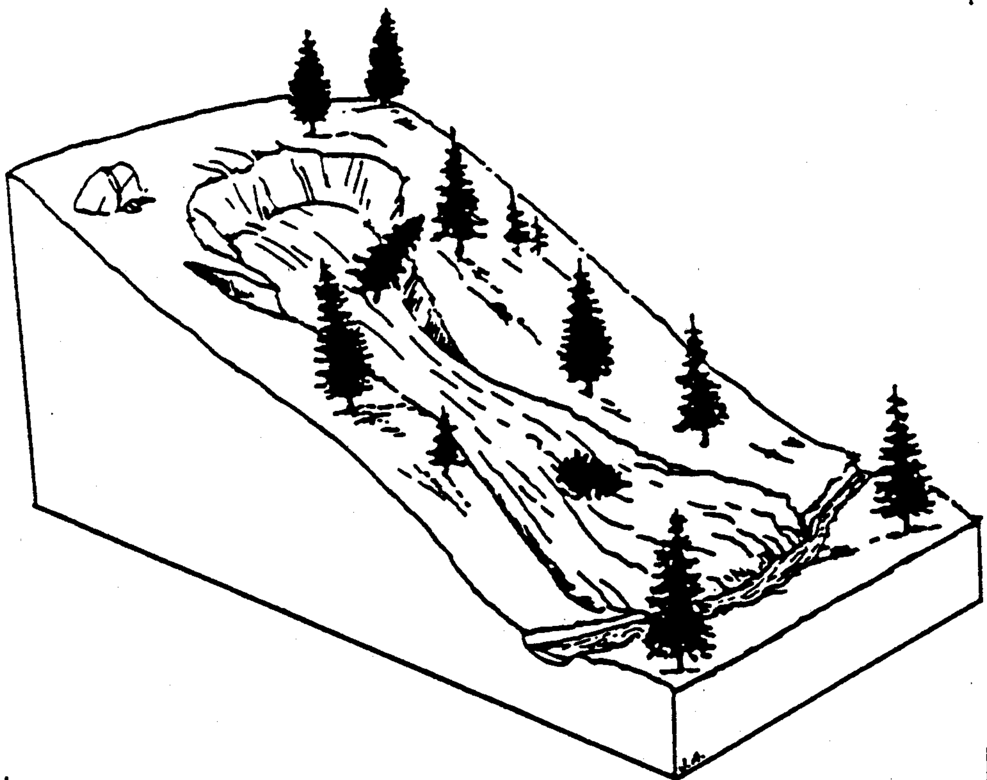
Earthflows are sensitive to soil moisture and slope gradient. When either one of these factors is reduced, so is the tendency for additional movement. Earthflows respond to gravitational stresses by flowing to a lower position on the hillslope and coming to rest at flattened portion of the slope profile. The result is that the deposited soil mass is generally in a more stable position. Once stabilized, earthflows may not reactivate or contribute sediment for many decades or more. However, dormant earthflows may become destabilized by such actions as road cuts into the toe (effectively steepening the slope again), excessive input of water from major storms or extensive timber harvest. Earthflows may be stabilized but continue to be large sediment producers because of severe erosion of exposed soils.

Soil productivity is not normally adversely affected by earthflows over the long term unless the failure results in loss of the entire soil mass. Once earthflows are stabilized, the deep, relatively moist soils provide a good environment for vegetative growth. Densely forested earthflow terrain found in the Squaw and Elliott basins is testimony to the ability of conifers to return and flourish at sites of previously active slope failures.

4.2 Debris Slides

Debris slides tend to be features that react quickly to triggering precipitation events. The failed soil mass often is removed down to the bedrock surface. As such, the amount of additional material available to stream sedimentation is drastically reduced once the slide has occurred. It can be decades or more before the site has accumulated enough colluvial infilling to become a candidate for another failure. However, the scarp slope region at the head of slides may be so oversteepened as a result of failure that it becomes a site of upslope migration of future debris slides.

Both long and short-term soil productivity can be expected to be severely impacted at sites where debris slides remove the soil mantle down to bedrock. While the debris slide scar can be expected to receive colluvial infilling over time, these sites would have greatly reduced productive capacity compared to the soil profiles found on adjacent non-failed slopes.



Diagrammatic sketch of an earthflow. *Drawing by Janet Appleby and Richard Kilbourne; modified from Varnes (1978).*

FROM:
CALIFORNIA GEOLOGY June 1983

Earthflow

Definition. An earthflow is a landslide resulting from slow to rapid flowage of saturated soil and debris in a semi-viscous, highly plastic state. After initial failure, the flow may move, or creep, seasonally in response to destabilizing forces.

Factors affecting landslide potential. Earthflows are composed of clay-rich materials that swell when wet, causing a reduction in intergranular friction. When saturated, the fine-grained, clay-rich matrix may carry larger, more resistant boulders with them in slow, creeping movements.

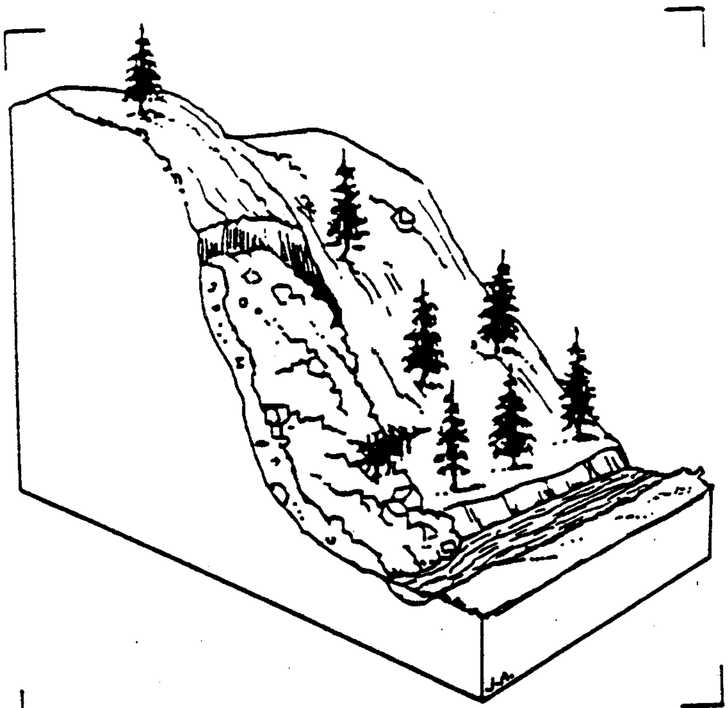
Slide materials erode easily, resulting in gullying and irregular drainage patterns. The irregular, hummocky ground characteristic of earthflows is generally bare of conifers; grasslands and meadows predominate. Failures commonly occur on slopes that are gentle to moderate (Figure 5), although they may also occur on steeper slopes where vegetation has been removed. Undercutting of the toe of an earthflow is likely to reactivate downslope movement.

Management objectives. Because earthflow materials are so easily erodible, the main management objective is to minimize the physical disturbance of the slide by (1) avoiding the concentration of water onto the slide mass, and (2) avoiding deep cut slopes into slide deposits.

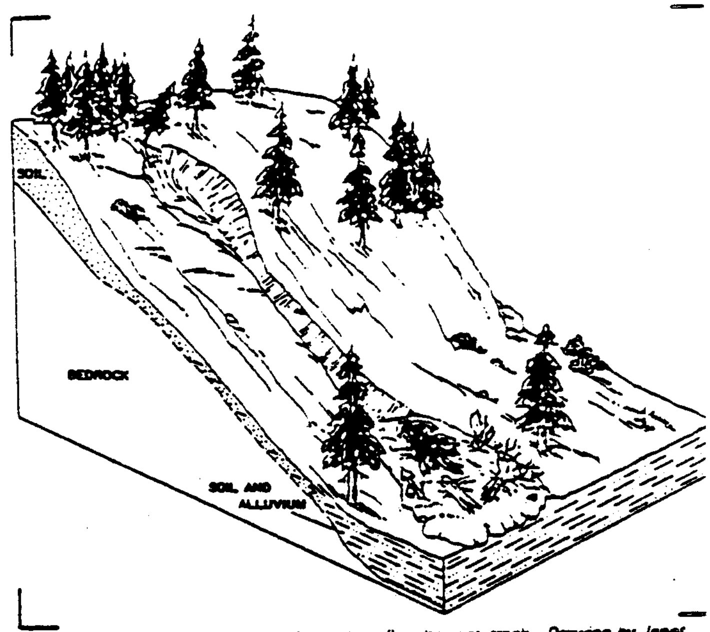
Management guidelines. Road construction across earthflows should be avoided whenever possible. Likewise, earthflows are not appropriate locations for landing sites. When conditions necessitate road construction, the road should be carefully designed and located to utilize benches, avoid wet areas and seeps, and where possible, follow contour. The road should be single lane in width and outsloped to avoid cutting into and concentrating water on slide materials. Areas exposed during road construction should be reseeded to minimize surface erosion. Winter construction and use is not advisable, and continued maintenance of drainage is recommended for major road construction across all earthflows.

During timber harvesting, ground disturbance should be minimized and the use of heavy equipment avoided. In logging areas adjacent to an earthflow, water should be drained away from the slide to prevent gullying and reactivation of earthflow movement. Natural drainages on the earthflow should not be disrupted, for example, by the use of heavy equipment while being crossed to reach an adjacent logging site.

FIGURE C-1



Diagrammatic sketch of a debris slide. *Drawing by Janet Appleby and Richard Kilbourne; modified from Varnes (1978).*



Diagrammatic sketch of a debris flow/torrent track. *Drawing by Janet Appleby and Richard Kilbourne.*

FROM :
CALIFORNIA GEOLOGY July 1983

Debris Slide

Definition. A debris slide is characterized by unconsolidated rock, colluvium, and soil that has moved downslope along a relatively shallow translational failure plane (Figure). Debris slides form steep, unvegetated scars in the head region and irregular, hummocky deposits (when present) in the toe region. Debris slide scars are likely to ravel and remain unvegetated for many years. Revegetated scars can be recognized by the even-faceted nature of the slope, steepness of the slope, and the lightbulb-shaped form left by many mid- and upper-slope failures.

Factors affecting landslide potential. Debris slides are most likely to occur on slopes greater than 65 per cent where unconsolidated, non-cohesive, and rocky colluvium overlie a shallow soil/bedrock interface. The shallow translational slide surface is usually less than 15 feet deep. The probability of sliding is low where bedrock is exposed, except where weak bedding planes and extensive bedrock joints and fractures parallel the slope.

The presence of near surface bedrock creates a shallow, impervious slide plane which restricts the vertical movement of water and tends to concentrate subsurface water flow parallel to the slope. For this reason, sliding often occurs during high intensity storms. Springs may be present where water has concentrated along the slide plane. Because the removal of root support is likely to change the slope hydrology and shear strength of debris slide deposits, the vegetative cover where present is important to slope stability.

The undercutting of slide materials into or below the slide plane is likely to reactivate downslope movement. The placement of fill materials on steep, unconsolidated slide deposits may also increase landslide potential.

Management objectives. Because debris slides are characterized by unconsolidated materials located above a shallow slide plane, the main management objectives are to: retain root support, minimize water flow along the soil/rock interface, avoid the undercutting of materials to the slide plane, and minimize the weighting of unconsolidated materials on steep slopes.

Management guidelines. Road construction across debris slides should be avoided where possible and existing roads used. When active or potentially active slides on slopes over 65 per cent must be crossed, the registered professional forester should consult a certified engineering geologist in the preparation of the road design. Planning of the road should take into consideration a careful evaluation of both road and landing locations. Full bench cuts should be used across the slide where soils are most shallow and cut materials endhauled to minimize sidecast. If filling is necessary, fill materials should be retained during the road use and pulled before winter storms begin. Where possible, the road grade should be arched across the slide to drain water away from the slide. Where water must be drained onto the slide, energy dissipators should be used to reduce water impact on slide deposits. The undercutting of slide materials should be avoided in areas that are already buttressed; cribbing, retaining walls and/or riprap should be used where necessary. All small areas of unstable soil and debris should be removed from the roadcuts and cut and fill slopes seeded where vegetation will grow.

During logging, silvicultural practices should be designed to maintain maximum root support. In general, equipment exclusion zones and cable yarding are recommended. Site preparation burning should be designed to retain a maximum litter layer and some residual vegeta-

Debris Flow/Torrent Track

Definition. Debris flow and debris torrent tracks are characterized by long stretches of bare, generally unstable stream channel banks that have been scoured and eroded by the extremely rapid movement of water-laden debris (Figure). They commonly are caused by debris sliding or the failure of fill materials along stream crossings in the upper part of a drainage during high intensity storms.

Factors affecting landslide potential. Debris flow/torrent tracks are formed by the failure of water-charged soil, rock, colluvium, and organic material down steep stream channels. They are often triggered by debris slide movement on adjacent hill slopes and by the mobilization of debris accumulated in the stream channels themselves. Debris flows and torrents commonly entrain large quantities of inorganic and organic material from the stream bed and banks. Occasionally, the channel may be scoured to bedrock. When momentum is lost, scoured debris may be deposited as a tangled mass of large organic debris in a matrix of sediment and finer organic material. Such debris may be reactivated or washed away during subsequent events. The erosion of steep debris slide-prone streambanks below the initial failure may cause further failure downstream. The potential for failure is largely dependent upon the quantity and stability of soil and organic debris in a stream channel and the stability of adjacent hill slopes. The location of roads and landings upslope also affects landslide potential.

Management objectives. The main management objectives in mitigating areas containing debris flow/torrent tracks are to protect water quality and to avoid or minimize the possibilities of reactivating debris flow and debris torrent failures.

Management guidelines. Road and landing construction should be avoided across debris flow/torrent tracks. Where possible, scour-resistant crossings, such as low water crossings and rock fills, should be utilized.

In planning the harvesting of slopes adjacent to debris flow/torrent tracks, consideration should be given to the stability of the channel slopes. Soils exposed by logging operations adjacent to the tracks should be stabilized. Although an equipment exclusion zone around the track is recommended, the removal of logged debris below the stream transition line may be appropriate in some circumstances. A suitable overstory and understory should be left on slopes adjacent to the track.

FIGURE C-2

Landscape Subdivisions

Earthflow Schist

Elevation Range: 2400 - 5500
Aspect: north, south, some east and west
Slope Shape: concave, broken, humocky
Slope Gradient: 30 - 60%
Rocktype: black schist and some green schist
Dominent Slope Processes: earth flow and deep weathering, channel erosion
Soils: very gravelly loam & sandy loam topsoils and subsoil, 4 - 8' deep
Erosion Potential: high
Slope Instability: very high
Site Productivity: high - very high - deep soils, soil minerology, mid elevation climate.

This landscape is dominated by large scale mass movement slope processes. Deep seated earthflows and slumps characterize the terrain and in some areas extend from ridgetop to toeslope. The landslide activity levels vary since some of these landslide features are very old and inactive while others are exhibity recent movement. Drainage patterns are deranged and because soils are deep and easily eroded, streams have a steep incised appearance.

The Condrey Mountain Dome controls the dip orietation of the bedrock . Where the bedrock dip is parrallel to the slope angle, a higher incident of slope instability and springs occurs. Undulating topography, extremely thick earthflow deposits along with the micaceous nature of the soils makes these very productive.

Glaciated Uplands

Elevation Range: 5500-7000 feet
Aspect: all
Slope Shape: U-shaped, concave
Slope Gradient: 25-50%
Rocktype: amphibolites, serpintine, gabbro, granite, peridotite
Dominent Slope Processes: cold weather processes, surface erosion
Soils:
Erosion Potential: low
Slope Instability: low
Site Productivity: low - cold climate, poorly developed soils

Glaciers formed this landscape over 10,000 years ago, during the last major glacial period. Typical of glacial terrain, the upper slopes and ridges are steep with shallow soils. The gentler slopes in the valleys, where glacial material was deposited, have deeper soils. Since the rocktype mattix is very complex and includes 5 major rocktypes in such a small area, the diversity of minerology is great. Present day processes are different than the ones that formed this landscape, nevertheless cold temperature still dominates the soil and slope forming processes. Weathering processes are very slow and consequently, the soils are extremely rocky.

The deep glacial material acts as an excellent reservoir for snow melt water accumulation. This water is released throughout the summer through seeps, springs and glades in this and adjacent landscapes.

Reforestation and revegetation of disturbed sites are difficult due to the harsh climate and relatively infertile soils.

Steep Black Schist

Elevation Range: 2500-7000
Aspect: north
Slope Shape: long, straight
Slope Gradient: 60-100%+
Rocktype: black schist
Dominent Slope Processes: rockfall, soil creep, ravel and debris sliding
Soils: very gravelly loam & sandy loam topsoils and subsoil, 1.5-3' deep
Erosion Potential: high
Slope Instability: high
Site Productivity: high

This landscape is one of the steepest areas found in Southern Oregon. Formed by the recent downcutting of Elliott and Joe Creeks in the Condrey Mountian Dome terrain, this landscape is dominated by steep slope forming processes like rockfall, creep and ravel. Material from these processes accumulates in the deep drainages and during major storm events is dislodged and transported through debris slides and torrents into the major stream systems. Steeply dipping, resistant interbeds forms ridges and transmits water toward drainages where they surface as channel flows. Dipslopes tend to have deeper soils which tend to be very productive while ****slopes are shallower and less productive.

Steep Green Schist

Elevation Range: 2500 - 5800
Aspect: all
Slope Shape: long, straight
Slope Gradient: 60 - 80%
Rocktype: green schist
Dominent Slope Processes: ravel, rockfall, creep, debris slides
Soils: very gravelly loam & sandy loam topsoils and subsoil, 1.5-3' deep
Erosion Potential: high
Slope Instability: high in drainages
Site Productivity: low on southern aspects, moderate on northern aspects

This landscape has formed on green schist associated with the Condrey Mountain Dome terrain. It is dissected by a very actively set of downcutting stream systems - Elliott and Squaw Creeks - which have oversteepened these slopes, creating an extremely steep topography. Processes associated with steep slopes, such as rockfall, creep and ravel are very active. Colluvial material accumulates on dipslopes and drainageways but in general, the soil mantle is very shallow, and not relatively prone to mass movement. However, during flood events, accumulated material in draws is subject to downcutting and debris sliding.

Soils derived from green schists are draughty due to the high rock content and shallow depths. This effect is more pronounced on the southern aspects, where the vegetative communities are xeric in nature.

Resistant Metavolcanics

Elevation Range: 2000 - 5000
Aspect: all
Slope Shape: long, smooth, concave
Slope Gradient: 45-70%
Rocktype: metavolcanic with some diorite
Dominent Slope Processes: ravel and soil creep
Soils: gravelly silt and sandy loams, over loams and clay loams, 2-4' deep
Erosion Potential: low to moderate
Slope Instability: low
Site Productivity: low

Much of the lower portion of the Squaw Elliott Watershed Anaysis area is comprised of this landscape. The slopes of this landscape have long, concave profiles with steep, rocky ridgelines, grading moderately sloping toeslopes. Soils are shallow and skeletal near the ridges to deeper, finer textured soils on the lower slopes. Many of the shallow drainages are "filled" with cobble size material that has moved through rockfall or soil creep processes from the surrounding sideslopes. Though many of these shallow drainages transmitts water through the rock cobble, the occurance of surface water is uncommon due to the presence of this material.

Kinney Mountain is typifical of this landscape. The mid to upper reaches of the south slopes tend to be non forested due to the shallow soils, low rainfall and high evaporation rates. By contrast, the northern slopes are cooler and favorable for conifer growth. Reforestation is extremely difficult in areas of high rock content.

Subdued Metavolcanics

Elevation Range: 2000 - 5000
Aspect: all
Slope Shape: smooth, convex & concave
Slope Gradient: 20 - 50%
Rocktype: metavolcanic, some granitic
Dominent Slope Processes: deep weathering and surface erosion
Soils: silt and sandy loam topsoil, loam & clay loam subsoil, 2 - 4' deep
Erosion Potential: high
Slope Instability: low
Site Productivity: low on south slopes, moderate on north

Gentle, low gradient topography typifies this landscape. It was possibly formed from an older, more mature landscape that subsequently was uplifted, creating a terrain composed of short slopes with gentle transitions between concave and convex topographies. Slope forming processes do not included mass instability because of low precipitation and gentle topography. Soils are relativey fine textured and subject to surface erosion when disturbed.

Site productivity is high on the north slopes and moderate on the south due to the deep, fine textured soils. The exception to this are the steeper south slopes and the sites where soil densities are very high. Pole stands are commonly associated with high density soils.

Amphibolite Complex

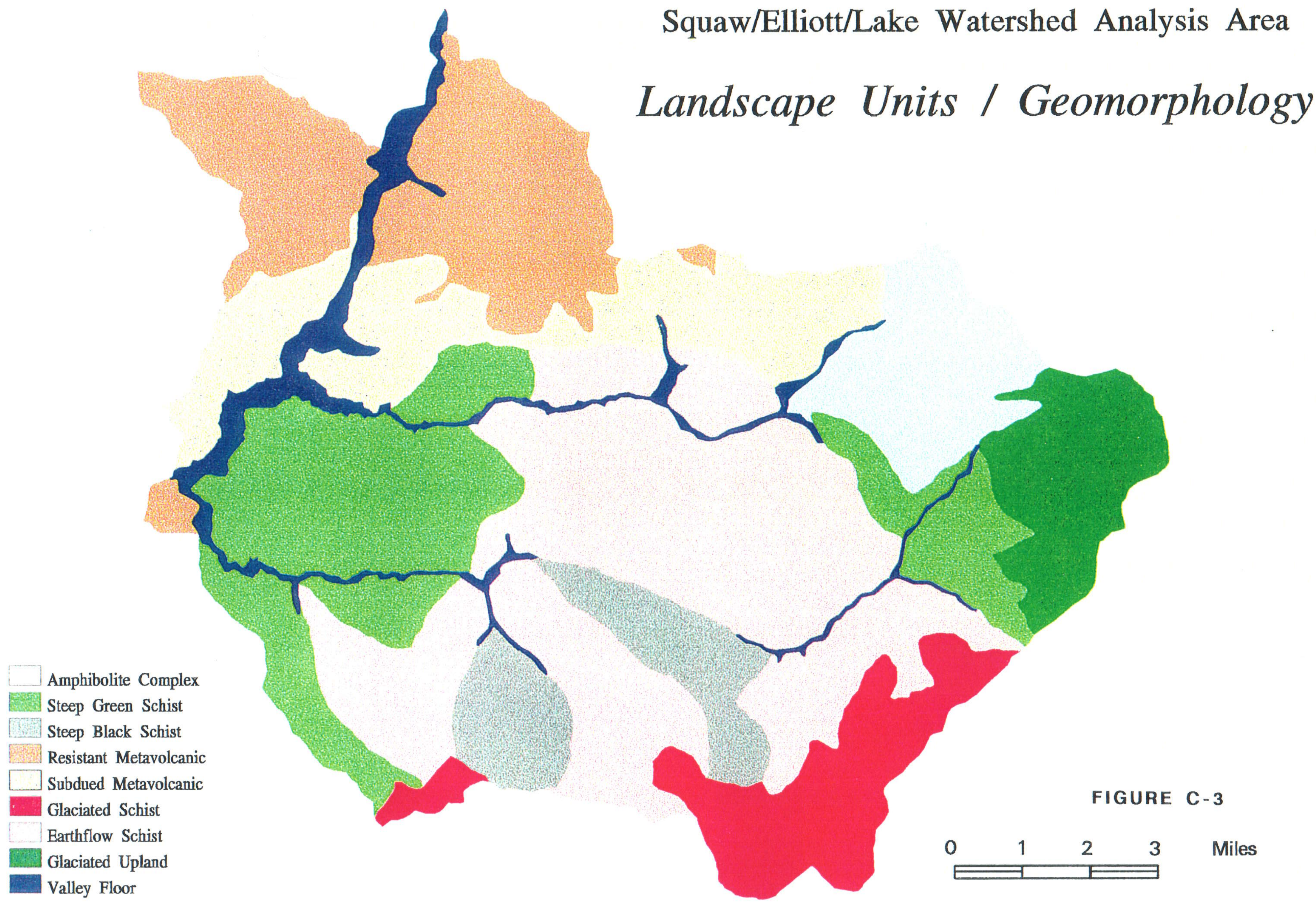
Elevation Range: 3500 - 5000
Aspect: mainly north, some east, west and south
Slope Shape: all
Slope Gradient: 50 -70%
Rocktype: amphibolites, serpentine, gabbro, granite, peridotite
Dominent Slope Processes: soil creep, ravel and surface erosion
Soils: variable, generallly very gravelly loams, 2 -4' deep
Erosion Potential: moderate
Slope Instability: moderate
Site Productivity: moderate

This landscape occurs at mid elevation and encompasses a wide variety of rocktypes. Though there are ancient earthflow features, much of the terrain is influenced by more surficial erosional processes.

Valley Bottoms

Elevation Range: 1800 - 4000
Aspect: all
Slope Shape: smooth, benches
Slope Gradient: <25%
Rocktype: alluvial - mainly metavolcanic and schist
Dominent Slope Processes: alluvial
Soils: sandy loams & loams, variable coarse fragement content, >4' deep
Erosion Potential: low to moderate
Slope Instability: very low
Site Productivity: high

The landscape of the Valley Floor is characterized by gentle slope gradients and its close proximity to the major streams of this study area - Squaw, Elliott and the main stem of the Applegate. Formed by alluvial processes, this landscape appears as terraces, flats and floodplains. The youngest soils of the watershed are forming in recently deposited alluvial material, while more older and more developed soils are found on the terraces upslope from the streams. Recreation and residential uses are common on this landscape. Floodplains and wet areas are covered by riparian species and are prone to flooding during periods of extreme rainfall events.



Squaw/Elliott/Lake Watershed Analysis Area
Landscape Units / Geomorphology
Amphibolite Complex
Steep Green Schist
Steep Black Schist
Resistant Metavolcanic
Subdued Metavolcanic
Glaciated Schist
Earthflow Schist
Glaciated Upland
Valley Floor
0 1 2 3 Miles

FIGURE C-3

APPENDIX D

FIRE MANAGEMENT

Primary Fire Management Strategies
Acres of Hazard and Risk
Fire Management Discussion; Snags and Firefighter Safety
Vegetation Zones; Influence to Fire Environment

Primary Fire Management Strategies

Explanation of Table 3: Comparison of Fire Management Strategies, within Fire Regime Findings. Also a brief discription and discussion of the benefits or disadvantages of each.

- **Fire Suppression and Fire Prevention**: This management strategy will provide protection from wildfire of the Squaw/Elliot WAA acres and its diverse vegetation and geology for the short term. Such suppression tactics as the use of initial attack engines, hand crews, helicopters and air retardent resources are implied in this strategy. Increased funding for initial attack suppression and prevention organization is not anticipated in the future. But as vegetation continues to increase in volume and decrease in viability, and increase in the ratio of dead to live wood, the fire suppression organization will be less successful in the long term. Basically the flammability of the vegetation will exceed the ability of the various government agencies to successfully achieve the necessary protection to prevent or suppress large high severity fires.

- **Shaded Fuel Break System:** Locate and construct shaded fuel breaks meeting minimum design critera for shaded fuel breaks. (see Appendix A for the minimum design criteria for shaded fuel breaks to be cost effective and useful). Shaded fuel breaks do not contain and control wildfires on their own. It takes available, trained, skilled suppression resources to take advantage of the shaded fuel breaks. Again, the condition and amount of the vegetation within the fuel breaks or flanks is a primary consideration for how successful wildfires are kept at minimum acres.

- **Fuels Modification Zones:** Within certain areas dead and down and live vegetation are modified to reduce the flammability, intensity and spread of wildfire. This method is one form of "hazard reduction". This method may entail roadside or around structures vegetation manipulation for example, at locations that help fire fighters control wildfires. Vegetation modification under this method usually isn't as stringent as the "minimum design criteria" for shaded fuel breaks.

- **General Area Underburning:** Where environmetally appropriate prescribe burn over large areas (landscape as compared with stand level). As stated in other portions of the Squaw/Elliot WAA, years of fire exclusion due to aggressive fire suppression has increased the type; influenced the health and amount of flammable vegetation within much of the ecosytem. In order to improve forest health, wildlife forage and reduce fire hazards prescribe burning will need to take place over large areas. This strategy has the greatest chance over the long run to improve forest health and reduce the severity or size of high severity wildfires.

  Prescribe burning on a landscape scale will reguire additional funding, personnel, and changes in the social/politial infrastructure (various conflicting environmental laws, etc.) before this strategy can be implemented. Burning on a landscape basis is not a "one shot" method. After an initial burn, a second burn is necessary after the area has "recovered" to compensate for the increased understory dead vegetation killed by the first prescribed burn. Subsequent maintenance prescribed burns are necessary (about every 5 to 10 years).

Prescribed burning results in a range of effects given a diversity of site conditions influencing fire intensity. Flame lengths, fire residence time, age of vegetation, species, ladder fuels and condition of overstory vegetation (to name just a few considerations) all help determine even with the best of prescription standards the degree of overstory mortality.

- **Density Management**: This strategy includes methods that devise silvicultural and fire treatments that mimic historical or other desired conditions that improve forest health and reduce fire hazards. At least in the short- to mid-term, much of the needed silviculture in white fir, mixed conifer and interior valley vegetation zones will involve thinning of small trees.

  This strategy has the problem of maintaining the economic viability and sustainability of harvesting and processing small material and developing new markets for utilizing it.

  Prescribed burning at a landscape level (many acres) would be in conflict with this strategy since prescribed underburning would normally kill small trees.

- **Early Seral Treatment**: Young, dense, unthinned conifer reproduction or poles are one of the more flammable vegetation components. This is partly due to the continuity of the vegetation on the horizontal and vertical spacial dimension. The size of the young trees with their preponderance of needles, twigs, branchlets and branches allow rapid fire spread but with greater intensity than cured grasses. Therefore to protect these developing stands, allocation of dollars to thin these stands with adequate fuels treatment will be necessary. Otherwise these sites will not realize mature trees in late seral conditions before high intensity wildfires destroy the majority of the trees.

  Studies after the 1987 fire season which was one of drought and thousands of fires showed the consequences of thinning and no treatments of the thinning residues. Unthinned plantations showed the least damage due to wildfire, whereas thinned plantations without treatments of the residues showed the greatest damage.

- **Combination of above strategies:** The varibility of elevational gradients, toprographic aspects, geologic conditions, location of urban influences, condition of vegetation, access and fire hazard (to name just a few of the elements of the complex environmental conditions) will require strategic planning. In order to successively achieve resource management objectives while improving forest health and reducing the fire hazard will require the implementation of the preceding strategies. For some sites this will entail one or several. For other sites on a landscape basis all the management strategies will need to take place.

Acres of Hazard and Risk Within Squaw/Elliott/Lake WAA

Using GIS (Geographic Information System) and actually ground surveillance of fuel conditions; the locations of various fuel models influencing fire behavior were plotted on maps. These plots were then digitized for computer queries. Where various hazards and risk classifications intersect, the acres and percentage of area within the analysis area were calculated.

Hazard Classification	Risk Classification	Acres	Percent
Enhanced	High	1,856	2.54
Enhanced	Low	426	.58
Enhanced	Medium	2,300	3.14
High	High	16,116	22.03
High	Low	228	..31
High	Medium	1,938	2.65
Low	High	5,475	7.48
Low	Medium	7,339	10.03
Medium	High	30,644	41.89
Medium	Low	657	.90
Medium	Medium	6,170	8.44
Total Acres		73,149	99.99

See the Hazard and Risk intersections map. This map shows where the locations of various hazard ratings and risk ratings occur within the Squaw/Elliott WAA.

POISSON PROBABILITY DISTRIBUTION
Predicting the Number of Human Caused Fires
Squaw Elliott WAA

The Poisson Distribution is used to describe a number of processes, including the distribution of random human caused fire occurrences. The term random needs to be qualified. Predicting future human caused fires assumes that the present level of fire prevention (funding, staffing, public education, fire prevention patrols, and the like) will continue in the future, as the basis of comparision.

Probability of exactly 1 human caused fire:	0.201537
For exactly 2 human caused fires:	0.254945
For exactly 3 human caused fires:	0.215003
For exactly 4 human caused fires:	0.13599
For exactly 5 human caused fires:	0.068811
For exactly 6 human caused fires:	0.029015
For exactly 7 human caused fires:	0.010487
For exactly 8 human caused fires:	0.003316
For exactly 9 human caused fires:	0.000932
For exactly 10 human causedfires:	0.000236
SUM of Probabilities	0.920273

The above table shows that there is a .20 probability that exactly one human caused fire will occur with the Squaw/Elliott WAA. Or another way to describe the probability is, there is a .92 probability that 10 or less human caused fires will occur.

Fire Management Discussion; Snags and Firefighter Safety

Snags are second only to aviation accidents, causing fatalities or injuries to fire fighters While constructing shaded fuel breaks, snags must be removed not only to minimize the spot fires due to snags, but for fire fighter safety. Fire fighters cannot use the constructed fuel breaks if there are snags that are burning, obscured by smoke, etc.

NATIONAL WILDFIRE COORDINATING GROUP

July 20, 1993

TO: NWCG Members
SUBJECT: Snag Hazard Task Group- Initial Report
FROM: Elmer Hurd, Chair NWCG

The Snag Hazard Task Group formed by the Safety and Health Working Team and chaired by Jerry Schmidt, Forest Supervisor of the Routt National Forest, developed this "early alert" notification of useful information during their initial meeting. It is relative to snag and tree hazards encountered during wildfire and prescribed burning activities. **These hazards are second only to aviation accidents when accounting for the fatality and injury rate due to fire suppression activities**. I recommend that you share this information with your firefighters and other field personnel.

This information was developed by a special ten person ad hoc task group organized to review 14 fatal and/or debilitating snag accidents which have occurred during the past 6 years. This group included people ranging from the crew boss and firefighter levels to national management levels and a Behavioral Scientist from University of Montana. In addition, they interviewed approximately 70 to 80 people from all levels of fire suppression operations relative to their experiences and feelings about safety standards, guidelines, training, and tactics currently being used. They have outlined precautions that should be taken to ensure effective firefighter safety relative to the snag hazards.

The ad hoc task group will develop specific recommendations for improving firefighter safety with regard to snag hazards, but here are immediate actions that can be implemented immediately.

1 - Strengthen snag hazard awareness for all firefighters. Many firefighters are surprisingly naive and are not aware of all the dangers associated with the snags and damaged or infected trees in a burning or burned-over area and how un-discernible some hazards can be.
2 - Emphasize 10 Standard Fire-fighting Orders and 18 situations that shout "watch out." Discuss how some of these apply specifically to snag hazards and how firefighters would employ these when hazards have been identified. Perhaps, given the magnitude of the snag related accident situation, there is a need to consider a 19th situation, i.e., "Feeling complacent when mopping up or working in a burned-over timber area."
3 - Include "Snag Intelligence" (which includes information about possible green tree hazards) in all fire suppression discussions and briefings. Add snag intelligence information to all current communications such as the following:

    Line Officer briefing
    Escaped Fire Situation Analysis (ESFA) or equivalent documents
    Incident Action Plans

Other briefings such as shift, crew or strike team or replacements

Fire Behavior reports
Safety Officer reports
Tail gate sessions
Job hazard analysis
Prescribed fire plans

*Note: Snag intelligence should consider things like the following: occurrence and extent of snags, anticipated snag "burn-out time"; hazard-added due to slope; acres of hazardous area to be avoided due to tree heights; stand structure, forest health, and snag density; additional crew strength and costs due to additional acres burned while allowing for snag hazard requirements.

4 - Strengthen leadership skills for dealing with heterogeneous organizations and crews. We are all dealing with professionally, technically, and culturally very diverse organizations and uniform understanding of goals, objectives, standards, and guidelines require more communication and leadership effort by supervisors at all levels in the fire organization.

5 - Be aware of complacency on fires of all sizes during all phases. Many of the most tragic accidents have occurred during what appeared to be non-threatening, uneventful situations during all phases of fires suppression operations.

6 - Direct all firefighters and train them to be able to do their own safety assessments and encourage all to interact with their supervisors to ensure better safety. Sometimes, overhead members overestimate crew capabilities and direct people into relatively unsafe situations and sometimes crew foremen or individuals know this, but do it anyway to avoid falling short of expectations.

On August 18, 1986, a firefighter working on the Ace Creek Fire in Northeast Washington was struck by a "green" White Pine with heart rot(132 feet tall) as his crew walked up the fireline en-route to their assigned area. There were many snags in the area and as the tree fell other crew-members shouted warnings but the victim could not get out of the way.

- On July 17, 1987, an experienced faller working on the 400 acres Reynolds Fire was killed by a falling snag. The faller was clearing fireline and was aware of the hazardous snags in the area.

- On October 11, 1988, a male firefighter was killed on the Clover Mist Fire by a falling snag that hit him on the head while he was watching a helicopter bucket dump on a hot spot in burned-over lodgepole pine. The crew had been given an assignment to mop up smokes down a ridge from a helispot. The victim was with his brother and another firefighter at what appears to be a safe distance from the effects of helicopter down-wash. The victim and other crew members were well aware of the snag hazards.

- On August 13, 1990, a CDF male firefighter working on a hose-lay on the Recer Fire was killed by a falling snag. The hose-lay was being made to control a spot fire in medium to heavy understory of timber. The victim received a blow to the head that broke his helmet in several places. The snag was 20-30 feet tall. The victim had been warned about the snag's presence and heard warnings from others as it was falling but couldn't get out of the way in time.

- On September 18, 1991, a 22 year old, second year male firefighter was killed on the Vaughn Lake Fire by a falling snag that hit him while he was on a rest break at night. He was part of a two-person crew taking suppression action on a lightning-caused fire that was about 70 feet by 70 feet in dense spruce timber with presence of heavy blowdown and standing snags. The snag was about six (6) inches in diameter where it made contact with him across the chest breaking ribs and rupturing several internal organs. Both firefighters noticed that snags and trees had been scorched, but neither noticed any burning or weakened snags in the area. There was no wind.

- On July 30, 1992 a female engine crew member was killed by a falling snag while establishing a pump and hose lay at the base of a fire perimeter on the Silver Creek Fire. The fire was 4 acres in heavy logging slash, within a six acre clearcut, on a 25-65 percent slope. Rate of spread was relatively slow, burning intensity high. Fifty six firefighters were on the fire. The engine crew was working as a functional group un-assigned to a geographic area of the fire. Personnel failed to accurately assess the threat of known snag hazards and communication links were fractured.

- On August 31, 1992, a male firefighter with the Oregon Department of Forestry working in the Pryor Fire was killed by a falling snag. The firefighter was working in the fireline with a hoe, knew about the pole snag, and heard the warnings about the falling snag as it fell. However, the victim turned toward the snag, apparently not knowing what direction it was coming from. All witnesses agreed that there was not enough time for the victim to avoid the accident. The snag was a seven inch (D.B.H.) pole snag growing from the base of a much larger Douglas Fir.

/s/ Elmer Hurd, Chair
National Wildfire Coordinating Group

VEGETATION ZONES; INFLUENCE TO FIRE ENVIRONMENT

The production and maintenance of water quality is dependent upon vegetation. Not only does the amount, type and location of vegetation influence water quality, vegetation influences fire probability and occurrence. From a fire management standpoint stand age and type, fuel loading, fuel arrangement and continuity of fuels are important considerations. The make up of vegetation, either dead or live, must be considered when discussing a fire and fuel complex.

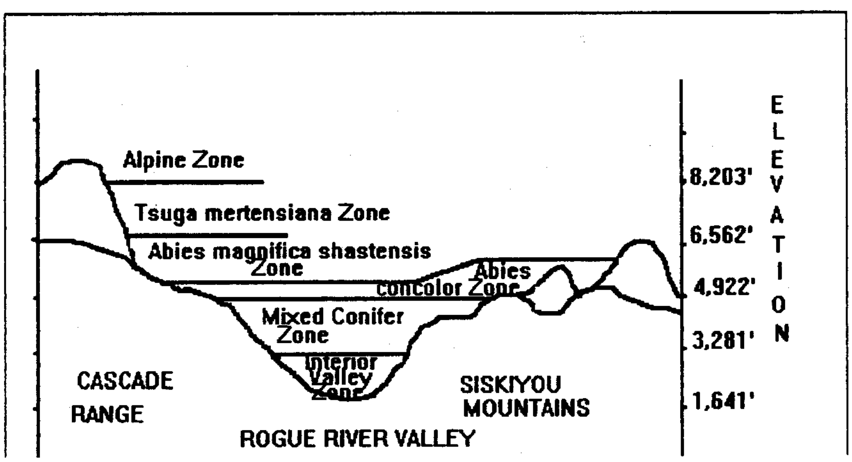
Emphasis discription will take place for the Interior Valley Vegetation Zone and the Mixed Conifer Vegetation Zone of the Squaw/Elliott Analysis Area. These two zones are where the greatest fire hazard and risks are located., Vegetation Zones.

Jerry Franklin in his Vegetation of Oregon and Washington, publication states that zonal description of vegetation is most helpful in defining areas in which one plant association is the climatic climax. Vegetation on undulating topography is primarily a product of macro-climate and occur sequentially on mountain slopes, but often they interfinger. By describing the environmental composition and successional processes of each zone, conclusions can be drawn as to the types of vegetatation that exist(ed) either live or dead.

See Vegetation Zone Map for theSquaw/Elliott Analysis area.

Figure 1

Description of Interior Valley Vegetation Zone.



A) Environmental Characteristics- Rogue Valley area warmest and driest region west of the Cascade Range. Primarily because of the rain shadow influence of the coast and Siskiyou Mountains.

B) Vegetation Composition-

1) Oak Woodlands: Range from very open savannas with grass understories to dense forest stands and from pure oak types to communities with an abundance of conifer associates.

2) Conifer Forest: The Rogue Valley area has perhaps the most diverse valley coniferous forests. Douglas-fir and ponderosa pine are the most important species. These forests vary greatly with the moisture regime, which include: (a) Tree layer of Douglas-fir, ponderosa pine or sugar pine of both. (b) Golden chinquapin, tan oak, madrone. © Understory shrubs.
3) Grasslands: Grasslands are representative of the Interior Valley Vegetation Zone.
4) Sclerophyllous Shrub Communities: Conspicuous in southern interior valleys especially the Rogue River Valley. Some consider the southern Oregon shrub communities as an extension of northern California chaparral types. Narrow-leafed buckbrush, white-leafed manzanita, chief components of Oregon chaparral. Some chaparral areas within the Rogue Valley are considered climax and depend upon fire for continuance.

C) Successional processes specific for interior southwest Oregon, Interior Valley Vegetation Zone.

Fire was primary disturbance mechanism. Frequent low intensity fire return intervals of 8 to 10 years. Climax with disturbance may be Douglas-fir, ponderosa pine, oak with chaparral.

Description of Mixed Conifer Zone

A) Environmental
Very little precipitation during the summer. Summers are distinctly warmer and drier than similar elevations located at northern latitudes. Moisture regimes more favorable than within Interior Valley Zones.

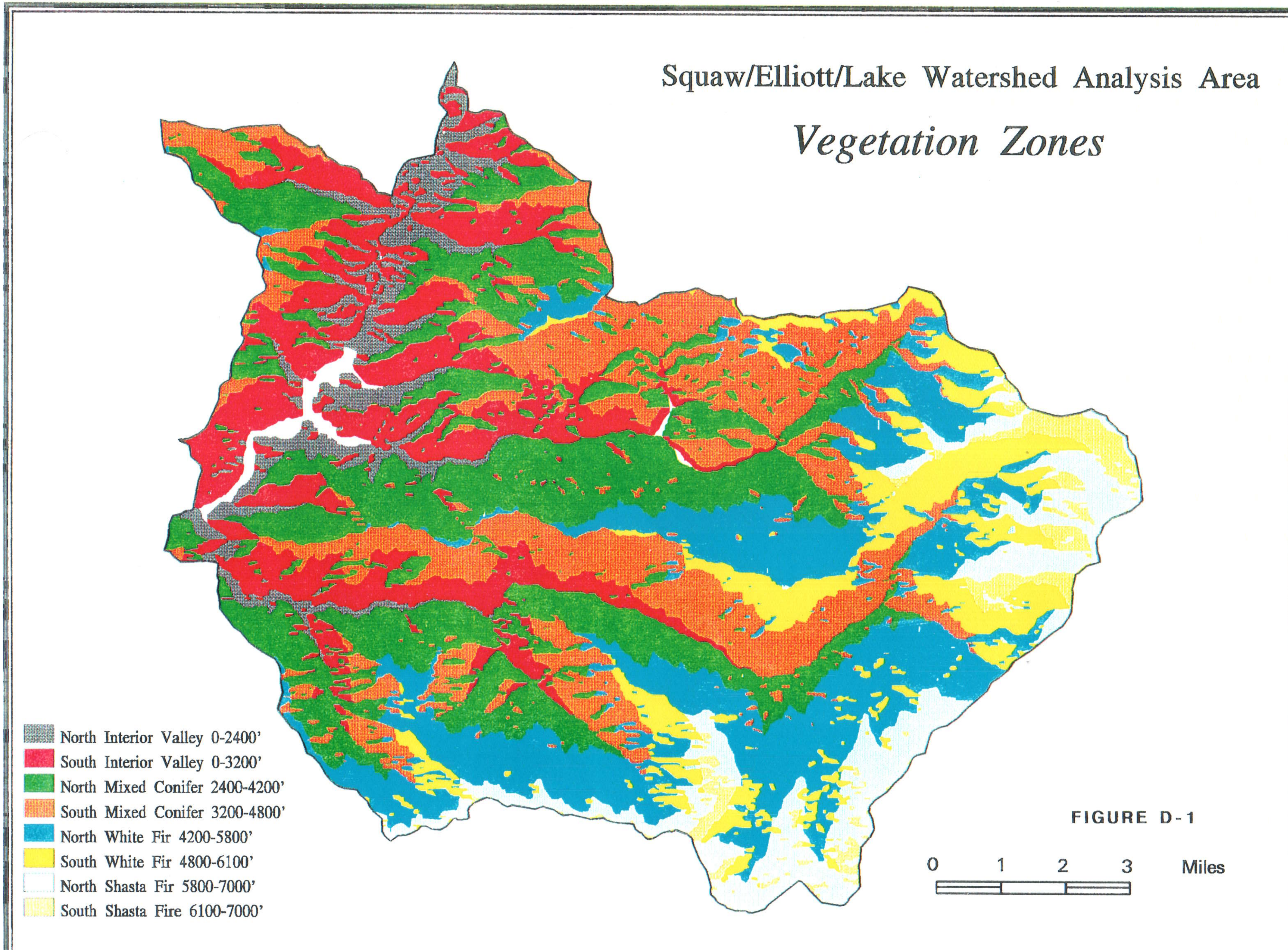
B) Composition
Species occur in many combinations and degrees of moisture: Pseudotsuga menziesii, Pinus lambertiana, P. ponderosa. Calocedrus decurrens, and Abies Concolor. Pseudotsuga menziesii is probably the most abundant species, but it tends to decrease and Pinus spp. tend to increase in importance as one travels from the northend of interior southwest Oregon to the south.

Abies concolor is often represented only by seedlings and saplings in existing mixed-conifer stands.

C) Succession
Brushfield communities can significantly slow the rate of forest succession or, with repeated fire, become semipermanent communities. Ceanothus velutinus is important as a brushfield dominant or invader following logging or fire within this zone.

Many tree species are relatively young and/or have been subjected to one or more fires since their establishment. Pinus labertiana is seral. Pinus ponderosa is also seral, although may reach climax status on poorly drained sites or extremely xeric site. Abies concolor appears to be the major climax species within the Mixed Conifer Zone but usually climax occured on wetter sites according to Franklin.

Fire primary disturbance mechanism. Frequent low to moderate intensity fire return intervals of 15 to 20 years.



Squaw/Elliott/Lake Watershed Analysis Area
Vegetation Zones
North Interior Valley 0-2400'
South Interior Valley 0-3200'
North Mixed Conifer 2400-4200'
South Mixed Conifer 3200-4800'
North White Fir 4200-5800'
South White Fir 4800-6100'
North Shasta Fir 5800-7000'
South Shasta Fire 6100-7000'
0 1 2 3 Miles

FIGURE D-1

APPENDIX E

ACCESS AND TRAVEL MANAGEMENT

Status of Access and Travel Management
Reference Notes; Rights of Way and Easements

SQUAW ELLIOTT WATERSHED ANALYSIS

Access And Travel Management

The objective of this input is to briefly discuss and display several Access and Travel Management (A&TM) components as it relates to our existing and future transportation system for the Forest and this Watershed Analysis. Several charts will be included into this write up to give a visual display of A&TM components. It will also briefly discuss the following topics;

What is Access and Travel Management ?
When is it needed ?
How will it be used ?
What is the current status of Forest A&TM Plan ?

The above information will be referenced from an array of Washington Office, Regional Office and several Forest Level A&TM Plans within our Region including the Rogue River National Forest A&TM Process Guide.

What is Access And Travel Management

Access and Travel Management is a critical link in all programs essential to the stewardship of the National Forest. The Forest Service has managed Access and Travel Management from the first days of the agency, but only in the last twenty years has it become a major issue. The concept of Access and Travel Management was generated by enforcement concerns created by Off Road Vehicles. An Executive Order issued in 1972, made management of travel and access a high priority. From this origin, the A&TM program has evolved into a multi-faceted approach of getting people into and through the National Forests.

Access and Travel Management is the movement of people and products to and through our National Forests. It is fundamental to what the Forest Service does whether it is associated with recreation, wildlife, timber, range, water, fire, minerals, or any other program or resource. It is essential that all aspects of A&TM, including planning and implementation, be integrated with other programs and activities.

The Regional Office has developed the following A&TM policy statement:

"National Forest Lands belong to the People. They have the right to access and use these lands. They must be involved in the development of travel management policies that consider the development, maintenance, and protection of all Forest resources. They want to know how and where they can travel".

Restrictions of access and travel should be the minimum necessary to achieve approved management objectives consistent with 36 CFR 295 and user safety, environmental considerations, and economics.

SQUAW ELLIOTT WATERSHED ANALYSIS

Access And Travel Management

When Is A&TM Needed And How Is It Used

A&TM is needed during the planning process of a proposed activity/project. At this time, the question to ask is; **Does the activity being considered, use an Access or Travel Infrastructure**?

Infrastructure: A physical object or area that provides or controls movement of people into and through the National Forest. The following are examples of infrastructures:

- -roads; including control devices like barriers and gates.
- -bridges
- -trails and trailheads
- -waterways
- -airways
- -facilities; like fences, signs, boat ramps and docks, campsites, helicopter landings.
- -areas; like vehicle restrictions, area closures or airspace restrictions.

Another important question for individuals or teams conducting the planning effort of an activity or analysis is; **What level of activity is being undertaken**? The planning level for example could be on a project or landscape level.

Project level planning is where there is a site specific, proposed action. A decision is to be made about whether of not to implement the action, as well as where the action will happen on-the-ground. Landscape level of planning is typically more analytical and of a larger scope. It will develop opportunities and may or may not involve decision making.

Current Status of A&TM (RRNF)

As of June 1994 the Rogue River National Forest has published an Access and Travel Management Process Guide. It is an internal document for managers, interdisciplinary teams and other teams and individuals involved in planning and decision making related to implementation of Forest activities. It is designed to assist in the overall integration of resource management needs and concerns while implementing Access and Travel Management.

In FY 95 Forest Management had concerns about Access and Travel Management needs on the Forest. As a result of that meeting two A&TM projects were to be started this year, with the first project to be completed by the end of the year. The first project was to be a A&TM assessment that could then be applied to a Forest A&TM Plan (second project). The second project (Final A&TM Implementation Plan-decision-NEPA document) was to be started in FY 96.

Access And Travel Management

Current Status of A&TM (cont'd)

The first project core team met once and realized quickly that all required specialists were not available. The second project could not be started until the first project was completed. Shortly afterwards both projects were postponed until next year.

REFERENCE NOTES
ELLIOTT CREEK WATERSHED AREA

On most of the easements that the Government has acquired or granted rights for road right-of-way from/to private landowners, the easement language is for 33 feet each side of the centerline of the road, (66 feet total), with such additional width as necessary to maintain cuts or fills. There may be some easements that have a varied right-of-way width to accommodate larger cut and fill slopes. On easements that the Government has acquired, the Government or it's agent, has the right to work within this easement strip of land, but resources such as trees, rocks, and plants belong to the landowner. It is required that the Government make arrangements with the landowner prior to removal of any of these resources.

A major exception to the above paragraph is on several segments of road 1050 and a small segment of road 1065 that cross land owned by Eldred Cobb within T.48 N., R. 10 and 11 W., M.D.M. This road easement was acquired by the Government by condemnation and special conditions apply. If any road restoration work is being planned in this area PLEASE contact Jon Parman for further information.

A large portion of the Elliott Creek Watershed Area is in the Upper Elliott Creek Construction and Use Agreement Area. Many of the roads in this area are shared roads with Fruit Growers Supply Company (FGSCO). We are required by this agreement to notify FGSCO in advance of any reconstruction or construction to any of the roads inside the Cost Share Area. It is further recommended that we include FGSCO in the initial planning of any work we may be doing to the road system so they may be included in the decision process. Contact Jon Parman for further information.

There are some roads and trails segments that are on the Forest's road system that the Government does not have easement rights on. If through the Watershed assessment or ATM process, the decision is made to have these roads/trails remain on the Forest's road system, then right-of-way will have to be acquired.

APPENDIX F

HISTORIC HUMAN PROCESSES INFLUENCING CURRENT WATERSHED CONDITIONS

HISTORIC HUMAN PROCESSES INFLUENCING CURRENT WATERSHED CONDITIONS

1. Prehistory (Ca. 10,000 years before present to A.D. 1775)

Throughout the prehistoric period, as during the subsequent historic period, the diverse terrain characteristics and other geographic factors of the Squaw/Elliott/Lakes Watershed Analysis Area influenced the location and the kinds of human activities that occurred. Ranging from broad alluvial terraces along the Applegate River and lower Squaw Creek at the lowest elevations to the rugged Siskiyou Crest that forms the southern headwaters of Elliott Creek at the highest elevations--and with much of the intervening area composed of very steep slopes, topography has been a major determinant in where prehistoric people lived and traveled. Geological and hydrological factors (massive landslides, presence of "soapstone" talc deposits, gold and copper ores, flood-prone alluvial terraces) have had a major influence in the patterns of human occupation from prehistory through the present.

Based on information from the wider Pacific Northwest/California area, as well as archaeological evidence excavated from sites within the Applegate Lake project area during the 1970s-1980s, people have probably lived in and used the Squaw/Elliott/Lakes Watershed for the past 10,000 years. Two archaeological sites, 35JA52 and 35JA53, located at or near the mouth of Squaw Creek yielded artifacts that probably document native habitation from at least 8,000 to 3,000 years ago. Other nearby sites along the main river, also excavated by Oregon State University under contract to the U.S. Army Corps of Engineers (A.C.E.), provide evidence of succeeding human habitation, on through the early historic period (e.g., the presence of glass trade-beads and metal among the artifacts at a small pithouse village near the mouth of Brushy Gulch).

Because of numerous surveys and excavations generated by the A.C.E.'s Applegate Lake project, the portion of the Applegate River between the mouths of Kinney Creek and Elliott Creek is probably by far the best-documented area in the eastern Siskiyou Mountains in terms of archaeological resources. Intensive surveys indicate that village/base-camp sites are found almost solely along extensive alluvial terraces adjacent to the main river, often near the mouths of major tributaries such as Squaw Creek, French Gulch, and Kinney Creek. Above Squaw Creek, river-edge sites become much smaller in size (e.g., a sparse lithic scatter near the mouth of Elliott Creek). The adjacent low-elevation oak- and brush-covered slopes, although they doubtless were important resource-gathering areas, contain few archaeological sites except at major ridge-top saddles and springs. In higher elevations of the Watershed Analysis Area, which includes the vast majority of its acreage, over fifteen years of archaeological survey of proposed timber sales, etc. by the Forest Service has given a solid understanding of the site-location pattern in the remaining portions of the W.A.A. Aside from two "upland base-camp" sites (at a major ridge-saddle between Mule Creek and Beaver Creek and near Big Squaw Lake), most of the prehistoric sites in this area are very small, sparse lithic scatters (places where stone tools were made or re-sharpened during hunting forays).

These are typically situated at ridge-top saddles, springs, and at or very close to meadows and other major openings.

Human populations in the Squaw/Elliott/Lakes W.A.A. probably remained quite small throughout prehistory, but with some growth in numbers ocurring over the Early Archaic and Middle Archaic periods (ca. 8,000-2,000 year B.P.) and a possible "spike" in growth during the Late Archaic (after 2,000 years ago). It is likely that, as in other areas of southwestern Oregon/northern California, anthropogenic fire increased during the Middle Archaic, in an attempt to maintain the more drought-tolerant (and food-rich) vegetation that had characterized the dry climatic era between 8,000 and 4,000 years ago. Use of fire to maintain and create favored food-gathering areas continued into the early historic period, until the natives were forcefully removed from the region by Euro-American settlers.

Three major native groups that inhabited or used the general area during the Late Archaic period would have been the Takelma, Dakubetede, and Shasta peoples. Their major enduring legacy to the land was the extensive acreage kept "cleared" of dense vegetation through repeated burning, particularly at low elevations and at the highest meadows; this legacy has only begun to fade during the past eighty years of fire suppression in the area.

2. Early Euro-American Exploration (ca. 1775-1850)

Although Euro-American explorers sailed along the southern Oregon coast by the 1770s, the first penetration of the interior came in the late 1820s, with the arrival of Hudson's Bay Company fur-trapping brigades. Although H.B.C. and others attempted to "trap out" the streams of the region during the 1820s-40s, it seems doubtful that beaver trappers had much if any environmental impact within the Applegate River drainage south of the Little Applegate/Beaver Creek areas. The Squaw/Elliott/Lakes area was simply too remote for most of these fast-moving groups, which passed through the Rogue River Valley region annually and pursued only a few weeks' worth of trapping while travelling on to the the north or south.

3. Mining and Initial Settlement (ca. 1850-1900)

The first recorded prospecting in the uppermost Applegate River drainage occurred in 1852-53. Small placer-gold operations proliferated along the main river and Elliott Creek during the 1850s and continued through the 1860s. (Squaw Creek seems to have been somewhat less affected by placer gold mining than other areas within the W.A.A.) During the 1870s, relatively large-scale hydraulic mining of "high terrace" placer deposits began. Major hydraulic operations occurred along the main river near Water Gulch, Kanaka Gulch, Brushy Gulch, French Gulch, and Grouse Creek. Later in the nineteenth century, extensive hydraulic mining began at a number of locations along lower Elliott Creek, particularly near the mouths of Joe Creek and Dutch Creek (e.g., the "Boggs Mine"). Hydraulic mining entailed the construction of lengthy, large-capacity ditches, diverting water from the Applegate River and its tributaries to the mines. Turbidity caused by hydraulic mining, depending on the amount and timing of the resulting debris, may have had significant effects on the local fishery. In the 1870s-80s, Squaw Creek (although very little hydraulic mining actually occurred within its drainage) supplied the bulk of the water used to mine the Squaw Lakes Mining Company's property between French

Gulch and Brushy Gulch; impacts to the creek's anadromous fishery habitat may have been significant. Hard-rock, or lode, mining within the W.A.A. was extremely limited during the nineteenth century and was confined almost exclusively to a few small-producing gold deposits.

Areas with agricultural potential were restricted largely to the broader alluvial terraces along the main river; Elliott Creek's steep terrain discouraged any would-be farmers. Therefore, what little farming settlement that occurred during the nineteenth century (and subsequently) took place along the river (from French Gulch downstream) and lowermost Squaw Creek. These small operations focussed on rasing livestock, growing hay or other forage, and tending small vegetable gardens and fruit orchards; open range on federal lands in the higher elevations of the Siskiyou Mountains supplied summer grazing. The average agricultural population living within the W.A.A. at any one time probably never exceeded 50-100 people.

Miners and settlers "high-graded" the forests of the W.A.A. of good-quality, accessible sugar pine and ponderosa pine for cabins, barns, flume boards, mine timbers, and so on. They also continued (and perhaps intensified) the aboriginal pattern of "light burning."

4. Intensive Resource Use and the Early Forest Service Period (ca. 1900-1930)

The three decades following the turn of the century witnessed steadily increasing resource extraction within the Squaw/Elliott/Lakes W.A.A. Simultaneously, the Forest Service began to administer the federal lands within the area; it embarked on initial infrastructure development (trails, roads, telephone lines) that allowed some resource uses, usch as grazing, to expand.

Hydraulic mining continued after 1900, albeit on a reduced scale and largely at the more remote, higher elevation placer deposits that had not been mined previously (i.e., at Elliott Creek's Daffodil Mine, Pennsylvania Mine, etc.) Some hard-rock gold mining persisted as well. The most dramatic lode mining activity involved the low-grade copper ores of the middle sections of Elliott Creek (Blue Ledge Mine, New Bloomfied Mine) and Squaw Creek ("Great Eastern" claims). Of these, the Blue Ledge operation on Joe Creek involved by far the most extensive development (including several miles of adits and a sizeable mining camp complete with electricity and indoor plumbing). Although the copper mines of southwestern Oregon never even began to rival the contemporary copper operations of the American southwest (e.g., Bisbee, Arizona), they encouraged a flurry of economic investment and created hopes (unfulfilled) for a railroad from Medford into the headwaters of the Applegate River drainage. By 1920, the area's brief and comparatively minor copper boom was over.

Local livestock ranchers expanded their operations during the second decade of the twentieth century, particularly with the high prices of World War I. Heavy grazing pressure, including what Forest Service range examiners described as "overgrazing," resulted during the 1910s-1920s, particularly in the higher elevation meadows of Silver Fork Basin, Donomore Meadows, and other places along the Siskiyou Crest. Flood irrigation of pasture at the "home ranches" within the W.A.A. (i.e., along the main river) typically did not use fish screens at ditch intakes; over the course of several decades, this probably contributed to a significant decline in the fish population.

Forest Service management during this period concentrated on initial infrastructure development and fire supression, particularly after the severe 1910 fire season (the "Windy Peak Fire" at one time allegedly threatened the copper mining "town" of Joe Bar, on Elliott Creek). Local fire-setting practises probably continued well into the new century. Whether human-caused or not, at least three large fires (in excess of 1,000 acres each) burned the steep, south-aspect slopes of Elliott Creek Ridge during the 1920s. However, the government's fire-supression campaign took hold by about 1930, ending the centuries-long pattern of human-set, human-aided, or human-permitted light ground fires that had kept much of the low- and mid-elevation forests relatively open. Brush species encroached on meadows and grassy savanna. Within the forest, conifer cover gradually became more dense and composed of far more Douglas-fir and white fir than the previously dominant pine.

5. The Depression, World War II, and After (1930-1970)

The Great Depression saw a reduction in livestock numbers within the W.A.A. In addition, the previously small acreage of timber harvest (for the most part associated with local ranchers' needs and development of the Blue Ledge Mine) became even smaller.

However, the higher price of gold after 1932 stimulated another round of small-scale placer and lode mining; placering undoubtedly created turbidity in the main river and tributary streams, but winter remained the main mining season, and conflicts with fish habitat quality were therefore less than if miners had muddied the streams during low-flow, warmer periods of the year. Depression-era mining included not only a number of small gold mines (for example, the Grubstake Mine in the upper Elliott Creek drainage), but several cinnabar (mercury ore) operations as well (i.e., along Squaw Creek and at Maple Dell Gap). (Although some retorting of the cinnibar apparently occurred, there is no indication of adverse effects on streams; these operations were brief-lived and miniscule in the amount of ore recovered.)

With an increased labor force provided by the Civilian Conservation Corps, the Forest Service built more trails, roads, and administrative structures (e.g., Hutton Guard Station, Squaw Peak Lookout, Perks Pasture Guard Station) during the 1930s and early 1940s. Construction of the "Applegate/Mt. Ashland Loop Road" (current FS Road 20) in 1936-37 opened up the highest elevations of the W.A.A. to motorized access. It resulted in more recreational use and, with the high lumber demand of World War II and the post-war boom, dramatically increased harvest of mid-to-high-elevation timber stands on federal and private lands.

Access to the lower-elevation timber of Elliott Creek canyon was provided by a road and bridges built during training exercises by Camp White detachments of the U.S. Army Corps of Engineers in 1942-44. (During the Blue Ledge Mine period, a road had penetrated up to the mouth of Joe Creek, but commercial timber harvest was not viable in the area until after 1940.) Additional roading, both Forest Service and private, proliferated during the 1950-60s. These roads permitted logging in some the heretofore most remote and topographically rugged portions of the Applegate River drainage.

6. Recent Trends and Events

The 1970s and 1980s witnessed intensive logging (much of it using skyline cable systems and other technologies adapted to steep terrain) throughout the mixed-conifer and true fir forests of the W.A.A.; clearcutting and shelterwood harvest systems dominated, whereas earlier logging had relied largely on selective cutting. The Squaw Creek Road, a challenging engineering project built across steep terrain in the 1970s, replaced a crude low-water route along the creek bottom and was one of the last major additions to the W.A.A.'s transportation system.

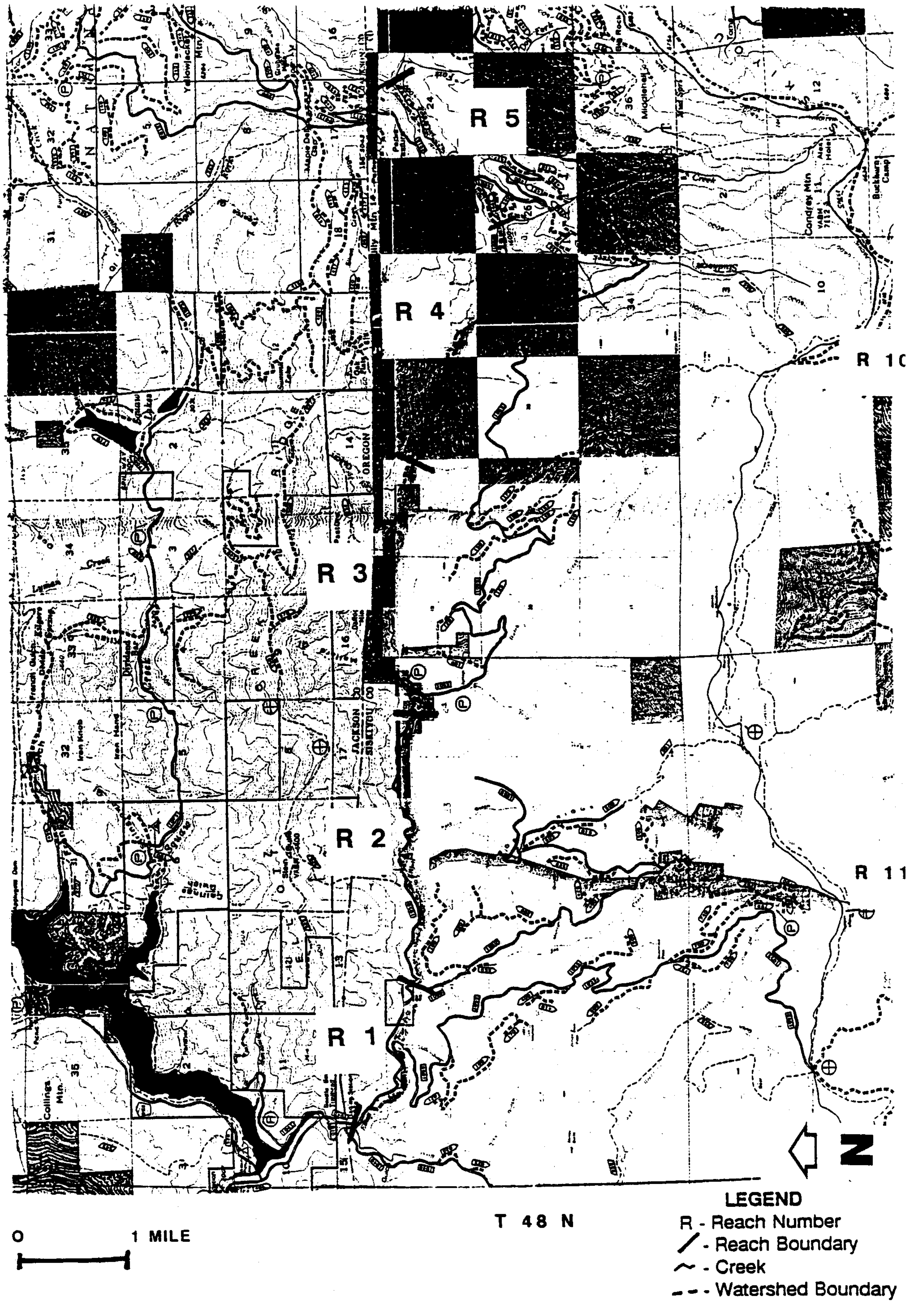
During the 1970s, the land around Squaw Lakes, formerly privately owned, became part of the National Forest, leading to small-scale recreational development at the site. Development by the Army Corps of Enigneers of Applegate Lake Reservoir, which covered the former pasturelands along the main river, was by far the most dramatic and environmentally important change of this period. In addition to the impoundment of a sizable portion of the W.A.A., new roads and recreational sites were built and new public use patterns evolved. Because of Applegate Lake, recreational use of the lower elevations of the Squaw/Elliott/Lake Watershed Analysis Area has (a) increased substantially and (b) changed in character from pre-1980 use.

APPENDIX G

STREAM REACH BREAK MAPS

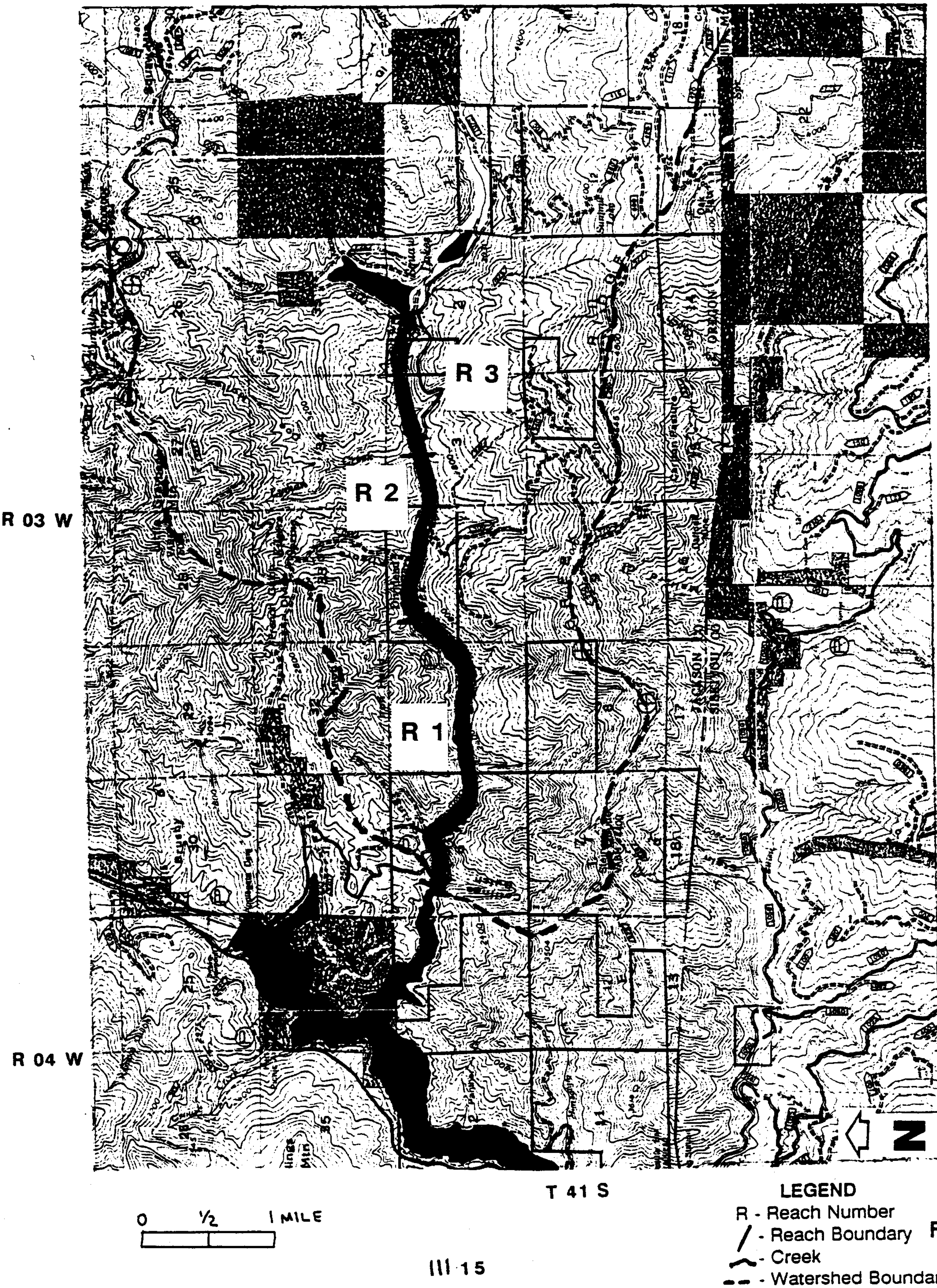
REACH MAP

Elliott Creek



REACH MAP

Squaw Creek



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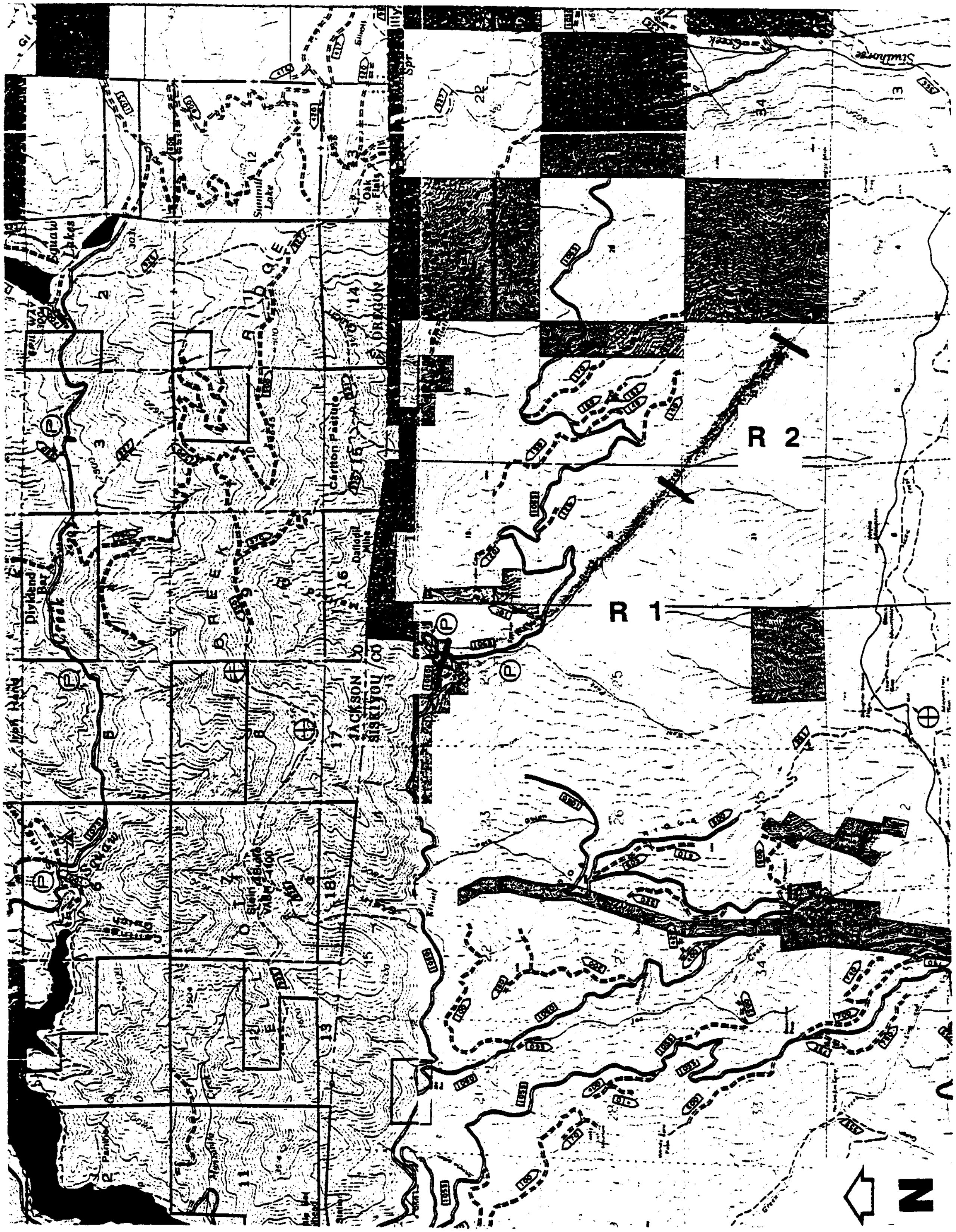
REACH MAP

Dutch Creek



0 1/2 1 MILE

T 48 N

LEGEND

R - Reach Number

/ - Reach Boundary

~ - Creek

- - - Watershed Boundary