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Upper Bear Creek Watershed Analysis

Version 1.1

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Bureau of Land Management, Medford District
Ashland Resource Area

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EXECUTIVE SUMMARY

Introduction

Watershed analysis is the primary tool for generating information to implement ecosystem management as directed in the Northwest Forest Plan and the Medford District Resource Management Plan. The Upper Bear Creek Watershed Analysis describes conditions and interrelationships of ecosystem components for the Upper Bear Creek Watershed Analysis Area. The analysis focuses on issues and key questions that are most relevant to the management questions, human values, and resource conditions within the analysis area. Management objectives and recommendations for Bureau of Land Management (BLM)-administered lands are prioritized based on conclusions reached through the analysis. The watershed analysis formulates an overall landscape plan for BLM-administered lands and recognizes the inventory, monitoring, and research needs for the analysis area.

The Upper Bear Creek Watershed Analysis was prepared by an interdisciplinary team of resource professionals and specialists from the BLM Ashland Resource Area and Medford District Staff. The watershed analysis team followed the six-step process outlined in the *Ecosystem Analysis at the Watershed Scale, Federal Guide for Watershed Analysis, version 2.2.* The six steps or sections included in the Upper Bear Creek Watershed Analysis are: 1) characterization, 2) issues and key questions, 3) current conditions, 4) reference conditions, 5) syntheses and interpretation of information, and 6) recommendations.

The Upper Bear Creek Watershed Analysis addresses the entire analysis area and is based on existing information and recent data collection. Where resource information is missing, a data gap is identified. The watershed analysis process is iterative and new information will be used to supplement future versions of the analysis.

Public participation for the Upper Bear Creek Watershed Analysis included a public meeting in April 1999 and the opportunity to submit written and/or verbal comments. Approximately 1,200 notices regarding the open house were sent to residents within the analysis area, people who had previously submitted comments regarding the Cascade/Siskiyou Ecological Emphasis Area Plan, local agencies, local groups, and the Klamath Tribe, the Quartz Valley Indian Reservation, the Cow Creek Band of Umpqua Indians, and the Confederated Tribes of Siletz and Grand Ronde. The notice provided a map of the area, explained the watershed analysis process, and included a comment form for people to mail if they couldn't attend the open house. The open house was held at the U.S. Forest Service's Ashland Ranger District Office in Ashland, Oregon. The purpose of the open house was to give the public the opportunity to share with the watershed analysis team their ideas, concerns, information regarding the historic or current conditions, and recommendations on how the analysis area should be managed. In addition to comments received at the open house, the BLM received 83 comment letters concerning the Upper Bear Creek Watershed Analysis Area.

Watershed Characterization

The Upper Bear Creek Watershed Analysis Area covers approximately 110-square miles (70,231 acres) in the southern Cascade range in southwestern Oregon. The analysis area is at the upper reaches of the Bear Creek Watershed and the southern and eastern ridges form the divide between the Rogue and Klamath River Basins. The two major streams in the analysis area are Walker and Emigrant Creeks, which join to form Bear Creek. Tributaries to Walker Creek include Frog and Cove Creeks and tributaries to Emigrant Creek include Carter, Sampson, Tyler, Baldy, Green Mountain, and Porcupine Creeks. Emigrant Lake/Reservoir is a prominent feature that is located in the west/central portion of the analysis area.

Land ownership within the Upper Bear Creek Watershed Analysis Area includes: Bureau of Land Management (16,472 acres), Bureau of Reclamation (1,410 acres), and private lands (52,349 acres). Federal land use allocations include: Matrix, Riparian Reserves, Late-Successional Reserve, Special Areas (Pilot Rock Area of Environmental Concern and Cascade/Siskiyou Ecological Emphasis Area),and a Special Recreation Management Area (Pacific Crest National Scenic Trail).

Regional public issues reflect the dominant uses of the analysis area and include: concerns with recreational activities, such as use of the Pacific Crest National Scenic Trail and off-highway vehicle use; concerns with grazing and timber harvest on public lands; concerns over general degradation of the natural environment; concerns about fish and water quality; and concerns regarding Siskiyou/Cascade ecological linkages. Public concerns more specific to this analysis area include: urban interface issues, especially issues of wildfire, fire protection, and smoke; the spread of noxious weeds; timber harvest; grazing; low water flows in local streams due to irrigation withdrawals; and the use of Schoolhouse Creek by the Bureau of Reclamation to transport water from Howard Prairie with subsequent channel damage.

The Upper Bear Creek Watershed Analysis Area is characterized by mild, wet winters and hot, dry summers. The lower elevations of the analysis area are classified as having a low severity fire regime with frequent, low intensity fires, while the mid-elevations and drier portions of higher elevations have a moderate fire regime with less frequent fires and varying intensity.

The Upper Bear Creek Watershed Analysis Area lies mainly within the Western Cascade Subprovince of the Cascade Mountain Geologic Province. The terrain within the analysis area consists of steep hillsides and flat valley bottoms. Landslides resulting from steep, unstable slopes are primarily located in the upper portion of the analysis area. Surface erosion is primarily from the steeper, stream-adjacent slopes in the analysis area.

The west/central portion of the Upper Bear Creek Watershed Analysis Area is primarily composed of grasslands, which extends to approximately 2 miles east of Emigrant Lake. The remainder of the analysis area is predominately forest lands with patches of grassland, shrubland, and woodland interspersed. The southwest facing slopes tend to be dry and rocky; rock outcrops and rocky surfaces are common throughout the analysis area. Tree species in the forest lands include ponderosa pine, incense cedar, Douglas-fir, and white fir. There are ten populations (eight species) of special status vascular plants known to exist within the analysis area and fourteen sites (six species) of Survey and Manage plants. Noxious weed species known to occur within the analysis area include yellow starthistle, Canada thistle, spotted knapweed, St. Johnswort (Klamath weed), and medusahead wildrye. Other non-native species that have been seen in the analysis area are ripgut brome, softchess, cheatgrass, bulbous bluegrass, orchard grass, and hedgehog dogtail.

Northern spotted owls and bald eagles, both listed as threatened, are present in the analysis area. A portion of the analysis area is in a northern spotted owl critical habitat unit. Nineteen special status wildlife species are known or are likely to be present in the analysis area. Several of the Survey and Manage and Protection Buffer species designated in the Northwest Forest Plan are also known to be present in the analysis area: great gray owl, silver-haired bat, blue-grey tail-dropper, and Oregon shoulderband. The area supports a deer winter range and an elk management area.

Fishery resources in the Upper Bear Creek Watershed Analysis Area are a combination of native and introduced fish that include anadromous (summer and winter steelhead), cold-water resident (rainbow and cutthroat trout), warm-water (largemouth bass, smallmouth bass, bluegill sunfish, pumpkinseed sunfish, yellow perch, black crappie, and brown bullhead), and non-game species (reticulate sculpin).

Water quality limited streams identified by the Oregon Department of Environmental Quality in 1998 as not meeting the state temperature standard include the following streams within the Upper Bear Creek Watershed Analysis Area: Baldy, Carter, Emigrant, Hobart, Tyler, and Walker Creeks. Emigrant Creek from the mouth to Emigrant Reservoir is also listed due to exceeding the state nutrient standard.

Human Uses

Two radically different patterns have characterized land use in the Upper Bear Creek Watershed Analysis Area. For thousands of years, indigenous people followed a hunting-fishing-gathering way of life, based on a small-scale, subsistence-oriented economy. Approximately 150 years ago, the advent of Euro-American settlement brought fundamentally different land use patterns based on complex technologies and an economic system connected to global markets.

The last 150 years have contributed to substantial changes in the landscape of the analysis area. In the nineteenth century, newcomers cleared land for ranches and for fuelwood; introduced a host of new plant (agricultural crops and weeds) and animal (farm and ranch animals) species; plowed under native meadows for farms; dammed, diverted, and channelized streams; and hunted unwanted predators (grizzly bears and wolves) and other species (antelope and bighorn sheep) to local extinction. In the twentieth century logging has expanded with the post-World War II explosion of roads and improvements in transportation; fire suppression has affected the local vegetation; and a host of state, federal, and local policies guide human operations on both public and private lands.

The effects of these actions are written on the land: the hydrology of the analysis area has been altered through irrigation, water withdrawals, dams, roads, channelization, and other actions; erosion is more severe in some places than in the past; soil productivity has been affected in some areas by compaction, hot fires, and changes in vegetation patterns; vegetation patterns have been altered through agriculture, fire suppression, grazing, and other actions; topography has changed in places through the construction of quarries and roads, and stream alterations; and native species (plants and animals) have disappeared or become reduced through a number of human actions or through competition with non-native species.

The twentieth century has witnessed the advent of federal land management policies that affect a portion of the analysis area's lands. The advent of ecosystem management suggests a shift from an extractive perspective to one combining economic concerns with stewardship practices. Fire suppression policies have operated with timber harvest to change the character of the forests in the analysis area, and numerous laws and regulations now guide human actions on these federal lands.

Terrestrial Ecosystem

Fire suppression, plant succession, logging, road building, vegetation conversion for agricultural uses, livestock grazing, and the introduction of non-native plants are the main processes that have designed the landscape since the turn of the century. Results stemming from these processes include: increased forest stand density with a low level of growth or vigor; increased susceptibility of forest stands to bark beetle attacks and pathogens; a change in the species composition and structure of forest lands, grasslands, shrublands, and oak woodlands; and habitat alteration of shrublands, oak woodlands, and savannahs. These changes have caused an increase in fire hazard and a shift in the intensity and effects of wildfires when they occur. Current trends in silvicultural and prescribed fire practices are focusing on restoring and maintaining vegetative communities to a more fire resilient, native vegetation condition.

Vegetative conditions are the primary influence on terrestrial wildlife/animal populations and their distribution within the analysis area and across the greater landscape. Declines in mature/old-growth habitat and the quality of early and mid-seral conifer, oak woodland, shrubland, and grassland habitat have likely contributed to the decline of populations of wildlife species that prefer these habitats. The decrease in mature/old-growth habitat is likely to have resulted in lower populations of northern spotted owl and some special status species. Poor winter range forage conditions may limit the size of the deer herd.

Aquatic Ecosystem

The streamflow regime reflects human influences that have occurred since Euro-Americans arrived. Road construction, timber harvest, land development, Emigrant Dam, and water withdrawals are the major factors having the potential to adversely affect the timing and magnitude of both peak and low streamflows in the analysis area.

Channel conditions, water quality, and riparian habitat in the Upper Bear Creek Watershed Analysis Area have changed considerably in the last 150 years primarily due to human activities such as logging, road building, removal of riparian vegetation, channelization, beaver removal, poorly managed livestock grazing, irrigation development, and land alteration for agriculture and residential developments. Some of the results are fragmented connectivity of riparian habitat; reduced quantity of snags and large woody material; reduced streambank stability; increased sediment production to streams; and reduced stream shading. Lack of riparian vegetation and water withdrawals have contributed to increased stream temperatures that can stress aquatic life and limit the long-term sustainability of fish and other aquatic species. Sediment is mainly transported to streams from landslides (natural and human-caused), road surfaces, fill slopes, and ditchlines. Human-caused landslides have mostly resulted from road building and clearcuts in unstable areas. The combination of these factors have contributed to reduced stream channel complexity and stability resulting in poorer quality habitat for aquatic species and an increased susceptibility to streambank erosion.

Riparian Reserves along intermittent, perennial nonfish-bearing, and fish-bearing streams on BLM-administered lands will help to provide a future long-term source of large woody material recruitment for streams, improve stream shading, and increase the potential for use by wildlife. The use of silvicultural treatments within riparian stands could improve the health, vigor, and diversity of these areas.

Since the construction of Emigrant Dam, anadromous fish habitat in the analysis area is limited to Emigrant Creek downstream of the dam and in lower portions of Walker and Cove Creeks. Summer and winter run steelhead are the only migratory fish that are currently known to exist in these streams. Steelhead attempting to spawn in Emigrant Creek between the Walker Creek confluence and Emigrant Dam are subject to unnatural stream fluctuation and de-watering after the irrigation season begins.

Resident trout have greater access and use of the analysis area, but many of the upper tributaries are steep and lack suitable habitat to support healthy populations. Because of the loss of stream channel complexity, trout and other aquatic resources are presumably less plentiful and confined to fewer reaches than prior to these changes.

Overall, the interrelated aquatic and riparian habitats in the Upper Bear Creek Watershed Analysis Area are in marginal to poor condition and are below their potential for trout production. Much of the habitat lacks quality pools and large woody material necessary for maintenance of pools, cover, spawning material, and bank stability.

INTRODUCTION

Objective of the Watershed Analysis

The Upper Bear Creek Watershed Analysis documents conditions and interrelationships of ecosystem components for the analysis area. It describes the dominant features and physical, biological, and social processes within the analysis area. The document compares prehistorical (before 1850) and historical (reference) conditions with current ecosystem conditions and discusses the development of current conditions and future trends. It also ranks management objectives and recommendations for Bureau of Land Management (BLM)-administered lands as high, medium, or low priority, and directs development of a landscape plan for BLM-administered lands. This document is intended to guide subsequent project planning and decision making in the Upper Bear Creek Watershed Analysis Area. This document is not a decision document under the National Environmental Policy Act (NEPA) and there is no action being implemented with this analysis. Site-specific analysis incorporating the NEPA process would occur prior to any project implementation on BLM-administered lands.

How The Analysis Was Conducted

The Upper Bear Creek Watershed Analysis was prepared by an interdisciplinary team of resource professionals and specialists from the BLM Ashland Resource Area and Medford District Staff (see List of Preparers). The team also included a representative from the U.S. Fish and Wildlife Service. Group discussions identified linkages among resources and resulted in an integrated, synthesized report.

Guidelines used to direct the preparation of the Upper Bear Creek Watershed Analysis include: the *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 and USDI 1994a) (these two documents are combined into what is known as the Northwest Forest Plan), and *Ecosystem Analysis at the Watershed Scale:* Federal Guide for Watershed Analysis, Version 2.2 (USDA et al. 1995). Other documents referred to include the *Medford District Resource Management Plan* (USDI, BLM 1995), the *Jenny Creek Late-Successional Reserve Assessment* (USDI, BLM 1999), and the *CSEEA Draft Management Plan/Environmental Impact Statement* (USDI, BLM 2000b). The Cascade/Siskiyou Ecological Emphasis Area (CSEEA) includes a portion of the Upper Bear Creek Watershed Analysis Area. A draft management plan/environmental impact statement (EIS) is being developed for this area starting in September 1999. The record of decision for the EIS will dictate management actions in the portion of the analysis area that lies within the CSEEA.

The Upper Bear Creek Watershed Analysis is based on existing information and addresses the entire analysis area, although recommendations are only made for BLM-administered lands. Where resource information is missing, a data gap is identified. Data gaps are prioritized and listed in a separate section; missing information will be acquired as funding permits. The analysis process is dynamic and the document will be revised as new information is obtained. Types of new information may include resource data collected at the project level and monitoring data. An updated version of this document will be issued when new data and information collected indicate important changes in watershed conditions or trends.

Document Organization

The organization of this document follows the format described in the *Ecosystem Analysis at the Watershed Scale: Federal Guide for Watershed Analysis*, Version 2.2 (USDA et al. 1995). The Issues and Key Questions focus on the key ecosystem elements that are most relevant to the management questions and objectives, human values, or resource conditions within the analysis area. The Characterization section identifies the dominant physical, biological, and human processes or features of the analysis area that affect ecosystem functions or conditions. The Current Conditions section details current conditions of the physical, biological, and human ecosystem elements. The Reference Conditions section describes how ecological conditions have changed over time as a result of human influences and natural disturbances in the Upper Bear Creek Watershed Analysis Area. The Synthesis and Interpretation section compares existing and reference conditions of specific ecosystem elements and explains significant differences, similarities, or trends and their causes. The Management Objectives and Recommendations section identifies management objectives for BLM-administered lands within the analysis area and prioritizes management activities to achieve the objectives. The Landscape Planning section synthesizes resource data to create landscape objectives and recommendations for BLM-administered lands. Prioritized data gaps and monitoring and research needs are included in separate sections.

Maps are grouped together and placed at the end of the document. All maps for the watershed analysis were generated using BLM Medford District geographic information systems (GIS).

Public Involvement

Public participation for the Upper Bear Creek Watershed Analysis included two public meetings and the opportunity to submit written and/or verbal comments.

Letters were sent in January 1999 to the Klamath Tribe, the Quartz Valley Indian Reservation, the Cow Creek Band of Umpqua Indians, and the Confederated Tribes of Siletz and Grand Ronde, notifying them of the watershed analysis and requesting comments. A watershed characterization summary and the draft issues and key questions were sent to the tribes in April 1999. Verbal responses were received from the Klamath and Shasta Indian tribes. They both expressed an interest in archaeological and cultural resources and would like to be notified of any projects undertaken in the analysis area. The Klamath Tribe also relayed a strong interest in fisheries and water issues.

An open house was held on April 21,1999 at the U.S. Forest Service's Ashland Ranger District Office, Ashland, Oregon from 5:30 p.m. to 7:30 p.m. Approximately 1,200 notices regarding the open house were sent in April 1999 to residents within the analysis area, people who had previously submitted comments regarding the Cascade/Siskiyou Ecological Emphasis Area Plan, local agencies, and local groups including: Southern Oregon Timber Industry Association, Stockman's Association, Headwaters, Friends of the Greensprings, and Motorcycle Riders Association. The notice provided a map of the area, explained watershed analysis, and included a comment form for people to mail if they couldn't attend the open house. Flyers containing similar information were posted at public places in Ashland and a news release was issued to newspapers across southwest Oregon including Medford's *Mail Tribune*.

The open house was well attended and team members were available for questions from the public. The purpose of the open house was to give the public the opportunity to share with the watershed analysis team their ideas, concerns, information regarding the historic or current conditions, and recommendations on how the analysis area should be managed. Resource maps were displayed and several handouts were available. One handout explained the watershed analysis process and included a comment form, another handout summarized watershed characteristics identified by the team, and a third handout presented the draft issues and key questions.

Written comments received and verbal comments recorded at the open house meeting are summarized in Appendix A.

ISSUES AND KEY QUESTIONS

ISSUE: ***Human Uses***

Characterization

1. What are the land ownership patterns and land allocations in the analysis area?
2. What are the major ways in which humans interact with the analysis area?
3. Where are the primary locations for human use of the analysis area?
4. What are the regional public concerns that are pertinent to the analysis area (e.g., air quality, environmental degradation, commodity production, etc.)?
5. What are the public concerns specific or unique to this analysis area?
6. Are there treaty or tribal rights in the analysis area?
7. Are there tribal issues and concerns in the analysis area?
8. What road types are in the analysis area and where are they located?

Current Conditions

1. Who are the people most closely associated with and potentially concerned about the analysis area?
2. What are the current human uses and trends of the analysis area (economic, recreational, other)?
3. What is the current and potential role of the analysis area in the local and regional economy?
4. What are the current conditions and trends of the relevant human uses in the analysis area:
    a. government facilities, structures, and communication routes
    b. authorized and unauthorized uses
    c. transportation system
        i. What are the current road conditions?
        ii. What are the open and closed road densities (by road type) and where are high road densities located?
    d. logging
    e. special forest products
    f. grazing/agriculture
    g. minerals
    h. recreation
    i. cultural resources

Reference Conditions

1. How did native people interact with the environment to create the native reference ecosystem?
2. What changes in human interactions have taken place since historic contact and how has this affected the native ecosystem?
3. What are the major historical human uses in the analysis area, including tribal and other cultural uses?
4. What is the history of road development and use in the analysis area?

ISSUE: ***Human Uses (Continued)***

Synthesis and Interpretation

1. What are the causes of change between historical and current human uses?
2. What are the influences and relationships between human uses and other ecosystem processes in the analysis area?
3. What human effects have fundamentally altered the ecosystem?
4. What are the anticipated social or demographic changes that could affect ecosystem management?
5. What human interactions have been and are currently beneficial to the ecosystem and can these be incorporated into current and future land management practices?
6. What are the influences and relationships between roads and other ecosystem processes?
7. How do road stream crossings affect water quality, instream habitat, and fish migration?

ISSUE: ***Climate***

Characterization

1. What are the climatic patterns in the analysis area?

ISSUE: ***Geology and Geomorphology***

Characterization

1. What is the origin of the broad variety of rock types in the analysis area and where are they located?
2. How did the rock types influence landforms, soils, and vegetation?

ISSUE: ***Erosion Processes***

Characterization

1. What erosion processes are dominant within the analysis area?
2. Where have they occurred or are they likely to occur?

Current Conditions

1. What are the current conditions and trends of the dominant erosion processes prevalent in the analysis area?

Reference Conditions

1. What are the historical erosion processes within the analysis area?
2. Where have they occurred?

ISSUE*: Erosion Processes (Continued)*

Synthesis and Interpretation

1. What are the natural and human causes of changes between historical and current erosion processes in the analysis area?
2. What are the influences and relationships between erosion processes and other ecosystem processes?

ISSUE*: Soil Productivity*

Characterization

1. How critical/vulnerable is soil productivity in the analysis area?

Current Conditions

1. What are the current conditions and trends of soil productivity?
2. What areas within the analysis area are most vulnerable to soil productivity loss by management actions?

Reference Conditions

1. What were the historical soil productivity characteristics?

Synthesis and Interpretation

1. What are the natural and human causes of change between historical and current soil productivity conditions?
2. How do natural disturbances affect long-term soil productivity?
3. What are the influences and relationships between soil productivity and other ecosystem processes?

ISSUE*: Landscape Vegetation Pattern*

Characterization

1. What is the array and landscape pattern of native and non-native plant communities and seral stages in the analysis area?
2. What is the percent composition of the vegetation condition classes over the landscape?
3. What processes caused these patterns?

Reference Conditions

1. What is the historical array and landscape pattern of plant communities and seral stages in the analysis area?
2. What processes caused these patterns?

ISSUE: ***Landscape Vegetation Pattern (Continued)***

Synthesis and Interpretation

1. Have non-native species and noxious weeds changed the landscape pattern of native vegetation?

ISSUE: ***Plant Species and Habitats***

Characterization

1. Non-native Species and Noxious Weeds
   a. What is the relative abundance and distribution of non-native plants and noxious weeds?
   b. What is the distribution and character of their habitats?
2. Special Status Plant Species and Habitats
   a. What is the relative abundance and distribution of special status vascular plant species?
   b. What is the distribution and character of their habitats?
3. Survey and Manage Species and Habitats
   a. What is the relative abundance and distribution of survey and manage plant species?
   b. What is the distribution and character of their habitats?
4. Special Areas with Botanical Resources
   a. What are the values of the Special Areas in the analysis area?

Current Conditions

1. Non-native Species and Noxious Weeds
   a. What are the current habitat conditions and trends for non-native species and noxious weeds?
2. Special Status Plant Species and Habitats
   a. What are the current habitat conditions and trends for special status vascular species?
3. Survey and Manage Species and Habitats
   a. What are the current habitat conditions and trends for survey and manage species?
4. Special Areas with Botanical Resources
   a. What are the current conditions of the Special Areas in the analysis area?

ISSUE*: Plant Species and Habitats (Continued)*

Reference Conditions

1. Non-native Species and Noxious Weeds
   a. What was the historical relative abundance and distribution of non-native species and noxious weeds and the condition and distribution of their habitats in the analysis area?
2. Special Status Plant Species and Habitats
   a. What was the historical relative abundance and distribution of special status vascular species and the condition and distribution of their habitats in the analysis area?
3. Survey and Manage Species and Habitats
   a. What was the historical relative abundance and distribution of survey and manage species and the condition and distribution of their habitats in the analysis area?
4. Special Areas with Botanical Resources
   a. What was the historical condition of the Special Areas in the analysis area?

Synthesis and Interpretation

1. Non-native Species and Noxious Weeds
   a. What are the natural and human causes of change between historical and current species distribution and habitat quality for non-native species and noxious weeds in the analysis area?
   b. What are the influences and relationships of non-native species and noxious weeds and their habitats with other ecosystem processes in the analysis area?
2. Special Status Plant Species and Habitats
   a. What are the natural and human causes of change between historical and current species distribution and habitat quality for special status vascular species in the analysis area?
   b. What are the influences and relationships of special status vascular species and their habitats with other ecosystem processes in the analysis area?
3. Survey and Manage Species and Habitats
   a. What are the natural and human causes of change between historical and current species distribution and habitat quality for survey and manage species?
4. Special Areas with Botanical Resources
   a. What are the natural and human causes of change between historical and current conditions of the Special Areas?

ISSUE: Forest Density and Vigor

Current Conditions
1. What are the current conditions and trends of the prevalent plant communities and seral stages in the analysis area?
2. What is the site index of the soils and how does it relate to present tree growth?
3. What vegetation condition classes are not meeting their growth potential?
4. What are the major mechanisms for vegetation disturbance?
5. Are there some vegetation condition classes promoting insect and disease problems?
6. Where are the tree insect and disease problem areas?

Reference Conditions
1. What was the historical tree vigor and growth pattern?
2. Were tree insects and disease a problem historically?

Synthesis and Interpretation
1. What are the natural and human causes of change between historical and current vegetative conditions?
2. What are the influences and relationships between vegetation and seral patterns and other ecosystem processes in the analysis area?
3. Which processes or casual mechanisms are most likely responsible for similarities, differences, and trends?
4. What are the implications of the changes and trends, including the capability of the analysis area to achieve objectives from existing plans?
5. What are the reasons for differences between current and reference tree growth patterns?

ISSUE*: Fire and Air Quality*

Characterization
1. What are the fire regimes?

Current Conditions
1. What role does fire currently have?
2. What vegetation conditions are contributing to high fire hazard and risk?
3. What are the current fire hazards and risks?
4. What are the high values at risk that could be impacted by a wildfire?
   a. What are the risks to public health and safety?
5. How is air quality impacted by prescribed fire and wildfires?

Reference Conditions
1. What was the historic role of fire within the analysis area?

ISSUE*: Fire and Air Quality (Continued)*

Synthesis and Interpretation

1. How have fire suppression efforts over the past 80 years caused changes between the historical and current role of fire?
2. How has the fire role change caused changes between historical and current vegetative species distribution?

ISSUE: Terrestrial Wildlife Species and Habitats

Characterization

1. Wildlife Habitat - General
   a. What is the relative abundance, distribution and character of the various habitat types found in the analysis area?
2. Threatened and Endangered Species
   a. What is the acreage, distribution and character of habitat in the analysis area?
   b. What is the role of the designated critical habitat in the analysis area?
3. Special Status/Sensitive Species
   a. What is the amount, distribution and character of habitat for those special status species that are of management concern in the analysis area?
4. Survey and Manage Species
   a. What is the amount, distribution and character of habitat for the survey and manage species found in the analysis area?
5. Deer and Elk
   a. What is the amount, distribution and character of forage and cover on the deer and elk management areas in the analysis area?

Current Conditions

1. Wildlife Habitat - General
   a. What are the current habitat conditions and trends for the various habitat types found in the analysis area?
2. Threatened and Endangered Species
   a. What are the current habitat conditions and trends for the threatened and endangered species found in the analysis area?
   b. What is the current role of habitat in the analysis area?
3. Special Status/Sensitive Species
   a. What are the current habitat conditions and trends for the special status/sensitive species found in the analysis area?
4. Survey and Manage Species
   a. What are the current habitat conditions and trends for the survey and manage species found in the analysis area?
5. Deer and Elk
   a. What are the current forage and cover conditions and trends on the deer and elk management areas in the analysis area?

ISSUE*: Terrestrial Wildlife Species and Habitats (Continued)*

Reference Conditions

1. Wildlife Habitat - General
   a. What was the historical relative abundance, condition and distribution of the various habitat types found in the analysis area?
2. Threatened and Endangered Species
   a. What was the historical acreage, condition and distribution of habitat for threatened and endangered species in the analysis area?
   b. What was the initial role of habitat for threatened and endangered species in the analysis area?
3. Special Status/Sensitive Species
   a. What was the historical amount, condition and distribution of habitat for the special status/sensitive species found in the analysis area?
4. Survey and Manage Species
   a. What was the historical amount, condition and distribution of habitat for the survey and manage species found in the analysis area?
5. Deer and Elk
   a. What was the historical amount, condition and distribution of forage and cover on the deer and elk management areas in the analysis area?

Synthesis and Interpretation

1. Wildlife Habitat - General
   a. What are the implications of natural and human caused change between historical and current relative abundance, condition and distribution of the various habitat types found in the analysis area?
2. Threatened and Endangered Species
   a. What are the implications of natural and human caused change between historical and current acreage, condition and distribution of northern spotted owl habitat in the analysis area?
   b. What are the implications of the change in role of the northern spotted owl critical habitat in the analysis area?
3. Special Status/Sensitive Species
   a. What are the implications of natural and human caused change between historical and current amounts, condition and distribution of habitat for the special status/sensitive species found in the analysis area?
4. Survey and Manage Species
   a. What are the implications of natural and human caused change between historical and current amounts, condition and distribution of habitat for the survey and manage species found in the analysis area?
5. Deer and Elk
   a. What are the implications of natural and human caused change between historical and current amounts, condition and distribution of forage and cover on the deer and elk management areas in the analysis area?

ISSUE: Hydrology

Characterization

1. What are the dominant hydrologic characteristics and other notable hydrologic features and processes in the analysis area?

Current Conditions

1. What are the current conditions and trends of the dominant hydrologic characteristics and features prevalent in the analysis area?

Reference Conditions

1. What were the historical hydrologic characteristics and features in the analysis area?

Synthesis and Interpretation

1. What are the natural and human causes of change between historical and current hydrologic conditions?
2. What are the influences and relationships between hydrologic processes and other ecosystem processes?

ISSUE: Stream Channel

Characterization

1. What are the basic morphological characteristics of stream valleys or segments and the general sediment transport and deposition processes in the analysis area?

Current Conditions

1. What are the current conditions and trends of stream channel types and sediment transport and deposition processes prevalent in the analysis area?

Reference Conditions

1. What were the historical morphological characteristics of stream valleys and general sediment transport and deposition processes in the analysis area?

Synthesis and Interpretation

1. What are the natural and human causes of change between historical and current channel conditions?
2. What are the influences and relationships between channel conditions and other ecosystem processes in the analysis area?

ISSUE*: Water Quality*

Characterization

1. What beneficial uses dependent on aquatic resources occur in the analysis area?
2. Which water quality parameters are critical to these uses?

Current Conditions

1. What are the current conditions and trends of beneficial uses and associated water quality parameters?

Reference Conditions

1. What were the historical water quality characteristics of the analysis area?

Synthesis and Interpretation

1. What are the natural and human causes of change between historical and current water quality conditions?
2. What are the influences and relationships between water quality and other ecosystem processes in the analysis area?

ISSUE*: Riparian Areas*

Characterization

1. What is the array and landscape pattern of plant communities in the riparian areas?
2. What processes caused these patterns?
3. What riparian-dependent species are present in the analysis area?
4. What are the general distribution and character of their habitats?

Current Conditions

1. What is the current species composition of riparian areas?
2. What are the current conditions and trends of riparian areas?
3. Where are sensitive areas and what are the reasons for sensitivity?
4. What are the current conditions and trends of riparian habitat for riparian-dependent species?

Reference Conditions

1. What was the historical condition of riparian areas?
2. What was the historical species composition of riparian areas?
3. What was the historical distribution and abundance of riparian-dependent wildlife species (community)?

ISSUE*: Riparian Areas (Continued)*

Synthesis and Interpretation

1. What are the natural analysis area characteristics and human activities influencing riparian areas and riparian-dependent species?
2. How have these characteristics and activities influenced or changed riparian areas and habitat for riparian-dependent species?
3. What is the effect of riparian condition on instream habitat?
4. What are the influences and relationships between riparian areas and other ecosystem processes in the analysis area?

ISSUE*: Aquatic Wildlife Species and Habitats*

Characterization

1. Habitat
   a. What is the distribution and character of aquatic habitat throughout the analysis area, especially for threatened and endangered, special status, and sensitive species?
2. Species
   a. What are the relative abundance and distribution of threatened and endangered aquatic wildlife species?
   b. What are the relative abundance and distribution of special status/sensitive aquatic wildlife species?
   c. What are the relative abundance and distribution of other aquatic wildlife species present in the analysis area?

Current Conditions

1. Habitat
   a. What are the current conditions and trends of instream habitat (e.g., quantity and quality) throughout the analysis area?
   b. What are the current conditions and trends for specific habitat needs of threatened and endangered, special status, and sensitive species?
2. Relationship of Subbasin Habitat with Rogue Basin
   a. How does instream habitat in the Upper Bear Creek Watershed Analysis Area fit into the "big habitat picture" for the Rogue Basin threatened and endangered fish stocks?
   b. How does instream habitat in the Upper Bear Creek Watershed Analysis Area fit into the "big habitat picture" for the Rogue Basin special status/sensitive fish stocks?

ISSUE*: Aquatic Wildlife Species and Habitats (Continued)*

Reference Conditions

1. Habitat
   a. What was the historical condition and distribution of instream habitats throughout the analysis area?
   b. What was the historical condition and distribution of instream habitats specific to threatened and endangered and special status/sensitive species?
2. Species
   a. What was the historical relative abundance and distribution of threatened and endangered species in the analysis area?
   b. What was the historical relative abundance and distribution of special status/sensitive species in the analysis area?

Synthesis and Interpretation

1. Habitat
   a. What are the natural analysis area characteristics and human activities influencing species distribution and instream habitat condition?
   b. How have these characteristics and activities influenced or changed instream habitat condition, in general and specifically for threatened and endangered and special status/sensitive species?
2. Species
   a. How have changes in habitat condition influenced Upper Bear Creek threatened and endangered and special status/sensitive aquatic species?
   b. What are the limiting factors for long-term sustainability of threatened and endangered and special status/sensitive aquatic species?
3. Ecosystem Processes
   a. What are the influences and relationships of aquatic species and their habitats with other ecosystem processes in the analysis area?

WATERSHED CHARACTERIZATION

The purpose of the Characterization section is to identify the dominant physical, biological, and human processes or features of the analysis area that affect ecosystem functions or conditions. The watershed analysis team identified the relevant land allocations and the most important plan objectives and regulatory constraints that influence resource management in this analysis area.

INTRODUCTION

The Upper Bear Creek Watershed Analysis Area is located in the southern Cascade range in southwestern Oregon. The southern and eastern ridges form the divide between the Rogue and Klamath River Basins. The Upper Bear Creek Watershed Analysis Area is at the upper reaches of the Bear Creek Watershed, which is within the Middle Rogue River Subbasin (Map 1). The two major streams in the analysis area are Walker and Emigrant Creeks, which join to become Bear Creek. Tributaries to Walker Creek include Frog and Cove Creeks and tributaries to Emigrant Creek include Carter, Sampson, Tyler, Baldy, Green Mountain, and Porcupine Creeks.

The Upper Bear Creek Watershed Analysis Area is within Jackson County and covers lands immediately east of the town of Ashland, including Emigrant Lake, portions of Interstate 5, and residential areas in the southernmost part of Bear Creek valley. The analysis area covers approximately 110 square miles (70,231 acres) and the elevation ranges from 1,880 feet at the confluence of Walker and Emigrant Creeks to 6,089 feet at the top of Soda Mountain.

Land Ownership

Land ownership is a mix of public and private (Table 1 and Map 2). The Bureau of Land Management (BLM) manages 16,472 acres within the analysis area. The Bureau of Reclamation (BOR) operates Emigrant Dam and Reservoir for irrigation water supply and flood control within the analysis area. Irrigation users served by the project are Talent Irrigation District (TID), Medford Irrigation District (MID), and Rogue River Valley Irrigation District. In addition to the lake surface (approximately 806 acres), the BOR also owns an additional 604 acres around the lake. Of these 604 acres, Jackson County manages (per agreement with the BOR) approximately 531 acres for public access and recreational use of the lake (Howe 2000).

The private lands within the analysis area are generally at lower elevations, with BLM parcels scattered throughout the foothills and along the crest of the mountains on the eastern boundary of the analysis area. The Nature Conservancy owns land at Sharon Lakes; major timber company owners include Boise Cascade Corporation and Lone Rock Timber Company; and Superior Lumber Company and Hillcrest Orchards own smaller amounts of forested lands.

Table 1. Land Ownership

Ownership	Acres	Percent of Analysis area
Bureau of Land Management (BLM), Medford District Ashland Resource Area	16,472	23
Bureau of Reclamation (BOR)	1,410	2
Private	52,349	75
Total	70,231	100

Federal Land Allocations

Federal land use allocations in the analysis area are shown in Table 2 and Map 3. Objectives and management actions/directions for these land use allocations are found in the *Medford District Resource Management Plan* (USDI, BLM 1995:24-40).

Table 2. Federal Land Allocations

Federal Land Allocations	Acres[1]
Late-Successional Reserve	5,744
Riparian Reserves (estimated)[2]	6,037
Matrix	10,728
Special Areas Pilot Rock Area of Environmental Concern Cascade/Siskiyou Ecological Emphasis Area[3]	 105 6,886
Special Recreation Management Area Pacific Crest National Scenic Trail (PCNST)[3]	 124

1/ Acres within the Upper Bear Creek Watershed Analysis Area.
2/ Riparian Reserves occur across all land allocations.
3/ Overlaps Late-Successional Reserve allocation

HUMAN USES

People use the Upper Bear Creek Watershed Analysis Area not only for habitation, but for a variety of recreational and economic purposes. Individually owned ranches and homes occur throughout the analysis area, primarily in the valley and foothills east and south of Ashland. Small parcel residential lots are more frequent in the west, closer to Ashland and Emigrant Lake; there are still some ranches in the foothills in the south and east. Logging and timber harvest occur on public and private lands in the higher elevations. Emigrant Lake, a dammed reservoir, is used for a variety of water sports including swimming, boating, water-skiing, jet-skiing and fishing. The popular water slide owned and operated by the county is also located there. The Pacific Crest National Scenic Trail, located along the ridge in the southern and southeast portion of the analysis area, brings hikers and horseback riders through the southern mountains.

Regional public issues reflect the dominant uses of the analysis area and include concerns with recreational activities, such as use of the Pacific Crest National Scenic Trail and off-highway vehicle (OHV) use; concerns with grazing and timber harvest on public lands; concerns over general degradation of the natural environment; concerns about fish and water quality; and concerns regarding Siskiyou/Cascade ecological linkages and diversity. In addition, there are a number of regional issues that are reflected in local concerns for this analysis area, including urban interface issues, especially issues of wildfire, fire protection, and smoke; concerns over low water flows in local streams due to irrigation withdrawals; noxious weeds; timber harvest; and the apparent re-integration of cougar populations and/or ranges into this area.

Concerns more specific to this analysis area include grazing, especially along Tyler Creek; land subdivisions and increasing homesites; and the use of Schoolhouse Creek by the Bureau of Reclamation to transport water from Howard Prairie Reservoir (in the adjacent Jenny Creek Watershed) with subsequent channel damage.

Native American Tribes

This land was formerly inhabited by the Shasta Indians, with the Klamath Tribe bordering the analysis area on the east and south along the crest of the Cascades. Surviving Shasta were removed from the analysis area at the end of the Rogue Indian Wars in 1856, and the Klamath were largely confined to a reservation in the Klamath Basin in the subsequent decades. Some Shasta were taken to reservations in northern Oregon, where their descendants are members of two federally recognized tribes: the Confederated Tribes of Grand Ronde and the Confederated Tribes of Siletz. Shasta natives also managed to survive south of the border in California, where their members are part of the federally recognized Quartz Valley Rancheria and also of the Shasta Nation. Klamath descendants are members of the federally recognized Klamath Tribes, based in Chiloquin, Oregon. These groups should be contacted concerning any projects which might affect cultural resources representing their heritage.

There are no treaty reserved rights in the analysis area. However, descendants of the Shasta and Klamath, and the tribal groups to which they belong today, are active in promoting the heritage and current welfare of their members and take a strong interest in the management of their native lands. Traditional use areas, as well as archaeological sites reflecting these peoples' history, may occur within the analysis area. The Shasta are likely to be concerned with the management of such locations anywhere in this analysis area; the Klamath are concerned with those areas along the eastern and southern boundaries of the analysis area.

Transportation System

Roads in the analysis area are owned or managed by the BLM, timber companies, Jackson County, and many private landowners. Major roads within the analysis area include Oregon State Highway 66, Highway 722 (Dead Indian Memorial), and Interstate 5. These major roads and the BLM roads are shown on Map 4.

Travel routes in the analysis area are used by cars, trucks, heavy equipment, motorcycles, bicycles, horses, pedestrians, and other modes of transportation. These routes are used for recreation, resource management, and private property access. The BLM provides a transportation system for many different recreation experiences and management opportunities.

Three road surface types are found on BLM roads: bituminous (asphalt), rocked, and natural (no surface protection). Main access roads usually have a bituminous surface, but may have a crushed rock surface. Roads off main access roads usually have a crushed rock surface, and dead end spurs generally have a natural surface. Adequately surfaced roads generally allow for year-round travel and reduce soil erosion, which helps to minimize stream sedimentation. There are developed quarries on private and federal land in the analysis area where rock may be obtained for surfacing roads and drainage protection. The BLM obtains water from developed water sources in the analysis area for road operations such as surfacing and dust abatement.

Road planning, location, design, construction, use, and maintenance are conducted with the goal of meeting transportation objectives while protecting resources. Best Management Practices from the *Medford District Resource Management Plan* (USDI, BLM 1995:149-177) provide guidance for resource protection.

CLIMATE

The Upper Bear Creek Watershed Analysis Area is characterized by mild, wet winters and hot, dry summers. During the winter months, the moist, westerly flow of air from the Pacific Ocean results in frequent storms of varied intensities. Average annual precipitation in the analysis area ranges from approximately 22 inches near the confluence of Emigrant and Walker Creeks to 38 inches at Soda Mountain (elevation 6,089 feet), 54 inches at Henry Mountain (elevation 6,040 feet), and 44 inches at Grizzly Peak (elevation 5,922 feet) (Map 5). Winter precipitation in the higher elevations usually occurs as snow, which ordinarily melts during the spring runoff season from April through June. Rain predominates in the lower elevations with the majority occurring in the late fall, winter, and early spring. A mixture of snow and rain occurs between approximately 3,500 feet and 5,000 feet and this area is referred to as either the rain-on-snow zone or transient snow zone. The snow level in this zone fluctuates throughout the winter in response to alternating warm and cold fronts. Rain-on-snow events originate in the transient snow zone. Table 3 shows the percent of each precipitation zone by subwatershed (see Hydrology) and the zones are displayed on Map 6.

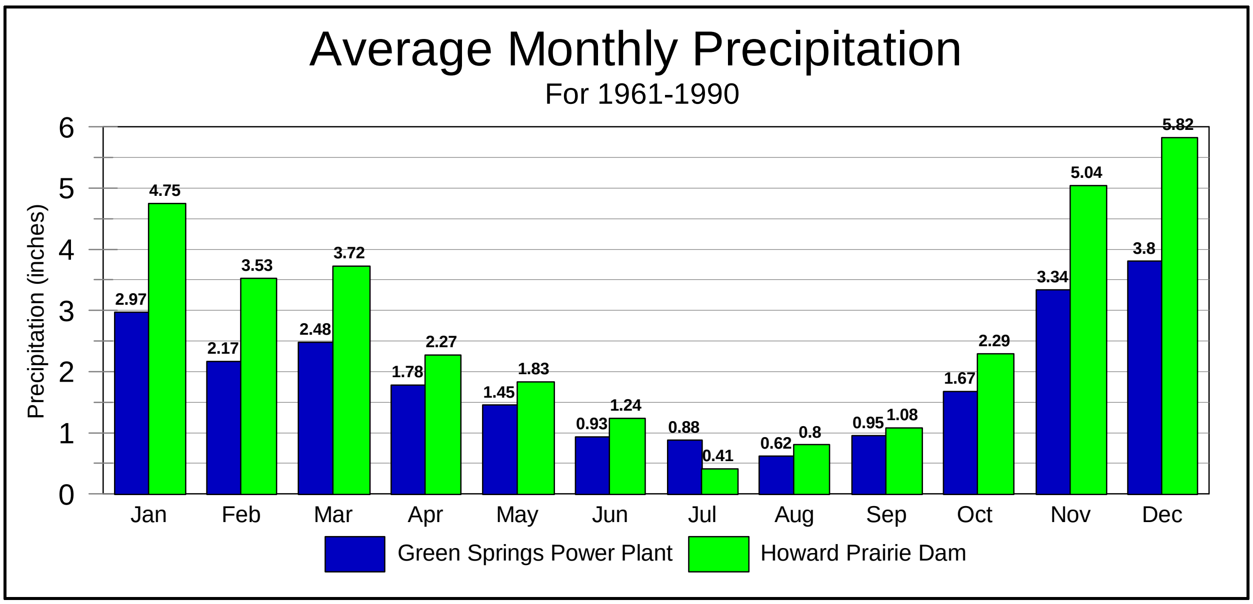
Table 3. Precipitation Zone Distribution

Subwatershed	Rainfall Zone (<3,500 ft.) (percent)	Rain-on-Snow Zone (3,500-5,000 ft.) (percent)	Snow Zone (>5,000 ft.) (percent)
Upper Emigrant Creek	36.2	56.9	6.9
Lower Emigrant Creek	64.1	31.2	4.7
Walker Creek	29.4	60.6	10.0
Total for Upper Bear Creek	41.5	51.1	7.4

Source: Medford BLM Geographical Information System (GIS)

The National Oceanic and Atmospheric Administration (NOAA) weather station at Green Springs Power Plant (elevation 2,434 ft.), located approximately eight miles southeast of Ashland, provides precipitation data for low elevations in the analysis area. The NOAA weather station at Howard Prairie Dam (elevation 4,567 ft.), located approximately six miles east of the northeastern portion of the analysis area in the adjacent Jenny Creek Watershed, provides precipitation data that is representative of high elevation areas within the analysis area. Precipitation distribution by monthly average for both stations is shown on Figure 1. The majority of precipitation falls during November through March (66 percent of the yearly total). Annual precipitation can fluctuate widely from year-to-year. The 30-year average (normal) annual precipitation at the Green Springs Power Plant station is 22.44 inches and at the Howard Prairie Dam station it is 32.78 inches (WorldClimate 1999).

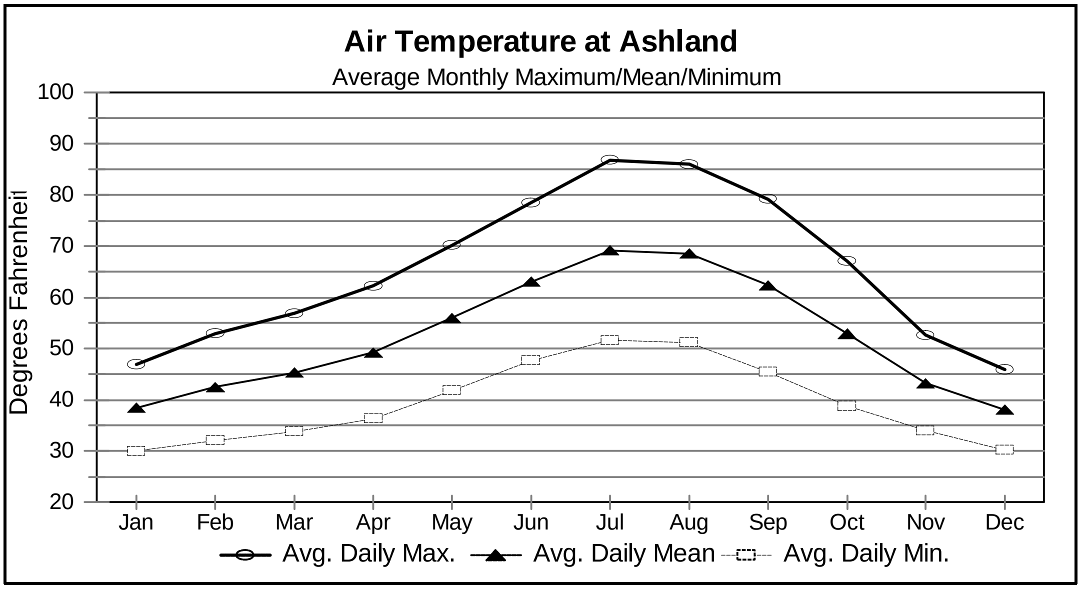
Figure 1. Precipitation at Green Springs Power Plant and Howard Prairie Dam NOAA Stations



Source: WorldClimate 1999

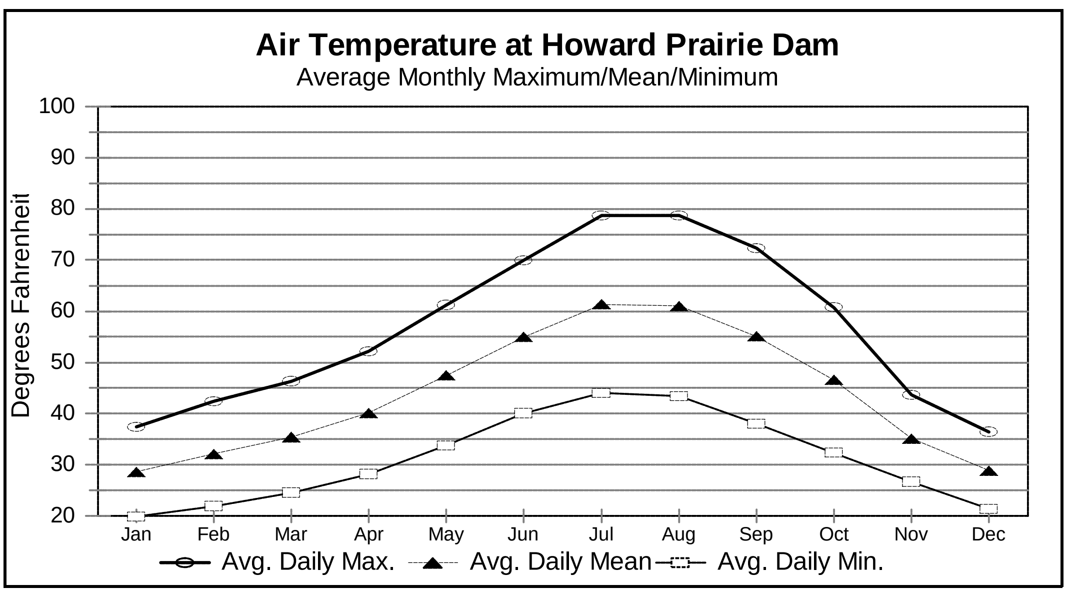
During the summer months, the area is dominated by the Pacific high pressure system, which results in hot, dry summers. Summer rainstorms occur occasionally and are usually of short duration and limited area coverage. The nearest NOAA weather stations with air temperature data are located at Ashland, elevation 1,748 feet (approximately two miles west of the analysis area) and Howard Prairie Dam, elevation 4,567 feet (approximately six miles east of the analysis area). Average monthly maximum, mean, and minimum air temperatures for these two stations are displayed in Figures 2 and 3.

Figure 2. Air Temperature at Ashland NOAA Station (1961-1998)



Source: Oregon Climate Service (1999)

Figure 3. Air Temperature at Howard Prairie Dam NOAA Station (1961-1998)



Source: Oregon Climate Service (1999)

Current climatic patterns need to be viewed with a long-term perspective. Based on tree-ring growth rates and recorded meteorological data, the past 200 to 300 years have been marked by cycles of hot, dry spells and temperate-to-cool weather that have lasted varying periods of time (LaLande 1995).

GEOLOGY

The Upper Bear Creek Watershed Analysis Area is located primarily in the Cascade Mountain Geologic Province with a small portion in the Klamath Mountain Geologic Province. The Cascade Mountain Province is divided into two belts (subprovinces) that trend north and south. The older, deformed rock on the west is referred to as the Western Cascade Subprovince, and the undistorted rock is on the top and east flank is the High Cascades Subprovince. The Upper Bear Creek Watershed Analysis Area lies mainly within the Western Cascade Subprovince with a small portion in the Siskiyou Mountain Subprovince of the Klamath Mountain Province.

Western Cascades Subprovince

The Western Cascades rest on top of, or adjacent to, the Klamath Mountains. The Western Cascades developed mainly from shield volcanos. A majority of the Western Cascades are dominated in this analysis area by lava flows of basaltic andesite, basalt, and andesite. These lavas are interlayered with softer pyroclastic flows of andesitic tuff, basaltic breccia, ash flow tuff, dacite tuff, and andesitic breccia (Appendix B and Map 7). These pyroclastic materials often interfinger with the lavas making the area subject to landsliding or soil movement during rain-on-snow or intense storm events.

Volcanic activities/eruptions of the Western Cascades were constructional features during the early formation of the Cascade Mountains. Geologic mapping and potassium-argon ages suggest that Cascade Range volcanism was widespread approximately 35 million years ago (Sherrod and Smith 1989). Fluid basaltic lavas from small, broad shield volcanos built the ancient topography into a more gentle and flatter mountain range.

During late Oligocene (35 million years ago) and early Miocene (25 million years) time, basaltic and andesitic volcanos of moderate height grew and lavas were erupted onto mountainous terrain and filled valleys (Kienle et al. 1981). Dacitic pyroclastic flows from distant sources were erupted and intermittently deposited in some of the lowland areas between and over portions of the basalt and andesite lava flows from larger stratovolcanos to the north. These softer rock types were eventually covered, at least partially, by newer lava flows and pyroclastic eruptions.

Following their formation, the Western Cascades were severely eroded and virtually buried beneath the younger High Cascade as a result of shield volcanoes that erupted seven to three million years ago. These volcanoes form gently sloping land beginning at about 3,500 feet and rise to near 5,000 feet above sea level. Tectonic plate movement began to uplift the Cascade Province. As the Western Cascades were uplifted, erosion tended to remove the “soft” Western Cascade slopes at a faster rate than the “hard” valley-filling lava flows of the High Cascades. This differential erosion over millions of years has resulted in an inversion of topography, with massive rock outcrops (old valley floors) now capping ridge tops.

The Ice Age began about two million years ago and was a time of glaciation on the landscape. Glacial erosion produced cirques, U-shaped valleys and glacial moraines. The Ice Age climate included cold periods during which glaciers formed and advanced downslope, and warm dry periods similar to today’s climate. The wet periods were conducive to development of landslides and earthflows. The retreat of the glaciers also left many over steepened headwalls and sideslopes that were not capable of maintaining stability.

Soil Development

By 10,000 years ago, the glaciers had disappeared, and the warm dry climate of the Holocene Epoch began. The interactions, through time, of climate, living organisms, parent materials, and topographical relief resulted in the development of soil. Most of the soil that originally formed alluviated to the valley floor. As the valley floor began to fill with soil it created a base for soil to accumulate on the mountain toe slopes and side slope depressions. Wet climatic periods would cause the soil to move down the landscape resulting in discontinuity of depth.

The soils and topography that formed in this analysis area were directly influenced by the weatherability of the parent material. The strata of hard andesite and basalt include soft breccia and tuffaceous rock. The soils in areas that receive a greater amount of precipitation tend to be moderately deep and well developed due to the interacting influences of the basic mineralogy of the volcanic parent material and the accumulation of organic matter.

Soils that formed in material weathered from hard andesite and basalt are shallow and medium textured. Other soils in this analysis area that not only formed from hard bedrock but also were influenced by soft, easily weathered tuff and breccia are fine textured and often have an argillic horizon. In the southwestern portion of the analysis area, soils formed from granitic rock are generally moderately deep over decomposed bedrock and are highly erosive as a result of low cohesive coarse textured particles.

Refer to the General Soil Types Map (Map 8) for location of soils across the landscape and to Appendix C for soil descriptions.

EROSION PROCESSES

There are three main erosion processes in the Upper Bear Creek Watershed Analysis Area: mass wasting, surface erosion, and channel cutting. Mass wasting and surface erosion are responsible for the majority of annual sediment transport to streams in the analysis area.

Mass Wasting

Mass wasting is a term for describing a wide variety of processes that involve natural or human-caused downslope movement of masses of soil and rock material. The term "landslide" is commonly used as a blanket term that covers several modes of slope instability (Haneberg and Sims 1995). When these processes are active, as they were during the January 1997 storm, large adjustments in stream channels and hillslopes can occur (Haneburg and Sims 1995). Landslides can transport material rapidly as in the case of debris torrents, or occur slowly as with earthflows or creep movement. These mass wasting events often cause adverse impacts to fisheries habitat by depositing large volumes of sediment into the streams. Roads, bridges, and culverts are often damaged when major flood events, such as the 1964, 1974, and 1997 floods, trigger landslides.

Large portions of the Western Cascades and the western edge of the High Cascades Subprovince in the Upper Bear Creek Watershed Analysis Area are moderately stable to unstable due to steep slopes, moderate precipitation rates, and the natural weakness of many of the volcanic soil/rock types. The many sag ponds in the Sharon Fen area at the headwaters of Frog Creek are the result of unstable slopes. Other areas of landslide deposits are the headwalls of Walker, Cove, Sampson, Tyler, Baldy, and Emigrant Creeks.

Surface Erosion

Surface erosion is the detachment and transport of individual soil particles or small aggregates from the land surface (Satterlund and Adams 1992). It is caused by the action of rain-drops and surface runoff. Surface erosion can move soil particles a small distance or transport large volumes of sediment to streams every year. It may remove soil in more or less thin layers (sheet erosion), in rills, or in gullies. Rills and gullies occur most often when surface water runoff is concentrated and confined into narrow spaces, especially on coarse-grained soils. On steep, dry slopes, gravity alone may be sufficient to cause movement (ravel) (Satterlund and Adams 1992). Surface erosion generally occurs in areas where bare soil is exposed by roads, fire, timber harvesting, grazing, or land development. The largest volumes of sediment are moved during intense, long-duration storms. The main factors influencing surface erosion in the Upper Bear Creek Watershed Analysis Area are high intensity storms, rain-on-snow events, clay or granitic soil types, and high water velocities.

Channel Cutting

Channel cutting is the detachment and movement of material from a stream channel. It may result from the movement of individual particles, as in shifting grains of sand in bars, or from mass movement, as when a large part of an undercut bank falls and is swept downstream (Satterlund and Adams 1992).

SOIL PRODUCTIVITY

Soil of the Upper Bear Creek Watershed Analysis Area serves two important functions: it is the primary medium for most vegetative life in the analysis area, and it filters and stores water that is slowly released into the nearby stream courses.

Soil productivity is the capability of a soil to produce a specified plant or sequence of plants under specific management (USDA 1993). Soil productivity of forest lands is largely defined in terms of site quality, which is measured by the volume of timber the land can produce in a given time. Site quality within a given microclimate is associated with the soil’s capacity to provide moisture and nutrients. The soil’s ability to provide moisture is dependent on the texture, depth, and rock fragment content in the rooting zone. The soil’s ability to provide nutrients necessary for plant growth is dependent on soil organisms and organic matter content. Beneficial soil organisms control many biological processes within the soil, such as organic matter decomposition, nitrogen fixation, and plant nutrient uptake (Amaranthus et al. 1989). A cool, moist environment with an abundance of suitable organic matter encourages the growth and productivity of these organisms.

Surface duff and woody material insulate the soil layer and keep soil conditions cool and moist. Therefore, the depth of surface duff and the abundance of downed woody material is a good indication of site productivity. Generally, the more productive forest soils are found in areas of higher precipitation, on northerly aspects adjacent to streams, or in areas of dense forest canopy.

LANDSCAPE VEGETATION PATTERN

Landscape Patterns

The present day vegetation pattern across the analysis area landscape results from the dynamic processes of nature and human influences over time. As a consequence, the variation and scales of landscape components are innumerable.

Landscape ecological analysis and design are not new concepts, but have been brought to the forefront of natural resource management with the concept of ecosystem-based management. Landscapes are thought of as aggregates of similar patches of vegetation and landforms that originate through climatic influences, geomorphic processes, natural disturbances, human activities, and plant succession (Forman and Godron 1986), or the relationships among species that compose the community. Diaz and Apostol (1992) describe landscapes as having three elements: matrix, patches, and corridors. Matrix is defined as the most contiguous vegetation type; patches are areas of vegetation that are similar internally, but differ from the vegetation surrounding them; and corridors are landscape elements that connect similar patches through a dissimilar matrix or aggregation of patches. Ecological analysis of the landscape considers the processes that form the landscape patterns, the arrangement and extent of various vegetative types, and the three-dimensional shape of the land, along with causes and rates of change.

The west/central portion of the Upper Bear Creek Watershed Analysis Area has a grassland matrix. This grassland matrix extends to approximately 2 miles east of Emigrant Lake. The remainder of the analysis area has a forest land matrix with patches of grassland, shrubland, and woodland interspersed. Dry, rocky, southwest facing slopes and anthropogenic disturbances are the main factors contributing to the irregular patch shape and chaotic arrangement of patches across the landscape. Rock outcrops and rocky surfaces are common throughout the analysis area.

Human activity is the primary reason for the large number of small patches in the forest area. Patch density is high within the forest matrix because only merchantable timber was logged or overstory trees were sometimes left. Other contributing factors include topography, aspect changes, soil differences, plant succession, and the edge effect between the different forest seral stages. The result is a close proximity between neighboring patches and an extreme richness in the number of landscape elements.

Vegetation Classification

The vegetation of the Upper Bear Creek Watershed Analysis Area is extremely diverse. This diversity applies to the many plant communities that are present and the interactions of the organisms which compose these communities. Franklin and Dyrness (1973) classify the vegetation of the analysis area into four distinct zones based on climax species: Mixed Conifer and Mixed Evergreen, White Fir, White Fir and Douglas-fir, and Ponderosa Pine zones (Map 9). The classification system is based on elevation, temperature, and moisture. As a result, bands or layers of vegetation create the landscape pattern. At a lower level of dichotomy, Atzet and McCrimmon (1990) describe plant associations within the forest zones. Some of these associations are discussed in the Current Conditions section.

A different vegetation pattern is evident when the vegetation structure (various seral stages of the endemic vegetation types and the inherent height differences) is analyzed within each vegetation zone. The vegetation pattern becomes more complex when more structural components are included in the analysis. A patchy vegetation pattern is the result of different vegetation diameter and height classes, topoedaphic influences, and disturbances. The vegetation map (Map 10) is derived from Western Oregon Digital Image Processing (WODIP) satellite imagery data (Pacer Infotec Inc. 1993). The satellite imagery map categorizes the vegetation into various vegetation types, landform types and seral stages. The percent composition of each plant classification in the analysis area is shown in Table 4.

Table 4. Structural Components by Vegetation Classification

Vegetation Classification	**Percent of Analysis area**	**Description**			
Water	1				
Grass	21				
Shrubland	17	Areas of mainly endemic shrub species.			
Hardwoods	11	Defined as all hardwoods regardless of size or canopy closure.			
Early Seral	19	Originally defined as recent clearcut but may also include grassland.			
		DBH[1]	**Vegetation Type**	**Structure**	**% Canopy Closure**
Poles	25	<10"	conifer & mixed	all stories	all closures
Mid Seral	5	10-19"	conifer & mixed	all stories	all closures
Mature/Old-growth	1	>20"	conifer & mixed	all stories	<65
		>20"	conifer & mixed	1 story	≥ 65
		>20"	conifer & mixed	2 story	≥ 65
		>30"	conifer & mixed	2 story	≥ 65

1/ Diameter at Breast Height

Source: Western Oregon Digital Image Processing (one pixel = 25 meters)

Seral Stages

Natural succession will be continuously changing the landscape vegetation and there is no single stage of a forest that can be considered to be the only natural stage. Most of the vegetation appears to be in the early (0 to 10 years) and pole size (approximately 11-80 years) classes. Trees in these size classes appear to be evenly distributed across the analysis area. Mid-size timber (11 to 21 inches DBH), when it is present, is found in larger patches. There is a paucity of mature/old-growth timber in large patches in the analysis area. This is probably due to the fact that most of the forest land has a south to west aspect.

Major Processes Influencing the Landscape Pattern

During the last decade, drought in combination with stand overstocking has contributed to low tree vigor. As a result, bark beetles have killed millions of board feet of timber across the landscape. In the white fir zones, root rot diseases (*Fomes annosus* and *Phellinus weirii*) are responsible for creating openings in the forest canopy layer. Douglas-fir dwarf mistletoe is creating openings in the Douglas-fir timber stands.

Other processes influencing the landscape pattern include the encroachment of non-native species and natural plant succession, animal damage to trees, soil frost action, fire, and fire suppression. Fire suppression has allowed plant communities to progress towards climax conditions. All of these processes are slowly shifting the forests from the stem exclusion stage to the understory reinitiation stage and old-growth stages of forest stand development. Silvicultural practices may help to speed up the forest stand development process and maintain certain plant communities.

Timber harvesting has had a noticeable effect on the landscape vegetation pattern especially on private lands south of Highway 66. This is the reason for so much vegetation in the early-to- pole size classes. Harvesting has also decreased the amount of forest land in the mid-to-mature size classes.

PLANT SPECIES AND HABITATS

Non-Native Plant Species and Noxious Weeds

There are innumerable non-native plant species established in the analysis area. Many of these are on the valley floor and in the low foothills where human disturbance has been most intense and climate is most favorable for the invaders. In these areas, the majority of the biomass of herbaceous vegetation is composed of non-native species. They are also abundant and often dominant in moist mountain meadows at higher elevations and other disturbed open areas where seeding has occurred in the past.

Noxious weeds designated by the Oregon Department of Agriculture (ODA) are divided into three groups: “T” (target list which are the highest priority for control), “A” (second highest priority for control), and “B” (third highest priority for control). Current data in the Upper Bear Creek analysis area identified three noxious weed species: yellow starthistle (“T”), Canada thistle

(“A”), and spotted knapweed (“B”). BLM range monitoring identified two additional noxious weed species in the analysis area: St. Johnswort (Klamath weed) (“B”), and medusahead wildrye (“B”). Other noxious weeds that are known to occur in the surrounding area and have the potential to spread to the Upper Bear Creek analysis area are: squarrose knapweed (“T”), skeletonweed (“T”), rush skeletonweed (“T”), purple loosestrife (“A”), dodder (“B”), meadow knapweed (“B”), and diffuse knapweed (“B”). Descriptions of the noxious weed that have been found in the analysis area and those species posing a threat are described in Appendix D.

Non-native species that have not been designated as noxious weeds by the ODA have also been seen in the analysis area: ripgut brome, softchess, cheatgrass, bulbous bluegrass, orchard grass, and hedgehog dogtail.

Special Status Plant Species and Habitats

Ten populations (eight species) of special status vascular plant species are known to exist in the Upper Bear Creek Watershed Analysis Area. Special status plants are those species whose survival is of concern due to: their limited distribution; low number of individuals or populations; and potential threats to their habitat. Generally, it is BLM policy to manage for the conservation of special status plants and their associated habitats and ensure that actions authorized, funded, or carried out do not contribute to the need to list any species as threatened or endangered.

Management categories for special status plant species:

a. listed as threatened or endangered by the U.S. Fish and Wildlife Service (USFWS).
b. proposed for listing as threatened or endangered by the USFWS.
c. identified as candidates for listing as threatened or endangered by the USFWS.
d. listed as threatened or endangered by the Oregon Department of Agriculture (ODA).
e. identified as candidates for listing as threatened or endangered by the ODA.
f. designated as Sensitive in Oregon by the BLM.
g. designated as Assessment in Oregon by the BLM.
h. designated as Tracking in Oregon by the BLM.
i. designated as Watch in Oregon by the BLM.

Rules, guidelines and recommendations for managing these species are addressed in the Endangered Species Act of 1973, Oregon Administrative Rule 603-073, and BLM Manual Section 6840.

Survey and Manage Plant Species and Habitats

Fourteen sites (six species) of Survey and Manage plants are known to exist in the Upper Bear Creek Watershed Analysis Area. Survey and Manage plant species include species of vascular plants, mosses, liverworts, hornworts, lichens, and fungi. Fungi are included in the plant group, however, taxonomically they are considered a separate kingdom. The standards and guidelines for these species are addressed in the Northwest Forest Plan (USDA and USDI 1994a) and are designed to benefit these species.

The four survey strategies, or components, are:

a. Manage known sites. Highest priority with appropriate action usually, protection.
b. Survey prior to ground-disturbing activities. Designed to locate new sites of rare species and establish management sites.
c. Conduct extensive surveys. Designed for difficult to survey for species.
d. Conduct general regional surveys. Designed to gather information for species particularly poorly known.

Protection Buffers are additional standards and guidelines for specific rare, locally endemic, and other species in the upland forest matrix.

Management recommendations have been developed for 12 species of vascular plants (BLM Instruction Memorandum (IM) OR-99-27), five species of bryophytes (IM OR-99-039), and 151 species of fungi (IM OR-98-003). Draft management recommendations are being reviewed for 18 species of bryophytes (IM OR-97-027). Species without management recommendations would use information in Appendix J2 of the *Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl* (USDA and USDI 1994b).

Special Areas with Botanical Resources

Pilot Rock Area of Critical Environmental Concern (ACEC)

The Pilot Rock ACEC was established to protect and prevent irreparable damage to important historic, scenic, wildlife, geological, and botanical values. The ACEC is 544 acres of which 105 acres are within the watershed boundary. No timber harvest or OHV use is allowed in the ACEC, also, mineral leasing is subject to the no surface occupancy special stipulations.

Cascade/Siskiyou Ecological Emphasis Area (CSEEA)

The Upper Bear Creek analysis area lies partly within the CSEEA. The *CSEEA Draft Management Plan/Environmental Impact Statement* (USDI, BLM 2000b) analyzes alternatives to provide coordinated management of this biologically diverse area that includes the Soda Mountain Wilderness Study Area, two Research Natural Areas, two ACECs, the Jenny Creek Late-Successional Reserve, and the Pacific Crest National Scenic Trail. The area has unique ecological values due to its location near the boundaries of the Cascade, Siskiyou, and Coast Range mountains and the Great Basin Desert. Timber harvest is deferred pending completion of the CSEEA management plan.

FIRE AND AIR QUALITY

Fire is recognized within the Northwest Forest Plan as a key natural disturbance process throughout the Cascade Mountain Geologic Province. An areas' fire regime is determined by the combination of climate, topography, and vegetation. Fire regime is a broad term that includes fire type, intensity, size, and return interval.

There are two broad categories of fire regimes within this analysis area: low and moderate. A low severity regime is characterized by frequent fires of low intensity with a fire return interval typically less than 25 years. Moderate-severity regimes are characterized by less frequent fires (25 to 100 years) and burn with different degrees of intensity. Stand replacement fires occur within this regime as well as low intensity fires. The overall effect of fire on the landscape is a mosaic burn.

Vegetation zones are helpful in delineating fire regimes. The zones listed in Table 5 are taken from *Vegetation of Oregon and Washington* (Franklin and Dyrness 1973).

Table 5. Vegetation Zones by Elevation

Elevation (feet)	Southern Cascade Vegetation Zones
6,562-4,811	White Fir/Shasta Red Fir
4,811-3,058	Mixed Conifer
3,058-1,419	Interior Valley

The fire regime is classified as a low severity regime in the lower elevation Interior Valley Vegetation Zone. Currently much of the lower elevation areas have dense shrubs, hardwoods and scattered conifer vegetation conditions. Fires within the shrub and hardwood areas were widespread and frequent and burned with lower intensity. Low severity fires generally maintain vegetation conditions across the landscape.

The fire regime is classified as moderate in the mid-elevations of the Mixed Conifer Vegetation Zone and drier portions of the White and Red Fir Zone. Fire return intervals for these areas range from 8 to 125 years with an average of about 35 years. Moderate severity fires generally produce a mosaic of low severity and stand replacement fire across the landscape.

Air quality within the analysis area is influenced by weather conditions and emissions sources. Emission sources that are most likely to adversely affect the air quality at the watershed scale are likely to be fires within the region during the summer months. Prescribed burning operations may produce local impacts to air quality during the fall, winter, and spring months. Prescribed burning operations within the watershed are usually managed to reduce the likelihood of smoke impacts to populated areas such as the Medford-Ashland area.

TERRESTRIAL WILDLIFE SPECIES AND HABITATS

The plant communities and their associated vegetative classifications, as described in the Landscape Vegetation Pattern section, provide habitat for the variety of wildlife species found in the Upper Bear Creek Watershed Analysis Area. Approximately 260 wildlife species are known or suspected to use habitat in the analysis area for breeding, feeding, or resting.

The northern spotted owl and bald eagle, both listed as threatened under the Endangered Species Act of 1973, as amended, are present in the analysis area. There are 9 northern spotted owl nest sites/activity centers, and 1 bald eagle nest site. Approximately 9,725 acres of the analysis area are in northern spotted owl critical habitat unit (CHU) OR-38. Approximately 5,735 acres of the CHU are also in the Jenny Creek/Soda Mountain LSR.

Nineteen special status species (see Table C-1, *Medford District Record of Decision and Resource Management Plan*, USDI, BLM 1995) are known or suspected to be present in the analysis area: 2 amphibians, 3 reptiles, 11 birds, and 3 mammals. These species are either federally-listed as threatened, or are BLM sensitive or assessment species. Several of the Survey and Manage and Protection Buffer species designated in the Northwest Forest Plan (USDA and USDI 1994a) are also known to be present in the analysis area: great gray owl, silver-haired bat, blue-grey tail-dropper, and Oregon shoulderband.

The Emigrant Creek Deer Winter Range and a portion of the Grizzly Peak Elk Management Area are within the analysis area. Management objectives for these areas are addressed in the *Medford District Resource Management Plan* (USDI, BLM 1995).

HYDROLOGY

For purposes of the hydrology discussion, the Upper Bear Creek Watershed Analysis Area is stratified into three subwatersheds: Upper Emigrant Creek, Lower Emigrant Creek, and Walker Creek (Map 11).

Hydrologic Features

Rock formations in the analysis area consist of low permeability rocks capable of yielding only small quantities of groundwater usually adequate for domestic or livestock use or other small uses (OWRD 1985). Numerous wells exist in the area surrounding Emigrant Lake and they are primarily used for domestic or household use.

Surface water in the Upper Bear Creek Watershed Analysis Area includes streams, springs, lakes, wetlands, reservoirs, and ditches. There are approximately 511 stream miles in the Upper Bear Creek Watershed Analysis Area. Emigrant Creek is a fifth order stream at the mouth and Walker Creek is a fifth order stream at the mouth. Bear Creek starts as a sixth order stream below the confluence of Emigrant and Walker Creeks. Major tributaries to Walker Creek include Frog and Cove Creeks. Major tributaries to Emigrant Creek include Sampson, Carter, Tyler, Baldy, Green Mountain, and Porcupine Creeks.

Table 6 displays area, ownership, stream miles, and stream density by subwatershed.

Table 6. Ownership and Stream Information by Subwatershed

Subwatershed	Area (acres)	Area (sq. mi.)	Ownership (percent)		Total Stream Miles	Stream Density (mi./sq. mi.)
			BLM	Private		
Upper Emigrant Creek	25,108	39.2	30	70	184.5	4.7
Lower Emigrant Creek	19,636	30.7	21	79	101.3	3.3
Walker Creek	25,487	39.8	19	81	224.9	5.7
Total for Upper Bear Creek	70,231	109.7	23	77	510.7	4.7

Source: Medford BLM Geographical Information System (GIS)

Table 7 displays stream miles by Northwest Forest Plan stream category (fish-bearing, permanently flowing nonfish-bearing, and intermittent streams) for BLM-administered lands. None of the nonfish-bearing streams have been inventoried to determine whether they are permanently flowing or intermittent. However, an approximation obtained from aerial photos was made to estimate miles of nonfish-bearing perennial and intermittent streams. Stream categories are displayed on Map 12.

Table 7. Stream Miles by Stream Category for BLM-Administered Lands

Subwatershed	Northwest Forest Plan Stream Category for Riparian Reserves			Total Stream Miles with Riparian Reserves
	Fish-bearing Streams Miles	Perennial Nonfish-bearing Streams[1] Miles	Intermittent Streams[1] Miles	
Upper Emigrant Creek	2.2	5.7	39.6	47.5
Lower Emigrant Creek	0.7	5.5	21.2	27.4
Walker Creek	0.3	0.7	26.9	27.9
Total for Upper Bear Creek	3.2	11.9	87.7	102.8

1/ Stream category estimated from aerial photos.
Source: Medford BLM GIS

Wetlands identified by the U.S. Fish and Wildlife Service in their 1984 National Wetlands Inventory are shown on Map 13. Wetlands in the Upper Bear Creek Watershed Analysis Area are classified as palustrine (ponds), lacustrine (lakes), or riverine systems. Many of the wetlands were created by excavations or dike construction. Table 8 summarizes information by subwatershed for palustrine and lacustrine systems. Additional wetlands may be located during site-specific project analysis.

Table 8. Wetlands

Subwatershed	Palustrine System		Lacustrine System	
	Acres	Number	Acres	Number
Upper Emigrant Creek	36.5	46	---	---
Lower Emigrant Creek	92.5	56	510.6	8
Walker Creek	75.8	83	---	---
Total for Upper Bear Creek	204.8	185	510.6	8

Source: USFW National Wetlands Inventory (USDI, FWS 1984)

Numerous springs in the analysis area are shown on the 7.5 minute USGS topographic map, particularly in the headwater areas. Lithia and Buckhorn springs are known for their mineral waters.

Hobart Lake (6 acres) is formed from an old slump on private land in the headwaters of Tyler Creek below Hobart Bluff. During the 1950s it was used for a muskrat operation. It is not known whether the operation affected the natural water levels of the lake. Icehouse Lake can be seen from the Dead Indian Memorial Highway in upper Frog Creek, which is a tributary to Walker Creek. Sharon Fen and associated lakes formed by old slumps are in the headwaters of Frog Creek. Sharon Fen is on Nature Conservancy land. In addition, there are several small ponds on private land in upper Cove Creek.

Emigrant Lake is the largest reservoir within the Bear Creek Watershed. At maximum pool elevation, the reservoir covers approximately 806 surface acres and has a total storage capacity of 40,500 acre-feet and an active capacity of 39,000 acre-feet (USDI, BOR 1995). It is operated by the Bureau of Reclamation for irrigation water supply and flood control. The reservoir was completed in 1924 with a usable capacity of 6,000 acre-feet. It was enlarged to its current capacity in 1960. There are no provisions for minimum releases from Emigrant Dam or providing minimum flows in Emigrant Creek. In many years, water is not released from the lake from the end of September to the end of March. During these periods, flows in Emigrant Creek immediately downstream from the dam consist of groundwater inflow and normal leakage past the dam (USDI, BOR 1995).

The Bounds Reservoir is a fairly large privately owned reservoir that is in Emigrant Creek below the Emigrant Dam. There are numerous ditches and small privately constructed reservoirs scattered throughout the analysis area.

Hydrologic Characteristics

The operational United States Geological Survey (USGS) gaging station that is closest to the analysis area is located downstream on Bear Creek below Ashland Creek. A USGS gaging station operated sporadically between 1920 and 1986 on Emigrant Creek 0.1 mile downstream of the Emigrant Dam. Stream gages have also been discontinued in the West and East Forks of Ashland Creek which is just west of the analysis area. Table 9 summarizes information regarding the operational and discontinued USGS gaging stations in or near the analysis area.

Table 9. USGS Gaging Stations

Station	Period of Record (water year)	Drainage Area (mi.^{2})	Extreme Discharges		Average Annual Discharge (cfs)	Average Annual Runoff (acre-feet/yr.)
			Maximum (cfs)	Minimum (cfs)		
Bear Creek below Ashland Creek	1990-1997	168	12,000	0.33	87.6	63,480
Emigrant Creek below Emigrant Dam	1925 1927-1930 1934-1935 1941-1947 1954-1986	64.3	5,260	0	34.0	24,630
East Fork Ashland Creek	1925-1932 1954-1960 1976-1982	8.14	335	0.47	9.37	6,790
West Fork Ashland Creek	1925-1932 1954-1960 1976-1982	10.5	330	1.3	8.92	6,460

Source: U.S. Geological Survey Water Resources Data (USDI, GS 1982, 1986, and 1997).

The discharge above the discontinued USGS gaging station for Emigrant Creek has been regulated since 1924 by Emigrant Lake. There are several diversions upstream of the station that are used for irrigation in the Ashland-Medford area. The principal diversion canals are the Ashland lateral and East lateral. From June 1923 to August 1960, water was diverted by the Keene Creek Canal from the Klamath River Basin into Emigrant Creek upstream from the gaging station. Beginning May 1960, water from Keene Creek Reservoir, in the Klamath River Basin, was diverted via canal and penstock to the Green Springs Power Plant located on Emigrant Creek approximately two miles upstream of Emigrant Reservoir. Water is used at the power plant to generate electricity and is then stored in Emigrant Lake. The electrical output meter is located in the powerhouse in T. 40. S., R. 2 E., Sec. 2, SWNE, 8 miles southeast of Ashland. This diversion includes water from South Fork Little Butte Creek (north and east of the analysis area) that is transported to Howard Prairie Lake via the South Fork Little Butte and Dead Indian collection canals. Water is transported from Howard Prairie Lake to Keene Creek Reservoir via the Howard Prairie Canal. The Keene Creek Reservoir has a capacity of 315 ac-ft, which provides temporary storage for releases from Howard Prairie Lake and Hyatt Reservoir.

Water diverted to the Green Springs Power Plant is occasionally transported down Schoolhouse Creek, which is a tributary to Tyler Creek. This occurs when the regular transport system is undergoing maintenance or repair.

Streamflow in the two mile stretch of Emigrant Creek below the power plant varies dramatically depending on demands for electricity and the need for stored water in Emigrant Reservoir. The streamflow in Emigrant Creek downstream of Emigrant Dam also fluctuates widely. As the reservoir is being filled in the winter months, the stream channel is often de-watered between October and April. Then as the irrigation season begins in April, stored water is released down Emigrant Creek and into canals at the dam and the power plant.

Although no streamflow data exists for the unregulated tributaries to Emigrant Lake, it can be assumed based on flow information from other unregulated streams in the Rogue Basin that flows generally follow the seasonal precipitation pattern. Moderate to high flows generally occur from mid-November through May. Streamflows during the months of April and May and part of June are augmented by melting snowpack in the high elevations. Low flows normally coincide with the period of low precipitation from July through September or October.

STREAM CHANNEL

The Oregon Department of Fish and Wildlife (ODFW) completed physical stream surveys in 1997 for upper reaches of Emigrant Creek (above the mouth of Tyler Creek) and Sampson Creek (ODFW 1997). Data from these surveys are used extensively in this analysis. Also, Level I Rosgen channel morphology classification (Rosgen 1996) has been done for streams in the analysis area (Map 14). Channel types are summarized in Table 10 and discussed in greater detail in Current Conditions (Appendix E provides descriptions of Rosgen morphological stream types).

Table 10. Stream Channel Types

Subwatershed	Stream Types							
	Aa+ (miles)	A (miles)	B (miles)	DA (miles)	E (miles)	F (miles)	G (miles)	Total Stream miles
Upper Emigrant Creek	142.9	31.4	1.3	0.0	0.0	5.8	3.1	184.5
Lower Emigrant Creek	63.3	22.0	4.8	1.0	0.0	3.4	6.8	101.3
Walker Creek	124.8	80.6	10.5	0.0	1.4	2.8	4.8	224.9
Totals	331.0	134.0	16.6	1.0	1.4	12.0	14.7	510.7

The streams in the analysis area cover a wide variety of channel characteristics, ranging from Rosgen type Aa+ to type G. Emigrant Creek downstream of Emigrant Reservoir has a Type B channel with a low gradient. It is a riffle dominated stream within a moderately entrenched channel. Sediment and gravels are trapped by Emigrant Reservoir and are not transported through this portion of the stream.

Emigrant Creek between Emigrant Reservoir and Green Mountain Creek, and the lower reaches of Walker, Sampson and Carter Creeks fall into the F type of channel. These channels are entrenched, but they meander through narrow valleys with low to moderate gradients. All of these channels have limited floodplains, consequently most transported material is moved through the system and is deposited in Emigrant Reservoir. Fines, cobble, and bedrock are the dominant substrate materials in these stream reaches. Stream gradient is low and averages around 2 to 4 percent.

Most upper reaches of Emigrant Creek and its tributaries are characterized by steep gradients and V-shaped valleys. Most of these stream channels are type Aa+. The gradient is steep, usually greater than 10 percent, and the channels are entrenched and confined by steep hillslopes (ODFW 1997). Transported material is quickly moved through these reaches. Substrate is mostly bedrock and cobble.

The ODFW survey concluded that there is a lack of large-diameter wood throughout upper Emigrant and Sampson Creeks. This appears to be the case with most of the streams in the analysis area.

WATER QUALITY

The Oregon Department of Environmental Quality (DEQ) has designated the following beneficial uses for the Upper Bear Creek Watershed Analysis Area: domestic water supply (municipal and private), industrial water supply, irrigation, livestock watering, anadromous fish passage, salmonid fish rearing, salmonid fish spawning, resident fish and aquatic life, wildlife and hunting, fishing, boating, water contact recreation, aesthetics quality, and hydro power (ODEQ 1992). The designation of beneficial uses is important because it determines the water quality criteria that will be applied to that water body. Water quality standards are typically designed to protect the most sensitive beneficial uses within a waterbody. The most sensitive beneficial uses for the Upper Bear Creek Watershed Analysis Area are anadromous fish passage, resident fish and aquatic life, and municipal and domestic water supply. Flow modifications, temperature, dissolved oxygen, pH, bacteria/pathogens, aquatic weeds or algae, turbidity, sedimentation, and habitat modifications are the key water quality indicators most critical to these sensitive beneficial uses.

The City of Talent, which is approximately eight miles downstream of the analysis area, obtains drinking water from Bear Creek (Talent Irrigation District). The City of Ashland (just downstream of the analysis area) has occasionally supplemented its water supply with Talent Irrigation District (TID) water that comes from Emigrant Lake.

RIPARIAN AREAS

Stream side vegetation varies considerably in the Upper Bear Creek Watershed Analysis Area depending on aspect and elevation. Oak savannah plant communities extend into the riparian zone in most lower reaches of the analysis area. Emigrant Creek up to the mouth of Tyler Creek, the lower 2.5 miles of Walker Creek, and lower reaches of Sampson and Carter Creeks fall under this dry-land influence. California black oak, Oregon white oak, and Oregon ash are common components of overstory riparian vegetation. Other deciduous trees, most commonly red alder, provide a discontinuous diversity. Big-leaf maple, black cottonwood, Ponderosa pine, Douglas-fir and incense cedar, while not common, are also present. Common understory plants are poison oak, manzanita, wedgeleaf ceanothus, and willow. A mixture of native and introduced grasses, and yellow starthistle provide much of the ground cover in these lower reaches. This variety of trees and shrubs provides remarkably good shading, however, there are short interruptions in riparian cover due to agricultural and urban development.

Riparian growth in drainages flowing from the east exhibits a pronounced influence from aspect. South facing slopes have dryland plant components while north facing slopes are covered with a mixture of coniferous and deciduous vegetation.

Douglas-fir and red alder provide good stream shading along Emigrant Creek above the mouth of Tyler Creek. This combination gives way to a white fir dominated plant community near the highest elevations in the analysis area.

There are numerous road crossings on streams throughout the analysis area. Several roads have been placed in close proximity to stream channels which have resulted in reduced riparian habitat and shading.

The Northwest Forest Plan provides interim Riparian Reserve widths for streams (USDA and USDI 1994a:C-30). These widths are adopted for streams in the Upper Bear Creek Watershed Analysis Area. Map 15 shows Riparian Reserves in the analysis area.

AQUATIC WILDLIFE SPECIES AND HABITATS

Fishery resources in the Upper Bear Creek Watershed Analysis Area include anadromous, cold-water resident, warm-water and non-game species (Map 16). They are a combination of native and introduced fish.

The lower 2.5 miles of Walker Creek and the lower 0.75 mile of Cove Creek are important spawning habitat for summer steelhead. Winter steelhead are known to spawn in Emigrant Creek downstream of Bounds Reservoir. The periodic watering and drying of this portion of stream due to TID operations at Emigrant Dam may result in failure of spawned fish eggs to hatch successfully. Even if spawning is successful, rearing of juvenile fish may be threatened by manipulation of streamflow. Before Emigrant Dam was constructed in 1924, summer and winter steelhead and coho may have migrated some distance up Emigrant Creek. Emigrant Creek contains suitable spawning and rearing habitat for these fish up to the mouth of Green Mountain Creek.

Both resident rainbow and cutthroat trout reside in the analysis area. An electrofishing survey conducted by BLM in January 1999 in lower Tyler Creek revealed the presence of native rainbow trout in the lower 1/4 mile of stream. Additional electrofishing surveys were conducted in the summer of 1999 (ODFW 1999). These efforts found resident trout in several tributaries. The ODFW stream survey of Emigrant Creek noted trout upstream to the mouth of Porcupine Creek. A BLM fish survey identified cutthroat trout in Porcupine Creek (Bessey 1999).

Suitable spawning and rearing habitat for resident trout is in short supply throughout much of the analysis area. There are very few deep (over a meter) pools that can be used for resting and rearing; and fine gravel, used for spawning, is limited to small deposits. Bedrock areas are extensive and lack hiding cover.

The Oregon Department of Fish and Wildlife annually releases hatchery-reared rainbow trout into Emigrant Reservoir and has released steelhead and coho in the past. In the spring, these trout accumulate at the inflow of Emigrant Creek, and some fish move into the stream above the lake. A fishery has developed around this activity. It is unknown how far upstream these non-native (i.e. of a different genetic stock) fish go, but it is assumed that they have altered the genetic integrity of native fish in a portion of this stream.

The reticulate sculpin is the only native non-game fish known to reside in the analysis area. It was found in lower Tyler Creek during BLM's electrofishing survey, and the 1997 ODFW stream survey and 1999 ODFW electrofishing survey noted its presence in upper Emigrant Creek. It is assumed this fish resides in Walker Creek and Emigrant Creek downstream of Emigrant Dam.

In addition to introduced trout stock, Emigrant Reservoir supports populations of several introduced warm-water fish species. Included are largemouth bass, smallmouth bass, bluegill sunfish, pumpkinseed sunfish, yellow perch, black crappie, and brown bullhead. A channel catfish was netted in the lake by ODFW in 1996. It is unknown if this species is reproducing in the lake.

In the 1970s, golden shiners were illegally introduced into Emigrant Reservoir as well as several other lakes in southwest Oregon. This member of the minnow family is native to eastern United States.

There is little information available about other aquatic resources in the analysis area. Pacific giant salamanders and rough-skinned newts are suspected residents in much of the analysis area because of the close proximity to populations known to exist in the adjacent Jenny Creek and the Klamath-Iron Gate Watersheds. No in-depth surveys have been conducted on macroinvertebrates, so the composition of this resource is unknown. Perennial springs in the Upper Bear Creek Watershed Analysis Area were surveyed for aquatic mollusks in 1998. The Fredenberg pebblesnail (*Fluminicola n. sp. 17)*, a survey and manage species, was found in two springs located high up in the Sampson Creek drainage.

CURRENT CONDITIONS

The purpose of the Current Conditions section is to develop information relevant to the identified Issues and Key Questions. The Current Conditions section provides more detail than the Characterization section and documents the current conditions and trends of the relevant ecosystem elements.

HUMAN USES

The Upper Bear Creek Watershed Analysis Area includes a mix of public and private lands, with the majority of the land in private ownership (see Characterization section, Human Uses). Private lands are primarily used for residence, ranching, and timber. Public lands are also used for grazing and timber harvest in addition to recreation which is a major use in the analysis area.

The people most closely associated with the analysis area include the local residents and landowners as well as many groups and individuals that have an interest in the analysis area and use it for a variety of purposes including economic and recreational activities.

Current Human Uses and Trends

Farming and ranching characterized the early communities of the analysis area (Wheeler 1971); descendants of early immigrants still reside in the analysis area. Two of the largest ranches in Jackson County are located in the analysis area. Timber production and logging are human uses that occur on public lands and lands owned by private timber companies. As elsewhere in the region, farming, ranching, and logging are not growing along with the growing population. Service, trade, and some manufacturing sectors of the economy are growing at a faster rate; these trends are likely to affect the analysis area as well.

Elsewhere in the region there is a growing “commuter” class of residents in the rural areas (Preister 1994). These people reside in rural areas but commute from their rural homes and communities to jobs in the more industrial urban areas. This trend is likely to continue in the analysis area, with people commuting to jobs in Ashland, Medford, and surrounding towns.

Recreation on public lands has been important in the past and is likely to continue in the future. Non-timber products and uses on public lands will probably receive more emphasis in the future. Interactions among private citizens, businesses, local groups, and government agencies will continue to be important for education and information sharing, and will probably be of increasing benefit to effective ecosystem management in the analysis area.

Facilities and Structures

Soda Mountain, a prominent peak in the Upper Bear Creek Watershed Analysis Area, is located on BLM-managed land in the NW1/4 of Section 28, T. 40 S., R. 3 E., W. M. The summit of this mountain is over 6,000 feet in elevation. There is a road to the top of the mountain and from the summit there are excellent views in all directions. Because of this, the Oregon Department of Forestry (ODF) constructed a fire lookout on the apex of Soda Mtn. many years ago. Over time, other agencies and companies have recognized the value of Soda Mtn. for use as a communication site. Consequently, there are now many authorized users on the mountain with an array of buildings, towers, and transmitting\receiving devices. The bulk of this equipment is located on the ridge running to the southwest of the fire lookout. More facilities may be added to the site if they are found to be compatible with the existing facilities. Soda Mtn. is one of the principle communication sites on BLM-administered land in southwest Oregon. It serves a multitude of users, both public and private.

Other authorized "facilities" which are located within the analysis area are the three major electrical transmission lines which are owned and operated by PacifiCorp. These lines cross through the analysis area on a mix of public and private lands. They are an integral part of the electrical grid system which serves the public in Oregon and California. Attached to one of these lines is a fiber optic line which was approved as an ancillary use of the transmission line right-of-way.

A similar "facility" is the natural gas pipeline owned and operated by Pacific Gas Transmission (PGT). This public utility line is completely underground and is located mostly across private property in the analysis area. It underlies public land for a short distance in the northeast portion of the analysis area. Within the same trench used for the gas line there is a fiber optic line. This line is owned and operated by U.S. West.

Authorized and Unauthorized Uses

A number of BLM authorizations have been granted for various uses within the analysis area. There are twelve right-of-way grants for roads, thirteen right-of-way grants for minor utility systems (electric and phone lines), and five right-of-way grants for water lines or irrigation systems. These authorized uses are mainly to private individuals or to utility companies providing service to private parties.

There are no known unauthorized uses of public land within the analysis area. However, some of these uses may exist. When discovered, BLM establishes case files and works to resolve the situation in accordance with BLM policy and directives.

Land Use Permits

BLM has issued special land use permits in the analysis area to a Native American group. For the past several years, this group has been authorized to use public land in the analysis area to hold their annual Sundance Event. This event is held during the summer season and lasts two to three weeks.

Easements

The Pacific Crest National Scenic Trail, part of the National Trail System, passes through portions of the analysis area as well as the adjoining Klamath-Iron Gate Watershed. Due to the significance of this trail system, BLM has acquired a number of easements for this trail over various private lands within the two watersheds. These easements grant right of passage to the public for the intended use i.e. hiking.

Land Exchanges/Sales

BLM is working to complete an ongoing exchange with a private timber company for a 160 acre parcel of land partially within the analysis area. Once completed, the exchange will serve to consolidate BLM ownership near Pilot Rock. That portion of the 160 acres which is not in the analysis area is located in the adjacent Klamath-Iron Gate Watershed to the south.

Since 1988, three public land sales have been approved within the analysis area. These lands were sold at appraised values and occurred in 1988, 1990, and 1998. In all three cases, there was no public access to the parcels and the purchasers were adjoining property owners.

Transportation System

BLM's Geographical Information System (GIS) and Transportation Information Management System (TIMS) identifies approximately 319 total miles of road within the analysis area, of which 27 percent are controlled by BLM. Roads in the analysis area vary from primitive four wheel drive roads to paved highways. BLM roads were constructed and are maintained for log hauling and administrative purposes. BLM inventories contain very little information about non-BLM controlled roads. Most of the county roads have a bituminous surface and the private roads are usually either rocked or are left unsurfaced.

Road maintenance is conducted by the different owners and management agencies. Water, oil, or lignin are usually applied to road surfaces when hauling during dry periods for dust abatement and to keep roads from disintegrating. There are developed water sources in the analysis area where the BLM may obtain water. Water is used when placing surface rock and for road maintenance, which allows for proper processing and reduced segregation of the road surface rock.

The BLM charges fees for commercial use of roads and then uses these fees to help pay for road maintenance. A reduction in timber harvest levels has resulted in a significant decrease in the primary funding source for maintaining the transportation system. Many roads previously maintained at a high level are not being maintained to that extent any longer. To reduce maintenance requirements and erosion potential, some unnecessary roads have been, or will be, decommissioned. Other roads are closed until future access is needed and many others are maintained at the lowest possible levels. BLM roads have a maintenance level assigned to them. The roads are monitored and the maintenance levels are modified when needs and conditions change. Maintenance levels range from minimal standards on short roads to high standards on main roads. Sharing and maintaining roads with landowners has also reduced the amount of road necessary for access and maintenance costs. The goal is to maintain the entire transportation system in a safe and environmentally sound condition. The result is a transportation system that provides for various recreational activities, private access, logging, fire fighting access, and other land management uses.

Road maintenance includes removing safety hazards, reducing soil erosion potential and providing for fish passage at all potential fish bearing stream crossings. Safety hazards include hazard trees that have the potential to fall on houses, recreation areas, or roadways. Hazard trees are usually dead, but may be alive with roots under-cut or with significant physical damage to the trunk or root system. Proper maintenance of road drainage systems and stream crossing culverts is essential to avoid both erosion and fish passage problems. Most of the existing culverts were designed to withstand 50-year flood events. New drainage structures will be designed to withstand a 100-year flood event and when appropriate, provide for fish passage. Road protection measures include constructing drainage structures, grass seeding, blocking roads, placing road surface rock, and applying bituminous surfacing.

BLM roads are generally open for public use unless blocked by gates or other methods. Gates and other road barriers regulate vehicle access to reduce maintenance costs, soil erosion, transfer of noxious weeds, and wildlife disturbance.

The effects of roads on other resources are discussed in the Erosion Processes, Wildlife, and Hydrology sections.

Logging

The most recent advertised timber sale on BLM-managed lands within the analysis area was Round Sampson, a thin/salvage sale. The prospectus of this sale states that 547 thousand board feet (MBF) was removed from 101 acres within the analysis area. Fifty-two of these acres were tractor logged and the rest were cable logged. Yarding was completed in Oct. 1996. There are no timber sales planned in this analysis area through the fiscal year 2002.

For more detailed information on Round Sampson and other recent timber sales see Appendix F. This appendix shows the sale name, date advertised, location, unit number, harvest type, harvest method, acres and volume removed for eight different sales. This information covers every sale advertised between 1986-1998 and was compiled from the BLM forest inventory data (Micro*Storms database) and the prospectus of each sale. During this period, 71 percent of the total acres (1,502) was tractor logged and the rest was cable logged. Partial cut harvest was conducted on 1,064 acres with a variety of different prescriptions and the rest of the acres were clearcut (98 percent of these were cut between 1986 and 1990). A total of 15.6 million board feet (MMBF) was removed.

Table 11 summarizes acres harvested by harvest type and volume removed each decade since 1940 in the Upper Bear Creek Watershed Analysis Area.

Table 11. Acres Harvested and Volume Removed on BLM-Managed Lands

Decade of Sale	Clearcut Acres	Select Cut Acres	Salvage Acres	Shelter-wood Acres	Overstory Removal Acres	Thinning Acres	Volume Removed (MMBF[1])
1940s	0	0	206	0	0	0	Not available
1950s	207	3	0	0	61	0	6.3
1960s	82	1670	5	0	0	0	19.7*
1970s	85	1843	16	153	19	0	20.9**
1980s	424	25	261	332	172	184***	20.1
1990s	7	16	525	92	42	86	4.6

1/ MMBF = millions of board feet
* 19.1 mmbf + 70 acres unknown
** 14.7 mmbf + 966 acres unknown
*** 30 acres double counted (overstory removal & commercial thin)

Table 11 reflects forest inventory data (Micro*Storms database) as of January 28, 1999. Data may not be complete because all historic data may not have been entered into the database. Approximately 1,900 acres were entered more than once.

Oregon Department of Forestry's (ODF) Notification of Operations database (1990-1999) was referenced in order to investigate logging and other operations conducted on private land within the analysis area. This database only contains the location, operator/land owner, year, activities, methods used, and acreage for proposed operations. The operator/landowner may deviate from the planned operation. Because of this potential deviation, only general information is available regarding operations within the analysis area.

Most of the notifications fell into one of the following categories: 1) herbicide, insecticide, rodenticide, fertilizer, and fungicide application; 2) road construction/reconstruction; and 3) harvesting. Herbicides, insecticides, rodenticides, fertilizers, and fungicides have been used by private landowners throughout the analysis area at different levels of application. Even though no quantitative or qualitative studies are available at this time it is important to note the usage of these chemicals. Approximately 4.4 miles of new road have been planned by private landowners/operators since 1990. The third category, harvesting, consisted of two different harvest types: 1) commercial thinning and 2) most, or all, conifer timber or large hardwoods will be cut and removed from the unit during harvesting. From 1990-1999, 20,621 acres of commercial thins were either harvested or planned for harvest from private lands in the analysis area. During the same period, only 207 acres of the second harvest type were planned. These forestry operations have potential impacts to the whole watershed that should be considered when doing projects on the ground.

Special Forest Products

The BLM is working with the Forest Service to develop regional and national strategies that recognize the importance of managing special forest products (SFPs). These strategies emphasize four themes: 1) to incorporate harvesting of SFPs into an ecosystem management framework with guidelines for sustainable harvest, species conservation, and protection of ecosystem functions; 2) to involve the public including industrial, Native American, and recreational users of these resources in making decisions about the future of SFPs on public lands; 3) to view the management of an accessibility to SFPs as major factors in assisting rural economic diversification in formerly timber-dependent communities; and 4) to develop and implement inventory, monitoring, and research programs to ensure species protection and ecosystem health (Molina et al. 1997).

Special forest products have been extracted from the analysis area for at least 15 years. In order of importance, the main SFPs are fuel wood, salvage saw timber, and cedar boughs. The level of fuel wood removal probably peaked in the late 1970s through the mid-1980s when logging activity and wood stove use were high. Since then, restrictions on wood burning in the Rogue Valley, combined with decreasing timber sale activity has resulted in a dramatic reduction in fuel wood cutting. The BLM-administered lands in the analysis area will continue to be a source for individual/family Christmas tree cutting due to its close proximity to the Rogue Valley. Currently, harvest levels are very low for other SFPs in the analysis area, such as floral greenery and mushrooms.

Grazing/Agriculture

Cattle operations are the number one agricultural commodity in Oregon, contributing 12.8 percent of the total gross value of agricultural products; Jackson County ranks 16th in the state for gross farm and ranch sales (Andrews 1993). Within the analysis area, cattle operations are the largest non-forestry agricultural venture. Ninety-six percent of the BLM-managed lands are allocated to 10 grazing allotments: 6 located entirely within the boundaries of the analysis area, and 4 which have acreage within the boundaries but the majority of the allotment resides in adjacent watersheds. Map 17 shows allotment boundaries within the analysis area. Table 12 summarizes grazing use in the analysis area. Appendix G summarizes information for each allotment in the analysis area.

Table 12. Grazing Information for BLM-Administered Lands[1]

BLM District	Number of Allotments	Total Area Managed (Acres)	Total Area Grazed (Acres)	Total Permitted Use (AUMs)[2]	5 Year Avg. Actual Use[3] (AUMs)
Medford District	10	16,472	15,894	4,654	2,695

1/ as of January 1999.
2/ AUMs = animal unit months.
3/ Actual Use (1994-1998)

The Upper Bear Creek Watershed Analysis Area is designated as open range outside of incorporated towns or livestock districts. There are two livestock districts within the study area: Greensprings Herd District on the upper reach of Tyler Creek and Siskiyou Summit Herd District located on lands to the east of and adjacent to Interstate 5, particularly the upper reaches of the Carter Creek drainage. There are two large private ranches within the analysis area. One is located in the Tyler and Emigrant Creek drainages, on what is locally referred to as the Mosby

Ranch. The owner/operators currently run cattle year-round on their private land, and from June through October on public lands. The other major private cattle operation can be found in the Walker and Cove Creek drainages. The owner/operator of this outfit also runs cattle seasonally on public land. There are four small allotments on Bureau of Reclamation (BOR) land near Emigrant Lake, however, none of the leases have been active since the early 1990s (USDI, BOR 1995:2-35). Grazing management on BOR land has been modified to eliminate existing grazing leases and allow for temporary, short-term grazing leases for weed control, wildlife habitat enhancement, etc. Jackson County is responsible for managing the leased areas (USDI, BOR 1995:4-5).

Federal grazing allotments are categorized to determine management levels. Categorization concentrates funding and personnel where management is needed most. The following are the categories for prioritizing the allotments: 1) improve - the allotment will be managed intensively for improvement; 2) maintain - current management will be sufficient to maintain conditions that are satisfactory; and 3) custodial - a minimum amount of effort will be expended to maintain existing resources, often due to a large percentage of private lands.

The primary goal of BLM's rangeland management program is to improve riparian and upland conditions thus meeting and maintaining rangeland health standards while providing livestock forage as one of the many uses of the public lands. Grazing management includes, but is not limited to, establishing preference, season of use, and permitted use under the grazing permit or lease. Preference is a priority position against others for the purpose of receiving a grazing permit/lease. This priority is attached to base property owned or controlled by the permittee/lessee. Season of use indicates the period during which cattle are allowed on the range. Permitted use indicates the forage allocated for livestock grazing and is measured in animal unit months (AUMs). An animal unit month (AUM) is the amount of forage required to sustain one cow or its equivalent during a one-month period. At present, no allotment within the analysis area is leased for horses or sheep. Total permitted use for BLM-administered lands is shown in Table 12. A coordinated resource management plan has been completed for the Soda Mountain allotment.

Other agriculture in the analysis area is varied and mostly small acreage, domestic farms and gardens. There may be some orchards still in production, although most operations are found at lower elevations and outside of the analysis area.

Range Monitoring

The primary purpose of rangeland monitoring is to evaluate the affects of livestock grazing on vegetation communities. Forested sites that have been previously harvested and/or are currently under active forest management are referred to as transitional areas. Trend studies to monitor these sites for livestock effects are impractical from a rangeland monitoring standpoint. Grasslands, shrublands, meadows, and oak woodlands are more appropriate for rangeland monitoring.

One of the primary long-term rangeland studies is trend. Trend describes the direction of change in range condition based upon plant frequency. Frequency describes the abundance and distribution of species and is useful to detect changes in plant communities over time. Other current studies include forage utilization, riparian and upland photo points, and precipitation data.

In August of 1997, the BLM adopted new rules for rangeland health (USDI, BLM 1997). Rangeland health can be defined as the degree to which the integrity of the soil and ecological processes of rangeland ecosystems are sustained. Additional studies and indicators for each standard of rangeland health will be developed in the future. These studies will relate to the functioning of both uplands and riparian systems.

Minerals

There are no valid mining claims on BLM-managed lands in the analysis area.

Recreation

Recreational opportunities within the analysis area include the Pacific Crest National Scenic Trail (PCNST), hiking, fishing, hunting, horseback riding, rock climbing, picnicking, camping, sightseeing, mountain biking, driving for pleasure, and mushroom and berry picking. Winter uses in the uplands include snowmobiling, snowshoeing, skiing, and sightseeing. There are no developed facilities managed by BLM within this analysis area. Some areas of concentrated off-highway vehicle (OHV) use exist and have resulted in disturbances to soil and vegetation. A local publication on rock climbing lists a popular site in this analysis area which is on private timberlands.

Jackson County manages the facilities around Emigrant Reservoir which include camping and day-use areas, boat ramps, a swimming area, a water slide, and a concert area. The lake provides fishing, boating, waterskiing, swimming, and personal water craft opportunities. Jackson County Parks maintains its facilities around Emigrant Reservoir with the budget it receives from the County. OHV problems exist in the reservoir area but they are being addressed by the Jackson County Parks Department.

Cultural Resources (Archaeological and Historic Sites)

There are numerous known archaeological sites within the analysis area, representing both the history of the native peoples and that of the early settlers. A portion of the Applegate Trail route runs through the analysis area, as do portions of the old Siskiyou Trail, and there is an historic pioneer cemetery above Emigrant Lake. Future work in the analysis area should take account of this heritage and avoid impacts to these native and historic sites.

EROSION PROCESSES

Natural Processes Affecting Erosion Processes and Slope Stability

Floods

The primary natural event that affects erosional processes in the Upper Bear Creek Watershed Analysis Area is a flood from a rain-on-snow event, that occurs when thick snow packs in the transient snow zone are rapidly melted by warm rainstorms. These storms, especially the 1964 and 1997 events, caused both natural and management-related slides to transport sediment to nearby streams. During the 1955, 1964, 1974, and 1997 rain-on-snow events, several earthflows and debris flows reactivated mainly in the steep canyon sideslopes. Several new small slides also occurred in the steep canyon sideslopes.

Wildfire

During the late nineteenth and early twentieth centuries, large wildfires periodically swept across the analysis area. These wildfires were caused by lightning strikes igniting dry vegetation.

Wildfire is a natural process capable of removing extensive soil cover in the Upper Bear Creek Watershed Analysis Area. There can be substantial erosion from a fire-disturbed site when an intense rainfall event occurs within a year or two after a severe fire. Once vegetative cover or litterfall is reestablished, generally within the first two years after a disturbance, soils are protected from further rainfall impact. The erosion that occurs after a wildfire can result in a significant amount of topsoil loss and stream degradation. Topsoil loss due to wildfires has been reduced over the past 70 years since fire suppression has resulted in fewer natural fires exposing soils. However, this situation increases the risk that an intense wildfire of long duration will occur and may cause severe soil erosion and landslide problems.

Slope Stability

Landslides resulting from steep, unstable slopes are primarily located in the upper portion of the analysis area. Many of the active slides are found within older earthflows, indicating that most of the sites had been active for long periods of time. Earthflows are slow moving landslides that can be very large and deep. An example of an earthflow is found in the upper Frog Creek drainage in the Sharon Fen area, where sag ponds, springs, seeps, scarps, tension cracks, and anomalous tree growth are common. These features on BLM-managed land are classified as unsuitable for management and are not treated. Debris landslides are also commonly found within the larger earthflows and are most active in the lower half of the canyon sideslopes, often traveling to the valley floor. Debris slides are rapid mass wasting events that carry large volumes of rock, soil, and vegetation downslope. These slides are likely to continue to occur due to the natural instability of the area.

Surface erosion due to natural processes is found where surface water is concentrated in drainages or draws. Sheet, rill, and ravel erosion occur most frequently on canyon sideslopes and valley floors. The largest amount of sediment transported to streams as a result of surface erosion comes from the steeper, stream-adjacent slopes.

Human Activities Affecting Slope Stability

Many of the erosion processes are most active near managed areas or areas managed in the recent past, such as roads and clearcuts. Slumps, debris flows and/or tension cracks are often found in road prisms, cut slopes, and fill slopes. The following are the major human activities that have impacted erosion processes in Upper Bear Creek Watershed Analysis Area. These activities are generally listed in order from largest to smallest impact potential.

Road Development

Road construction has been the largest human impact to the Upper Bear Creek Watershed Analysis Area in terms of sediment delivered to streams and negative affects to fishery habitats. Roads with inadequate drainage can result in rills, gullies, slumps, and earthflow landslides during peak flow events (especially the 1964, 1974, and 1997 storms).

Roads can intercept overland flows and concentrate the water into areas that can saturate weak soils and create conditions that are conducive for slope failures and surface erosion. Many roads in the analysis area have been constructed with culverts and ditches or drain dips as the drainage structures. However, some of these roads are unsurfaced and usually do not have armoring below water-bars or drain dips to protect against erosion and mass wasting. Natural surface roads left open during the rainy season have been rutted by off-highway vehicles (OHVs) which concentrate flow down the roads. Intense rain storms and rain-on-snow events have produced heavy runoff from these unsurfaced roadways. As a result of the concentrated run-off, rills and/or ruts sometimes develop on the steep grades. During intense storms, high energy runoff is often concentrated into rills on steep road grades which transports sediment into streams, especially at stream crossings and where roads parallel streams.

Some culverts were plugged by debris during the last three major flood events, causing streams to be diverted into or over road ditches and into low lying areas. The road cut and fill slopes were destabilized by these actions causing failures (slumps, earthflows, tension cracks) and surface erosion to occur. As a result, moderate to large volumes of sediment were transported to streams.

High road densities, greater than 4.0 miles per square mile, are found in some sections of the analysis area (see Appendix H and Map 18). When these high road densities are combined with weak soils and are near riparian and/or unstable areas, effects to the environment are the most severe. Road density is also addressed in the Wildlife and Hydrology sections.

Timber Harvesting

Clearcut timber harvesting is second only to roads in causing adverse impacts to streams, soils, and fisheries. Clearcutting is not currently a major concern on BLM-managed land in the Upper Bear Creek Watershed Analysis Area, as it is not permitted under the Medford District's *Resource Management Plan* (USDI, BLM 1995). However, clearcut timber harvest is still being conducted on private lands. Clearcut units with slopes greater than 50 percent in canyon sideslopes have the highest risk for landslide activation and reactivation during peak flow events. Clearcut logging decreases rooting strength in the soil and can increase the groundwater available to unstable and potentially unstable terrain, which increases the likelihood of accelerating landslide movements. This type of logging has caused some minor surface erosion (rills and raveling) in swales and larger drainages. Most of the units with any erosion/slide features are located on or just above steeper slopes of the canyon sideslopes. Surface erosion and landslides often start at the base or just below the clearcut units. Some of these areas of erosion and minor sliding have revegetated and healed naturally over time and they are no longer a major concern.

Livestock Grazing

In recent years, the use of lands within this analysis area for livestock grazing has diminished and new management strategies have been adopted. The number of cattle on the land today is significantly less than the early days of the range. Currently, impacts from livestock are primarily limited to local areas of disturbance in riparian areas and near watering holes due to concentrations of poorly managed livestock.

Prescribed Burning

Low intensity prescribed fires are used to remove slash following timber harvest in this analysis area. Most prescribed burning has occurred on the upper landscapes of BLM-managed lands. Low intensity prescribed fires usually leave enough organic matter to keep the soils in place. However, even with low intensity prescribed fires there are often spots of high intensity fires within the burn that can adversely affect the soils and slope stability. Some sheet erosion has occurred where hot broadcast burns were followed by intense rain storms. High intensity fires can burn off the duff layers that protect soils from erosive and gravitational forces. These fires may also cause soils to become hydrophobic (that is, soils will not allow penetration of rainfall and snow melt), which causes much less infiltration and a higher risk for soil erosion and topsoil loss to occur.

Prescriptions for low intensity burns can be met by burning when the weather and fuel conditions are conducive for a "cool" burn. This is usually in the late winter, early spring, and late fall of most years.

Conclusion

Roads, clearcut timber harvest, prescribed burning and livestock grazing have accelerated the rate at which erosion and landslides can transport sediment and debris to streams. Of these human activities, roads have had the greatest effect on moving sediment into streams. Thus, more sediment has been mobilized and deposited in streams in a much shorter time frame than would have occurred naturally. These human impacts have adversely affected fish habitat and water quality.

Future Trends

The future trend for sediment production will remain slightly above natural rates unless timber management intensifies. The natural surface roads will continue to be the main source of sediment to streams. As future major storms move into the analysis area, combined human uses will continue to be factors that contribute to accelerated mass wasting and surface erosion. Inadequately drained roads and unstable road cut and fill slopes will increase the likelihood that new failures will be initiated. In the steeper mountainous sideslopes, active earthflows, slump/earthflows, and debris slides will move sediment into streams. This is particularly the case around the Sharon Fen area.

The impact of future storm events and the extent they may affect the analysis area are unknown. Natural landslide and erosion processes cannot be halted; however, stabilization measures could be implemented to limit adverse impacts on water quality.

SOIL PRODUCTIVITY

Soils in the analysis area have been forming for thousands to millions of years. Environmental factors such as volcanic activity, wildfires, vegetation, and climate have been the major influence on soil formation and productivity. Only in the last one hundred years have human activities had an effect on soil productivity. Forest management activities such as timber harvesting, road building and wildfire suppression have interrupted the "natural" processes of soil development. Various agricultural activities also may have had an impact on the soils ability to produce vegetation and provide clean water to the streams.

Timber harvested areas have experienced a decline in soil productivity. This loss in soil productivity is directly related to an increase in soil erosion rates due to the yarding of material and the loss of vegetative cover. This is especially true for steep, mountainous sideslopes that have been clearcut and broadcast burned. The removal of organic material during logging operations that would otherwise be returned to the soil has had a negative affect on soil productivity.

Productivity losses can also be attributed to tractor logging that compacts the soil and decreases pore space used to store oxygen and water in the soil. Tractor logging has been used extensively on the flatter topography of the analysis area. The amount of soil productivity lost is dependent on the amount of area compacted. Compacted skid roads usually experience a 50 percent reduction in site productivity.

On major skid trails and roads, increased compaction has resulted in some surface erosion and sediment accumulation in depressed areas. Soil recovery is slow and could take many decades. Recovery processes, while not well understood, probably depend on the type of vegetative succession that occurs, amount of existing site organic matter, and future disturbance regimes.

Road construction has taken land out of production in the analysis area. The soil productivity loss is directly proportional to the amount of road built in the analysis area. Roads also have an indirect affect on soil productivity on steep mountain sideslopes. Inadequately built roads on unstable slopes and/or in headwall situations, often cause slope failure resulting in landslides or debris torrents.

Fire suppression activities over the last 70 years have changed the local fire regimes in the analysis area. Wildfire frequency has decreased, however, the fire intensity has increased, resulting in the consumption of more surface duff and large woody material. High intensity wildfires also heat the soil and greatly reduce the existing soil organism populations. Although the forest usually experiences a short-term flush of nutrients from the oxidation of burned organic material, the long-term nutrient cycling is interrupted. This same phenomenon has been observed as a result of broadcast burns with high fuel loadings.

PLANT SPECIES AND HABITATS

Non-Native Plant Species and Noxious Weeds

Non-native plant species can be found throughout the analysis area (Appendix I) and they maintain a continuous and increasing presence on lands in the analysis area. Some species may have been intentionally introduced after major ecological disturbances to reduce erosion and hold the soil until native species gradually re-establish. Other highly adaptive species may have been brought in to improve available forage for wildlife and livestock under past direction of public agencies and private individuals. Still others are plants which have escaped cultivation in lower elevation fields, lawns, and gardens. Finally, some non-native species have simply taken advantage of regional transportation systems to expand their range.

Any activity that creates disturbed soil and forms a corridor into an area, can act as a pathway for dispersal. Many non-natives in the analysis area can be found along roadsides, quarries, areas of previous timber harvest, power and telephone line right-of-ways, and other areas of disturbance. Once established, they can rapidly spread to other areas, as many of these species possess the ability to out-compete the native vegetation, even in the absence of a disturbance.

Most non-native species can potentially out compete and displace native plants and thus alter the composition and relationships of the ecosystem. These introduced species typically have superior survival and/or reproductive techniques. They can compete with native plants for water and nutrients, frequently develop and reproduce earlier at higher rates, and often can take advantage of many more opportunities for dispersal over long distances using wind, water, animals, outdoor recreationists, and passing vehicles.

Some non-native plants which cause extreme harm to the ecosystem and/or economic interests have been designated as noxious weeds. Federal land managers cooperate with Oregon Department of Agriculture's efforts to control and identify target species of noxious weeds by tracking their distribution on federal lands. Noxious weed populations must be located quickly to increase the effectiveness of control efforts. Integrated Weed Management (IWM) involves four general categories of management options including cultural, biological, physical, and chemical. IWM is a decision making process that uses site specific information to make decisions about treatment choices. IWM is based on the fact that combined strategies for weed management work more effectively than any single strategy. The current IWM practice method of choice for weed control is biological control. Not all noxious weeds, however, have current biological predators to control their populations and there are concerns that even under best management practices, populations of noxious weeds may continue to become established and/or expand.

Special Status Plant Species and Habitats

Eight species of special status plants are known to occur in the analysis area. Much of this analysis area has not been surveyed for special status plants with only small areas associated with management activities being inventoried.

Table 13. Special Status Plants

Scientific Name	Common Name	Status[1]	No. of Populations
Cirsium ciliolatum	Ashland thistle	BTO	3
Cimicifuga elata	tall bugbane	BSO	1
Cypripedium fasciculatum	clustered lady's-slipper	BSO;SM1,2	1
Fritillaria glauca	Siskiyou fritillary	BAO	1
Geranium oreganum	western geranium	BTO	2
Iliamna bakeri	Baker's globe mallow	BAO	1
Microseris laciniata ssp. *detlingi*	Detling's microseris	BSO	2 (pvt.)
Perideridia howellii	Howell's false caraway	BWO	2
Ranunculus austro-oreganus	southern Oregon buttercup	BSO	1
Solanum parishii	Parish's nightshade	BTO	1

1/ Status
BTO = Bureau Tracking in Oregon
BSO = Bureau Sensitive in Oregon
SM = Survey and Manage
BAO = Bureau Assessment in Oregon
BWO= Bureau Watch in Oregon

Habitat requirements for these plants are quite narrow for a particular species but most habitat types are occupied by one or more of these species.

Cimicifuga elata is a BLM Sensitive species in Oregon and a candidate for listing with the State of Oregon under the Oregon Endangered Species Act. This plant is found from Oregon to British Columbia and is considered threatened with extinction throughout its range. The plants of southern Oregon differ morphologically and occur in somewhat different habitat than other populations studied. With taxonomic investigation, southern Oregon populations could be classified as a new variety or subspecies. Habitat for southern Oregon populations ranges from small openings in conifer forests to open conifer forests, generally moist sites on northerly aspects. Forest habitat for this plant has been negatively affected by timber harvest and fire suppression.

Cypripedium fasciculatum is classified as a Survey and Manage Strategy 1 and 2 species under the *Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl* (USDA and USDI 1994b) and a candidate for listing with the State of Oregon under the Oregon Endangered Species Act. This plant is found east to the Rocky Mountains but is considered threatened with extinction in Oregon. Mid-to-late-successional forests with canopy closures greater than 60 percent appear to be the optimum habitat for this species. *Cypripedium fasciculatum* is a slow-growing, long-lived orchid with a mycorrhizal association and an arguable dependence on fire. Forest habitat for this plant has been negatively affected by timber harvest and fire suppression.

Fritillaria glauca is a BLM Assessment species in Oregon. The Oregon Natural Heritage Program considers this plant imperiled because of rarity or factors making it vulnerable to extirpation in the state but apparently secure globally. This plant has a very narrow habitat requirement, being found exclusively on talus slopes and serpentine. There are small inclusions of suitable habitat for this species principally on the south side of the analysis area and along the major ridges. Some of this habitat type has been lost due to road building and rock source development. *Fritillaria glauca* is found only in Oregon and California.

Iliamna bakeri is a BLM Assessment species in Oregon. This species produces a showy flower resembling a hollyhock and is considered endangered or threatened throughout its range. This species is known only from northern California and southern Oregon. Suitable habitat for *Iliamna bakeri* is somewhat open upland slopes, juniper woodlands, and lava beds.

Microseris laciniata ssp. *detlingi* is a BLM Sensitive species that is found only in Oregon. This species is considered endangered or threatened throughout its range. *Microseris laciniata* ssp. *detlingi* is known only from Jackson County in the area of Siskiyou Pass in habitats of grasslands, meadows, rocky slopes, and forest edges. The two populations in this watershed are on private land but with nearby suitable habitat on BLM. The habitat of this species has been negatively affected chiefly by grazing.

Ranunculus austro-oreganus is a BLM Sensitive species in Oregon and a candidate for listing with the State of Oregon under the Oregon Endangered Species Act. It is considered endangered or threatened throughout its range, which is only Jackson County, Oregon. This species is found in oak woodland and savannah communities typical of low elevations and the valley floor of the Rogue River Basin. This species is vulnerable to impacts from rural and urban development, farming, grazing, woodcutting, fire suppression, and OHV use.

Survey and Manage Plant Species and Habitats

Three species of Survey and Manage fungi are known to occur in the analysis area. A general inventory on nonvascular plants was conducted in this area in 1998 and 1999.

Table 14. Survey and Manage Plant Species and Habitats

Species	Survey Strategy[1]	Habitat Requirement	Number of Sites
Lobaria hallii	1, 3	Woods, usually riparian	2
Pithya vulgaris	1, 3	Coniferous forest, usually *Abies*	2
Plectania milleri	1, 3	Coniferous forest	1
Ptilidium californicum	1, 2, PB	Coniferous forest	1
Sarcosoma mexicana	3, PB	Coniferous forest	7
Sticta fuliginosa	4	Low elevation hardwood forest	1

1/ Survey strategies are from the Northwest Forest Plan (USDA and USDI 1994a) and are listed in the Characterization section. PB = Protection Buffer species.

All of these species are found in either hardwood or coniferous forests. Suitable habitat for these species has been negatively affected by timber harvest, woodcutting, and rural development.

Lobaria hallii, a rare nitrogen-fixing lichen, is known from riparian habitats but locally it has been found in dry oak woodland sites. Preliminary mitigation measures suggest maintaining old-growth patches in managed stands. This species (and other nitrogen-fixing lichens) exhibits poor growth and high mortality when exposed to the harsher conditions of an edge environment.

Pithya vulgaris, a rare cup fungus and component 1 species, has specific management recommendations that protect known sites and habitats. This species was previously known from only eight sites in Oregon, however, within the last year numerous sites have been documented in our area. Globally, this species is widespread in boreal forests of the North Temperate Zone. Management recommendations suggest retaining the *Abies* component of the overstory and avoiding disturbance.

Plectania milleri is a rare cup fungus and component 1 and 3 species. This species is a Pacific Northwest endemic and until recently, in Oregon, only known from two sites. Habitat requirements are poorly known for *Plectania milleri* but it is usually associated with mixed conifer forests. Management recommendations suggest retaining old growth forest structure and soil condition and avoiding disturbance.

Ptilidium californicum is a common liverwort with a known range of the pacific rim from Japan to California. It is widespread throughout the northern portion of its range but reaches its southern limits in southern Oregon and northern California. This plant is typically found at the bases of large conifers, stumps, and logs.

Sarcosoma mexicana, an uncommon cup fungus and a Protection Buffer species, has general mitigating measures and data gathering requirements. This species is usually found in closed canopy conifer forests and is known only from western North America and Mexico.

Special Areas with Botanical Resources

Pilot Rock Area of Critical Environmental Concern (ACEC)

The values requiring protection through the establishment of this ACEC are seemingly stable. The historic, geologic, and scenic values have remained unaffected since before the ACEC designation. Wildlife values have seen slightly more disturbance due to recreational climbing in possible habitat for nesting Peregrine falcons and three species of rare bats. Botanical values have seen some deterioration of habitat for known special status plants. This site is just over the ridge and addressed in the Klamath-Iron Gate Watershed Analysis (USDI, BLM 2000a). These habitats have been altered by fire suppression, overgrazing, urban and rural development, and vegetation conversion for agricultural uses. The usual result of this interference is shrublands that are overmature and overly dense, and oak woodlands that are overly dense and invaded by conifers, brush and nonnative forbs.

Cascade/Siskiyou Ecological Emphasis Area

This area is characterized by an environmental transition between the Great Basin to the east, the Cascade Mountains to the north and the Siskiyou Mountains to the south. In addition, a high elevation land bridge connecting the Cascade and Klamath Mountains transects the region. While generally regarded as a pristine landscape, this area has been affected by Euro-American management and uses. Road building, wood harvesting, recreation, fire suppression, livestock grazing, and rural development have all contributed to the modification of the reference condition. The BLM is currently developing a management plan for this area that will provide for coordinated, long-term management goals. A draft plan is scheduled to be available for public comment by the spring of 2000 (USDI, BLM 2000b).

FOREST DENSITY AND VIGOR

Vegetation disturbance mechanisms (abiotic and biotic) that influence the analysis area's forest stand structure are logging, soil frost action, animal damage, encroachment of non-native species, fire and fire suppression, bark beetles, pathogens, and dwarf mistletoe species associated with Douglas-fir and true fir species. In most cases, the biotic factors are influencing the forest structure in response to the low vigor of the forest stands and are therefore secondary. The primary concern with the pole, mid, and mature seral stage vegetation is the overstocked condition which causes low vigor and/or poor growth. Low vigor occurs when diameter growth falls below 1.5 inches over 10 years and results in trees that are more susceptible to bark beetle attack (Hall 1995).

Ponderosa Pine Zone

The BLM-managed land in this zone (Map 9) is all classified as late-successional reserve. This area is a connectivity area for plant and animal migration. Historically, the main tree species appears to have been ponderosa pine and incense cedar. Some 60 inch diameter pine trees are present (USDI, BLM 1998a). Since fire has been controlled in this area, Douglas-fir has out-competed the pine. Even white fir is migrating to the lower elevations. At the highest elevations white fir may even out-compete Douglas-fir over a long period of time. Oak woodlands are also common in this zone. Stand vigor appears to be low because of over stocking. Frost is a major problem at the higher elevations in regard to reforestation.

Mixed Conifer and Mixed Evergreen Zone

Fewer vegetation problems exist in the Mixed Conifer Zone (Map 9). The typical problem is overstocking of Douglas-fir in the Douglas-fir plant associations. The prolific second-growth Douglas-fir and white fir have out-competed ponderosa pine, sugar pine, incense cedar, Pacific madrone, and black oak in the mixed species stands. Many dead, large diameter oak trees can be found beneath the canopy of the Douglas-fir trees. The Shale City and Grizzly Peak areas have severe infection rates of Douglas-fir dwarf mistletoe *(Arceuthobium Douglasii*). At the higher elevations, shade tolerant white fir regeneration is abundant in the understory layer of the forest. Without any type of disturbance occurring, there may possibly be a reduction in the abundance of shade-intolerant species such as Douglas-fir and pine species.

White Fir and Douglas-fir Zone

Forest stand density and species composition are issues in this zone (Map 9) also. Unmanaged stands most likely have a high relative density. In the lower elevations Douglas-fir may be out-competing ponderosa pine and oak species. In the higher elevations white fir may be out-competing Douglas-fir. Old-growth pine trees in the higher elevations are being out-competed by the more shade tolerant species. Some old-growth pine mortality has occurred because of bark beetle attack in stressed trees.

White Fir Zone

The White Fir Zone (Map 9) is experiencing problems similar to the Mixed Conifer and Mixed Evergreen Zone. The lack of large scale disturbance in the white fir/Douglas-fir/Pipers Oregon grape plant association has allowed white fir to dominate the understory and the early seral species are less common. Individual trees within small patches of overstocked white fir have been killed by the fir engraver beetle (*Scolytus ventralis*). The insects are secondary to the root rot pathogens. In the lower elevations overstocked patches of ponderosa pine and Douglas-fir are being infested by the mountain pine beetle (*Dendroctonus ponderosae*) and the Douglas-fir bark beetle (*Dendroctonus pseudotsugae*). Many large diameter ponderosa pine trees have already succumbed to the western pine beetle (*Dendroctonus brevicomis*). This zone is also a frost problem area at the higher elevations in regard to reforestation.

Vegetation Disturbance Mechanisms

Biotic processes that are influencing the forest stand dynamics and structure in the analysis area include: dwarf mistletoe, bark beetles, and to a small extent forest pathogens. These biotic processes can cause tree and possibly stand mortality, shifting the forest stands to the understory reinitiation stage; the stage in which the tree canopy layer opens and allows regeneration to become established in the understory.

Douglas-fir dwarf mistletoe (*Arceuthobium douglasii*) is a problem in the Shale City and Grizzly Peak areas. Some stands have a 100 percent infection rate and patches of trees have died. Mistletoe species and pathogens can reduce tree vigor which enables bark beetles to invade the stressed trees. Infected true fir trees are susceptible to attack by the fir engraver beetle (*Scolytus ventralis*). Pathogens that could be in the analysis area include: laminated root rot (*Phellinus weirii*), annosus root rot (*Fomes annosus*), brown cubical butt rot (*Phaeolus schweinitzii*), red ring rot (*Phellinus pini*), and Indian paint fungus (*Echinodontium tinctorium*). Windborne spores can infect new hosts through tiny dead branch stubs or tree stumps and remain dormant until the tree is stressed, usually by wounding. All of these processes create unhealthy trees that become safety hazards when located near houses or recreation areas, or roadways.

Coarse Woody Material

Coarse woody material (CWM) appears to be the heart of numerous ecosystem processes and is a vital part of forest productivity. Perry (1991) lists various functions of CWM and how it affects forest productivity. Tree roots with their mycorrhizal hyphae transport nutrients into decaying logs. Nitrogen-fixing bacteria contained in decaying logs increases the nitrogen over time.

Nitrogen-fixation within logs adds approximately 1.2 pounds per acre of nitrogen annually on a per unit weight basis, approximately two to five times more than in mineral soil. If measured as plant available rather than total, logs contain from 10 to 30 percent of the available nitrogen (N) and phosphorus (P). In old-growth forests, approximately four percent of the total ecosystem N and P are contained in CWM.

Older, decayed logs serve as water reservoirs and because of their water content, become centers of biological activity during the summer months. One process that may take place is nitrogen-fixation by free-living bacteria. During the summer, logs have more water and are better buffered against temperature extremes. Almost all woody plants form a root symbiosis with certain fungi. It is hypothesized that CWM facilitates the reinoculation of clearcuts with truffle-forming mycorrhizal fungi. *Rhizopogon vinicolor* is especially important in gathering water. Microbes and invertebrates directly affect primary productivity through affects on nutrient cycling.

Maintaining the maximum levels of CWM consistent with reasonable fuel loadings appears to have considerable potential for enhancing site quality. Mid-seral stands with no CWM may have yields 12 percent lower than stands with sufficient CWM. As a crude estimate, primary production may be increased by a few percent for each ten tons of CWM left on site. CWM also stores carbon, which probably mitigates the "greenhouse effect".

CWM is not abundant in parts of the White Fir, Douglas-fir and White Fir, and Ponderosa Pine Zones due to logging and the present stand age and forest stand structure. The adjacent South Fork of Little Butte Creek watershed has approximately 8 tons of CWM per acre (USDI, BLM 1998b). The Porcupine Mountain area has approximately 15 tons of CWM per acre (USDI, BLM 1998a). Most stands are 80 to 150 years of age and just entering the understory reinitiation stage of stand development, the stage at which biotic and abiotic processes begin to cause tree mortality. The historic stands had significantly fewer trees per acre, thus CWM was probably found in lesser quantities.

Forest Productivity

Forest productivity is generally defined in terms of site quality, which is a measure of tree growth over a given period of time. Site quality is determined by the physical characteristics of the soil, steepness of slope, aspect, microclimate, and species present. An indirect method of measuring site quality is to determine the site index of the soil. Site index is simply the height a tree will grow in a given time period. The Soil Survey of Jackson County Area, Oregon (1993) uses a reference age of 50 years for Douglas-fir. The soil survey indicates most of the soil series in the analysis area are capable of growing Douglas-fir trees to a height of 60 to 90 feet in 50 years. The best soil (Tatouche series) will grow trees 90 feet tall in 50 years; the poorest soil (Tallowbox series) has a site index of 60 feet. These site potentials may not be met in the present-day overstocked forest stands.

For the majority of the mid/mature seral Douglas-fir stands in the analysis area, the average relative density index is approximately 0.70 (the ratio of the actual stand density to the maximum stand density attainable in a stand with the same mean tree volume) (Drew and Flewelling 1979). A relative density index of 0.55 is considered to be the point of imminent competition/mortality; and at this point, trees have a greater probability of dying from biotic factors, mainly bark beetles.

Trends

In general, throughout the analysis area, the overstocked pole through mature size seral stage forests have a low level of growth or vigor and are susceptible to bark beetle attack and pathogens. If forest stands are not thinned precommercially and /or commercially, tree mortality is expected to continue at increased rates. Dense forest stands with ladder fuels are prone to intense forest fires. If fires occur, more shrubs can be expected to grow.

Shifts in tree and shrub species can be expected to continue without thinning treatments or other abiotic and biotic disturbances. Early seral, shade intolerant species will continue to decline unless large openings (1 acre or more) are created. If tree mortality occurs in large patches, the early seral species will probably regenerate.

Without thinning treatments, the vegetation disturbance mechanisms previously discussed will become more evident. Bark beetles could kill large acreages of trees if populations are allowed to grow.

The forest zones in need of treatment because of declining stand vigor are: Ponderosa Pine, Mixed Conifer and Mixed Evergreen, White Fir and Douglas-fir, and the White Fir Zones.

FIRE AND AIR QUALITY

Over the past century, fire suppression has effectively eliminated five fire cycles in southwestern Oregon mixed conifer forests that occur at low elevations (Thomas and Agee 1986). The historic fire cycle was 20 years or less in this region. The absence of fire has converted open savannas and grasslands to woodlands and initiated the recruitment of conifers. Oregon white oak is now a declining species largely due to fire suppression and replacement by Douglas-fir on most sites.

The absence of fire due to suppression efforts has changed the make-up of the local forests to fire-intolerant, shade-tolerant conifers and has decreased species such as ponderosa pine and sugar pine. This conversion from pine to true fir has created stands that are stressed, which increases their susceptibility to accelerated insect and disease problems (Williams et al. 1980).

Horizontal and vertical structure of local forests has also changed. Surface fuels and the laddering effect of fuels have increased, resulting in the escalated threat of crown fires which were historically rare (Lotan et al. 1981). This trend is leading the forests from a low-severity fire regime to a high-severity regime, characterized by infrequent, high intensity, stand replacement fires. Fire is now an agent of ecosystem instability as it creates major shifts in forest structure and function. This trend continues throughout southwestern Oregon, as well as most of the western United States.

Fire suppression efforts over the past decades have altered, to some degree, how fires burn within areas classified under the low-severity regime. Typically, fires now burn more acres with high severity stand replacement fires. This is due to higher tree densities and increased ground fuels within timbered stands. Impacts of suppression efforts are difficult to quantify within this regime due to the varying degree of how fires normally burn within this regime.

Fire risk is defined as the chance of various ignition sources causing a fire that threatens valuable resources, property, and life. Historic lightning occurrence indicates there is the potential of lightning fires starting throughout all elevations within the analysis area. The highest fire risk areas are major ridge lines due to lightning strikes and lands adjacent to roads and private property because of the potential for human-caused fires.

Some of the higher values at risk within this analysis area are private residential and agricultural property, water quality, forest resources (such as northern spotted owl core areas, mature/old growth stands, and plantations), recreation sites, historic sites, and research natural areas. Table 15 summarizes these values at risk within the analysis area.

Table 15. Values at Risk Due to Fire Exclusion, High Intensity Wildfire, or Wildfire Suppression Activities

Resource	Values at Risk
Recreation/Social	Aesthetic: Visual, spatial, and spiritual.
Habitat	Threatened and endangered species, and thermal cover.
Improvements	Private homes, natural gas pipeline, power transmission lines, Buckhorn remote automated weather station, farming and ranching facilities, managed timber stands.
Historic Sites	Historic home sites.
Archeological Sites	Numerous sites (vulnerable to suppression activities).
Soils/Geology	Increased surface erosion, loss of litter layer, decrease in site productivity, change in soil structure, slope stability, and accelerated landslide activity.
Economic	Suppression costs and loss of products (recreation, timber, special products, livestock, range, and rural development).
Botanical	Numerous sites (vulnerable to suppression activities). All areas are susceptible to encroachment by non-native species in the event of high intensity fire. Suppression activities such as fireline construction, placement of camp sites, and vehicle use can impact all botanical habitat; moist mountain meadows are particularly sensitive.
Safety	Firefighters, public, visibility, telephone and power lines.
Air Quality	Public health and visual quality.

Fire hazard is the threat of fire ignition, spread, and difficulty of control, which is determined through assessment of vegetation by type, arrangement, volume, condition, and location. Hazard ratings were developed using vegetation (type, density, and vertical structure), aspect, elevation, and slope. Map 19 displays the fire hazard rating distribution with the analysis area and Table 16 summarizes the acres within each hazard rating.

Table 16. Fire Hazard Ratings

Hazard Rating	Acres	Percent
Low	248	<1
Medium	47,142	66
High	22,841	33

In general, the existing fuel profile in the lower elevations within the Upper Bear Creek Watershed Analysis Area represents a moderate to high resistance to control under average climatic conditions. Most of the timber stands have a dense overstory and a moderate amount of ground fuel and ladder fuels are present. This creates optimal conditions for the occurrence of crown fires which could result in large stand replacement fires. This type of fire also presents an extreme safety hazard to suppression crews and the public.

Air Quality

Levels of smoke or air pollutants have only been measured over the past three to four decades. The Clean Air Act directed the State of Oregon to meet the national ambient air quality standards by 1994. The Oregon Smoke Management Plan identifies strategies to minimize the impacts of smoke from prescribed burning on smoke sensitive areas within western Oregon. Particulate matter the size of 10 microns (PM10) or less is the specific pollutant addressed in this strategy. The goal of the Oregon Smoke Management Plan is to reduce particulate matter emissions from prescribed burning by 50 percent by the year 2000 for all of western Oregon. Particulate matter has been reduced by 42 percent since the baseline period (1991).

Currently, the population centers of Grants Pass and Medford/Ashland are in violation of the national ambient air quality standards for PM10 and are classified as non-attainment areas for this pollutant. The non-attainment status of these areas is not attributable to prescribed burning. Major sources of particulate matter within the Medford/Ashland area are smoke from woodstoves (63 percent), dust, and industrial sources (18 percent). Prescribed burning contributes less than 4 percent of the annual total.

Emissions from wildfires are significantly higher than from prescribed burning. The wildfires that occurred in southern Oregon in 1987 emitted as much particulate matter as all other burning that occurred within the state that year. Prescribed burning under spring-like conditions consumes less of the larger fuels creating fewer emissions. Smoke dispersal is easier to achieve due to the general weather conditions that occur during the spring. The use of aerial ignition reduces the total emissions by accelerating the ignition period and reducing the total combustion process due to the reduction of the smoldering stage.

The visual effect of smoke produced from prescribed burning could reduce visibility within a project area or could concentrate the smoke around a project site or surrounding drainages. Prescribed burning would comply with the guidelines established by the Oregon Smoke Management Plan and the Visibility Protection Plan.

TERRESTRIAL WILDLIFE SPECIES AND HABITATS

Wildlife - General

The Upper Bear Creek Watershed Analysis Area is primarily comprised of the following natural plant communities as described by Brown (1985): grass-forb dry hillside, mountain shrubland and chaparral, deciduous hardwood, mixed coniferous forest and high temperate coniferous forest. Cropland is present in the lower elevations, particularly along major streams. Emigrant Reservoir is a commanding feature of the analysis area and provides habitat for a number of large waterbody related species, e.g., waterfowl and shorebirds.

These habitats support approximately 260 species of terrestrial vertebrate species that are known or suspected to be present in the analysis area. This total includes both resident and migrant species. Table 17 lists species that are representative of the non-coniferous, non-cropland plant communities and the various condition classes of the coniferous plant communities.

Table 17. Representative Wildlife Species

Condition Class	Representative Species
Grass-Forb Dry Hillside	Gopher snake, western meadowlark, California ground squirrel
Mountain Shrubland and Chaparral	Western fence lizard, wrentit, dusky-footed woodrat
Deciduous Hardwood Forest	Ringneck snake, acorn woodpecker, western gray squirrel
Seedling/Sapling	Northwestern garter snake, mountain quail, pocket gopher
Pole (5-11" DBH[1])	Southern alligator lizard, golden-crowned kinglet, porcupine
Mid Seral (11-21" DBH)	Ensatina, Steller's jay, mountain lion
Mature/Old-Growth (21+" DBH)	Northern spotted owl, northern flying squirrel

1/ DBH = diameter at breast height

The quality of habitat provided by the various plant communities and condition classes in the analysis area varies considerably. Some areas of high quality habitat remain in each of the plant communities present. Generally, however, existing habitat conditions are in a declining state. Native grass-forb dry hillside habitat is being replaced by introduced noxious species, e.g., yellow starthistle, and by encroaching mountain shrubland communities. Most regeneration of mountain shrubland habitat is dependent on fire, and in its absence (due to fire suppression), the trend has been toward senescence with little regeneration. The result is a lack of early seral habitat in this plant community. Abundance and condition of oak-woodland/deciduous hardwood habitat has decreased due to the encroachment of conifers, overstocking of oaks in some areas, and removal for agriculture and development purposes.

In the coniferous plant communities, snags and down woody material are probably inadequate in much of the early seral and pole condition classes due to past timber harvest. Fire suppression has contributed to some pole and mature conifer stands becoming more dense than they would have under natural fire regimes. The high stem density in these stands result in reduced intrastand structure which in turn results in reduced species richness. The abundance of mature/old-growth habitat has declined due to timber harvest, and that which remains is quite fragmented which makes it less functional for interior species.

Although supportive data are unavailable, the general decline in habitat condition probably has not resulted in a significant decrease in the variety of wildlife species. However, there has likely been substantial change in species abundance and distribution.

Rock outcrops and the associated talus, and caves provide special/unique wildlife habitats in the analysis area. In combination with the proper microclimatic conditions these habitats are important for some species, e.g., mollusks and bats.

Threatened/Endangered Species

Bald eagle and northern spotted owl, both federally listed as threatened species under the auspices of the Endangered Species Act of 1973, are present in the analysis area. There are nine known spotted owl nest sites/activity centers and one known bald eagle nest site.

A draft management plan has been prepared for the bald eagle site by Oregon Eagle Foundation personnel (Oregon Eagle Foundation 1995). This draft plan provides proposed site specific management recommendations for the nest site and primary foraging area (Emigrant Lake and surrounding area).

There are approximately 14,970 acres of suitable northern spotted owl habitat within the analysis area; approximately 7,390 acres on BLM-managed land and 7,580 acres on privately owned land. Suitable habitat provides nesting, roosting or foraging functions for spotted owls, and generally has the following attributes: high degree of canopy closure (approximately 60 percent or more), multilayered canopy, and presence of large snags and coarse woody material. Approximately 3,045 acres of the suitable habitat on BLM-managed land are in the Jenny Creek/Soda Mountain Late-Successional Reserve (LSR). The LSR was designated under the Northwest Forest Plan (USDA and USDI 1994a) as part of an interacting reserve system with the objective of protecting and enhancing conditions of late-successional and old-growth forest ecosystems which serve as habitat for late-successional and old-growth related species including the northern spotted owl (USDA and USDI 1994a). This LSR in conjunction with the Ashland LSR to the west provide a link between the Western Cascades and Klamath Mountains Physiographic Provinces.

Northern Spotted Owl Critical Habitat

Approximately 9,725 acres of the analysis area are in designated northern spotted owl critical habitat unit (CHU) OR-38 (Map 20). The U.S. Fish and Wildlife Service designates critical habitat to preserve options for recovery of the species by identifying existing habitat and highlighting areas where management should be given high priority (USDI, FWS 1992). In the case of the northern spotted owl, critical habitat was designated to protect clusters of reproductively-capable owls and to facilitate demographic and genetic interchange (USDI 1992). A primary reason for designating CHU OR-38 was to facilitate linkage between the Western Cascades and the Klamath Mountains physiographic provinces (USDI, FWS 1994). CHU OR-38 is in the South Ashland I-5 area of concern where linkage between physiographic provinces is felt to be at risk due to past management practices (USDI, FWS 1992).

Approximately 5,735 acres of CHU OR-38 are in the Soda Mountain/Jenny Creek LSR, and the remaining 3,995 acres are in the matrix land allocation as described in the Northwest Forest Plan (USDA and USDI 1994a). Approximately 3,045 acres of the 5,735 acres in the LSR are suitable northern spotted owl habitat, and approximately 1,890 acres in matrix are considered suitable habitat. Six of the nine spotted owl nest sites/activity centers are within CHU OR-38. Map 20 shows critical habitat and LSR boundaries within the analysis area and the distribution of suitable habitat within the CHU and LSR.

Special Status Species

Special status species include those species that are listed by the U.S. Fish and Wildlife Service as threatened or endangered, proposed for listing as threatened or endangered, candidates for listing as threatened or endangered, or are listed by the BLM as sensitive or assessment species.

Nineteen special status species are known or suspected (based on known range and availability of suitable habitat) to be present in the Upper Bear Creek Watershed Analysis Area. Table 18 lists the species, status, and primary reason(s) for listing as special status species.

Table 18. Special Status Terrestrial Vertebrate Wildlife Species

Species	Status[1]	Primary Reason(s) for Status
Western Pond Turtle (*Clemmys marmorata*)	BS	Habitat loss/degradation, predation
Sagebrush Lizard *(Sceloporus graciosus*)	BS	Restricted range
California Mountain Kingsnake (*Lampropeltis zonata*)	BA	Demand by collectors. Spotty distribution
Common Kingsnake (*Lampropeltis getultus*)	BA	General rarity, demand by collectors, spotty distribution
Northern Spotted Owl (*Strix occidentalis caurina*)	T	Loss of habitat
Bald Eagle (*Hailaeetus leucocephalus*)	T	Shooting, pesticides, disturbance
Northern Goshawk (*Accipiter gentilis*)	BS	Loss of habitat
Great Gray Owl (*Strix nebulosa*)	BS/PB	Loss of nesting/roosting habitat
Northern Saw-whet Owl (*Aegolius acadicus*)	BA	Loss of habitat
Pileated Woodpecker (*Dryocopus pileatus*)	BA	Loss of habitat

Species	Status[1]	Primary Reason(s) for Status
Lewis' Woodpecker (*Asyndesmus lewis)*	BA	Fire suppression, salvage logging following fires
Western Meadowlark (*Sturnella neglecta*)	BA	Urbanization
Western Bluebird (*Sialia mexicana*)	BA	Urbanization, salvage logging, competition for nests
Townsend's Big-eared Bat (*Plecotus townsendii*)	BS	Limited suitable habitat, declining populations, susceptibility to human disturbance
Fringed Myotis (*Myotis thysanodes*)	BS	General rarity, susceptibility to human disturbance
Long-eared Myotis (*Myotis evotis*)	BS	Roosting/hibernacula habitat loss, susceptibility to human disturbance
Yuma Myotis (*Myotis yumanensis*)	BS	Lack of information, susceptibility to human disturbance
Long-legged Myotis (*Myotis volans*)	BS	Roosting/hibernacula habitat loss, susceptibility to human disturbance
Pacific Pallid Bat (*Antrozous pallidus)*	BS	General rarity, lack of information

1/ Status:
T = Listed as threatened under the ESA
BS = Bureau sensitive
BA = Bureau assessment
PB = Protection Buffer

Survey and Manage Species, Protection Buffer Species, and Bat Roost Sites

Nine species known or suspected to be present in the analysis area are afforded extra protection in the Northwest Forest Plan (NFP) under Standards and Guidelines for Survey and Manage Species (S&M), Protection Buffer Species (PB), and Bat Roost Sites. These species are: blue-grey taildropper (S&M slug), Oregon shoulderband (S&M snail), great gray owl (PB); Townsend's big-eared bat, fringed myotis, silver-haired bat, long-legged myotis, long-eared myotis, and pallid bat (Bat Roost Sites).

The NFP requires surveys, using developed protocol, for S&M and PB species in areas where there will be ground-disturbing activities. Surveys have not yet been conducted in the analysis area because no ground-disturbing activities have been proposed since implementation of the NFP. Because so little is currently known about the S&M mollusk species in this region, it is possible that when surveys are conducted several other S&M species may be found.

Deer and Elk

Roosevelt elk and black-tailed deer are other species of management concern present in the analysis area. These animals receive considerable public attention due to their recreational value; both consumptive and non-consumptive. Two areas in the analysis area have been identified for special management - Emigrant Creek Deer Winter Range and a portion of the Grizzly Peak Elk Management Area (Map 21).

Management for deer and elk in these areas is focused primarily on improving forage and cover conditions and decreasing the density of roads that are open to vehicular traffic, particularly in the winter period. Winter range is located at lower to mid-elevations in the analysis area, and generally on south to west facing slopes where solar radiation is most intense. Concentrating foraging and other life functions on these aspects allows the animals to maintain normal body temperature with less energy expenditure. Elk winter range is located at higher elevations than deer winter range.

High quality winter forage is important in the maintenance of healthy productive herds since this period is generally the most demanding in terms of physiological stress, e.g., maintaining body temperature. Winter forage, however, is declining in both quality and quantity in the analysis area. Introduced noxious herbaceous species, such as yellow starthistle and medusahead wildrye, which do not provide quality forage, are displacing native grasses and forbs which generally do provide high quality forage. Also, due primarily to fire suppression, browse species such as wedgeleaf ceanothus have become decadent, and are not providing the quality forage that younger plants provide. Oak-pine woodlands of the low elevations that would normally provide forage in the form of mast are being lost to development.

Hiding cover is important to deer and elk because it provides areas for escaping predators and avoiding disturbances caused by other mechanisms, such as off-highway vehicles (OHVs) and other vehicular use of open roads. Paradoxically, fire suppression which has negatively affected forage conditions, has generally improved hiding cover conditions in the analysis area. In the absence of fire, shrubs and trees that provide hiding cover have become more dense.

Both winter and summer thermal cover generally have canopy closure values in excess of 60 percent. The high canopy closure moderates microclimatic extremes, and can benefit deer and elk by reducing the energy required to maintain body temperatures.

HYDROLOGY

For purposes of the hydrology discussion, the Upper Bear Creek Watershed Analysis Area is stratified into three subwatersheds: Upper Emigrant Creek, Lower Emigrant Creek, and Walker Creek (Map 11).

Groundwater

The complex geology in the Upper Bear Creek Watershed Analysis Area provides for considerable variation in groundwater supplies. Lands adjacent to Emigrant Creek from the mouth to Carter Creek and lands adjacent to Carter Creek are formed from nonmarine sedimentary rocks and are generally capable of yielding 5-15 gallons per minute (gpm) to wells, but yields range from less than 1 to more than 50 gpm (Robison 1972). Water is usually of suitable chemical quality, but contains some constituents in excessive quantities in a few areas. The rest of the analysis area is primarily in the Roxy Formation which is capable of yielding 10 gpm or more to wells where sufficient saturated thickness is penetrated. Water is probably of suitable chemical quality for most uses (Robison 1972).

Water rights for groundwater in the analysis area are minimal, 1.64 cubic feet per second (cfs) for irrigation use and 0.22 cfs for industrial use (OWRD 1999). Groundwater uses exempt from water rights include: stock watering, lawn or non-commercial garden watering of no more than 0.5 acres, and single or group domestic purposes for no more than 15,000 gallons per day. No information is available regarding the amount of exempt uses.

Streamflow

Peak Flow

Based on historical records from U.S. Geological Survey gaging stations within or adjacent to the analysis area, maximum peak flows generally occur from December through February. These high flows are often a result of rain-on-snow storm events that occur when a substantial amount of rain falls on snow accumulated in the transient snow zone (elevation zone of approximately 3,500 to 5,000 feet). The combination of rain moving into the stream channels and the rapid snowmelt can result in flooding. A recent example of a rain-on-snow event that lead to flooding in the Bear Creek Watershed occurred on January 1, 1997. The transient snow zone occupies 35,868 acres (51 percent) of the analysis area (57 percent of Upper Emigrant Creek Subwatershed, 31 percent of Lower Emigrant Creek Subwatershed, and 61 percent of Walker Creek Subwatershed).

Upland disturbances, both natural and human-caused, occurring individually or in combination can result in increased magnitude and frequency of peak flows. Increases in size and frequency of peak flows may result in accelerated streambank erosion, scouring and deposition of stream beds, and increased sediment transport. The natural upland disturbance having the greatest potential to increase the size and frequency of peak flows is a severe, extensive wildfire. Loss of large areas of vegetation due to a wildfire would likely adversely affect the analysis area's hydrologic response. The primary human-caused upland disturbances that can potentially affect the timing and magnitude of peak flows include roads, soil compaction (due to land development, logging, agriculture, and grazing), and vegetation removal (due to timber harvest and conversion of sites to agriculture use).

Roads quickly transport shallow subsurface flow intercepted by roadcuts and water from the road surface to streams (Wemple 1994). The road-altered hydrologic network may increase the magnitude of peak flows and alter the timing when runoff enters a stream. This effect is more pronounced in areas with high road densities and where roads are in close proximity to streams. Map 4 gives a visual portrayal of road densities for all ownerships and Map 18 highlights sections with road densities greater than 4.0 miles/square mile. These sections with high road densities are listed in Appendix H. Road and stream crossing information is shown in Table 19 for subwatersheds in the analysis area. Sections with road/stream intersections greater than 10 per square mile are included in Appendix H. Upper Emigrant Creek Subwatershed has a greater road density than the other subwatersheds in the analysis area. Areas adjacent to upper Emigrant Creek and the Baldy Creek drainage area have road densities greater than 4.0 miles/square mile. In the Lower Emigrant Creek Subwatershed, several sections in the headwaters of Sampson Creek have high road densities. In the Walker Creek Subwatershed, the highest road densities are found in the Cove Creek drainage area.

Table 19. Road Information by Subwatershed

Subwatershed	Total Road Miles[1]	BLM Roads[2] (percent)	Road Density (miles per sq. mile)	Stream Crossings (number)	Road Surface Type (miles)			
					Natural	Rock	Bitum.	Unknown
Upper Emigrant Creek	127.6	32	3.3	306	18.7	29.3	12.1	67.5
Lower Emigrant Creek	76.2	20	2.5	123	1.4	13.2	11.2	50.4
Walker Creek	115.6	27	2.9	347	6.9	18.4	16.3	74.0
Total	319.4	27	2.9	776	27.0	60.9	39.6	191.9

1/ Roads shown on the GIS transportation theme.
2/ Roads with BLM control or on BLM-administered land.

Soil compaction resulting from roads, yarding corridors, agriculture, and concentrated livestock grazing also affects the hydrologic efficiency within a watershed by reducing the infiltration rate and causing more rainfall to quickly become surface runoff instead of moving slowly through the soil to stream channels (Brown 1983). Soil compaction data has not been compiled for the analysis area.

Vegetation removal reduces interception and transpiration and allows more precipitation to reach the soil surface and drain into streams or become groundwater. Until the new vegetation obtains the same crown closure as the previous unmanaged stand, it is considered to be hydrologically unrecovered. Douglas-fir and white fir stands are considered to be 100 percent hydrologically recovered when they obtain 70 percent crown closure. Pine stands reach 100 percent hydrologic recovery when the crown closure is 30 to 50 percent; 30 to 40 percent would be for south and west aspects, while north aspects would be at 40 to 50 percent.

The estimated percent hydrologic recovery by subwatershed is shown in Table 20. This data was calculated by applying recovery factors to the vegetation information derived from Western Oregon Digital Image Processing satellite imagery data (see Landscape Vegetation Pattern section). Areas classified as water, rock, and grassland/shrubland are considered fully recovered for this analysis. Urban/agricultural areas are treated as 0 percent recovered. Recovery factors for hardwood and forested areas are based on full hydrologic recovery occurring when a forest stand reaches 75 percent crown closure (see Table 20, footnote 1). Forest stands with 40 percent crown closure are considered to be 50 percent recovered and forest stands with a crown closure of 5 percent or less are treated as 0 percent recovered. Upper Emigrant Creek appears to be the only subwatershed that is in good hydrologic condition. Lower Emigrant Creek and Walker Creek subwatersheds are in fair hydrologic condition due to the large amount of agricultural lands.

Large areas of vegetation removal in the transient snow zone are of particular concern due to alterations of the streamflow regime and resultant increased peak flow magnitudes (Christner and Harr 1982). Estimated percent of hydrologic recovery in the transient snow zone is shown in Table 20. The transient snow zone for all three subwatersheds in the analysis area appears to be in good hydrologic condition.

Table 20. Estimated Percent of Hydrologic Recovery by Subwatershed

Subwatershed	Percent of Area Hydrologically Recovered[1]	
	All Lands	Transient Snow Zone
Upper Emigrant Creek	76	79
Lower Emigrant Creek	58	75
Walker Creek	64	72
Total	66	75

1/ The satellite imagery data is only available in 10 percent increments, starting at 5 percent, so full recovery had to be taken at 75 percent instead of 70 percent. Also, the satellite imagery data does not have the capability of distinguishing between tree series and the pine stands had to be treated the same as Douglas-fir. Therefore, the percent hydrologic recovery shown in Table 20 is a conservative estimate.

In addition to the upland disturbances, Emigrant Dam has moderated downstream high flows in Emigrant and Bear Creeks, resulting in fewer and smaller peak flows. No streamflow records exist for the analysis area prior to the completion of Emigrant Dam, thus it is not possible to compare pre- and post-dam streamflows.

Low Flow

Summer streamflows in the Walker Creek and Upper Emigrant Creek Subwatersheds reflect the low summer rainfall (Figure 1, Characterization section) and sustained high evapotranspiration. During the irrigation season, most of the water is diverted from Emigrant Creek into the Ashland Lateral above the reservoir or it is released from Emigrant Lake into the East Lateral and Emigrant Creek. Summer streamflows in Emigrant Creek below the dam are increased by releases from the reservoir; however flows downstream are diverted for irrigation. The greatest need for water occurs during the summer when demand for irrigation and recreation use is highest.

Total quantities of water are not sufficient to satisfy all existing uses of water in the Bear Creek Watershed (OWRD 1989). No water right applications may be filed for waters in the Bear Creek Watershed except appropriations for beneficial uses involving stored water (OWRD 1989). The Oregon Department of Fish and Wildlife filed an instream flow water right application in 1990 for anadromous and resident fish habitat in Bear Creek downstream of the analysis area.

Map 22 displays diversion point locations associated with places of use within the analysis area. Water diversions are scattered throughout the analysis area. Carter and Tyler Creeks have the highest number of diversions in the Upper Emigrant Creek Subwatershed. In Lower Emigrant Creek Subwatershed, diversions are primarily located at the reservoir and on the main stem of Emigrant Creek. Cove and Frog Creeks have the majority of diversions in the Walker Creek

Subwatershed.

Table 21 presents water right information obtained from the Oregon Water Resources Department (OWRD 1999) for the analysis area. The majority of water right diversions in the analysis area are used for irrigation; this includes 290 cfs used by the Talent Irrigation District from Emigrant Creek and the reservoir.

Table 21. Surface Water Rights

Area	Water Use (cfs)					
	Irrigation	Fish/Willife	Agriculture	Industrial	Domestic	Total
Emigrant Creek and Tributaries	299.87	0.05	0.33	1.50	0.68	302.43
Walker Creek and Tributaries	8.01	0.52	1.00	0.10	0.09	9.72
Totals	307.88	0.57	1.33	1.60	0.77	312.15

Source: OWRD 1999

Trends

Peak flows in Walker and Emigrant Creeks are not expected to noticeably change in the future. They will likely continue to result from major storm events that include rapid melting of snow in the transient snow zone. It is expected that peak flows in the headwater streams on federal forest lands will decrease slightly as the areas continue to recover hydrologically. Reduced harvest and restoration efforts under the Northwest Forest Plan (USDA and USDI 1994a) will accelerate the recovery process. Roads will continue to affect peak flows, although road decommissioning or obliteration will reduce the potential for peak flow increases.

The low summer flow situation in the analysis area is not likely to change substantially in the future. Years with below normal precipitation will be especially critical for fish and other instream uses. Increased development in the analysis area will place higher demands on streamflow. However, new water diversions are only being approved for stored water, therefore, there will not be any additional year-round withdrawals.

STREAM CHANNEL

Stream survey data is lacking for most streams in the analysis area. The only surveys completed to date were conducted by the Oregon Department of Fish and Wildlife (ODFW) in 1997 on Emigrant Creek above the mouth of Tyler Creek, and on a portion of Sampson Creek. ODFW survey data is used extensively in the following discussions on these stream channels and their associated riparian areas and aquatic wildlife species and habitats. Descriptions of streams that have not been surveyed are based on aerial photos and field observations by BLM personnel.

The Level I Rosgen stream channel morphology classification system (Rosgen 1996) was used to classify streams in the analysis area and the results are shown on Map 14. A variety of channel morphologies exist, ranging from Rosgen type Aa+ to type G. Appendix E provides descriptions of Rosgen morphological stream types. Current stream channel conditions are discussed by subwatershed in the following text.

Walker Creek

Walker and Emigrant Creeks join to form Bear Creek. Walker Creek drains the north and northeast portions of the analysis area. It is the largest of the three subwatersheds with an area of 25,487 acres of which 4,796 acres or 19 percent, are under BLM management. Lower Walker Creek flows through a narrow valley from its mouth upstream for a distance of 2.3 miles. Land uses along the lower portion of Walker Creek are rural residential and agriculture. The gradient in this reach is flat to moderate. The Rosgen channel type for this reach is F which describes it as entrenched and meandering with riffle/pool characteristics. The stream is confined by the Dead Indian Memorial Highway on the left bank which greatly restricts its ability to meander and to maintain a functioning floodplain. Substrate material is cobble, gravel, and fines. Above this point, Walker Creek becomes confined in a V-shaped valley with adjacent steep hillslopes, and the gradient begins to steepen. Rosgen channel typing becomes A and Aa+ which are characterized as steep, entrenched or deeply entrenched, cascading, high energy streams with step/pool contours. These are transport reaches with no floodplain. Substrate material is mostly cobble, boulder, and bedrock.

Cove Creek enters Walker Creek from the east about one mile above the mouth. The lower mile of Cove Creek flows through the same narrow valley as Walker Creek, and above that section it becomes confined and its gradient begins to increase. The lower portion of Cove Creek is a Rosgen type B channel which describes it as moderately entrenched with a moderate gradient that is riffle dominated. Cobble and gravels make up the substrate.

Frog Creek, the second major tributary to Walker Creek, enters from the east at 2.7 miles above the mouth. This stream is also steep and confined and has type Aa+ and A channel characteristics.

Lower Emigrant Creek

The Lower Emigrant Creek Subwatershed is the smallest of the three subwatersheds in the analysis area. It covers an area of 19,636 acres, but only 4,046 acres, or 21 percent of the area, is managed by the BLM.

Emigrant Creek, a fifth order stream, follows the valley floor from the mouth of Walker Creek upstream to the dam at Bounds Reservoir, a distance of approximately 3.25 miles, then another 0.5 mile to Emigrant Dam. Bounds Reservoir is a privately owned instream impoundment. The stream gradient in this lower reach of Emigrant Creek is fairly flat, averaging around 2 percent. There are three different Rosgen channel types between the mouth of Emigrant Creek and Emigrant Dam. The lower section (approximately two miles in length) is a type B channel that is moderately entrenched with a moderate gradient. The middle section, that extends approximately one mile below Bounds Reservoir, is typed DA and has multiple channels that are narrow and deep. The upper section that terminates at Emigrant Dam is typed G, which is an entrenched gully with a moderate gradient. Streamflow in this reach is totally dependent on releases from

Emigrant Dam, and the streambed is occasionally de-watered between October 15 and April 15, when the reservoir is filling. This reach does not experience flooding except during major flood events because of the control of outflow at the dam. Sediment and gravels are trapped by Emigrant Reservoir and not transported through this portion of the stream. Land uses along this portion of stream are also rural residential and agriculture.

Sampson Creek, the only major tributary to Emigrant Reservoir, enters the lake near the upper end of the Emigrant Creek arm. ODFW conducted a physical stream survey on this stream in 1997, but because they were not allowed access to the lower 1,900 meters, detailed information for that reach is lacking. The section they did survey includes 1,766 meters (1.08 miles) and extends upstream to the confluence of East Fork Sampson Creek. The survey reported it to be a riffle dominated stream. It is classified as a Rosgen type F channel, which indicates an entrenched meandering channel on a low gradient with high width-to-depth ratio. Above East Fork, the gradient steepens and the channel type changes to A. The gradient in the surveyed section averages between 3.8 and 4.5 percent, and the stream is confined in a narrow valley. There are few pools and all are less than 1 meter deep. Coarse woody debris amounts to less than one piece per 100 meters, and all of it is relatively small diameter. Surveyors found a very high level of silt, up to 40 percent of substrate composition, in the first 100 meters. The predominant material is cobble with a high percentage of sand. The surveyed area had about 60 percent shading. Above East Fork Sampson Creek, the gradient increases and becomes a type A channel.

Upper Emigrant Creek

The Upper Emigrant Creek Subwatershed begins at the upstream end of Emigrant Reservoir. The subwatershed is the second largest subwatershed in the analysis area and covers an area of 25,108 acres. The BLM administers 7,630 acres, or 30 percent of the subwatershed. Major tributaries in the subwatershed, progressing upstream, are Carter, Tyler, Baldy, Green Mountain, and Porcupine Creeks.

Above the reservoir, Emigrant Creek maintains a flat to moderate gradient within the confines of a narrow valley for a distance of 2.7 miles. Once Emigrant Creek reaches the confluence of Tyler Creek it becomes constrained by moderate to steep hillslopes within a V-shaped valley.

The physical stream survey completed in 1997 by the ODFW included 8,000 meters (approximately 4.9 miles) of Emigrant Creek above the confluence of Tyler Creek (ODFW 1997). Data from the survey indicates that the gradient of the stream increases from about 3 percent at the mouth of Tyler Creek to nearly 6 percent at the mouth of Porcupine Creek. Stream substrate is a mix of bedrock, cobble, and fines, and stream habitat is dominated by rapids and scour pools. There are few pools in Emigrant Creek, far less than the >35 percent desired ODFW benchmark, and most of the pools are less than one meter in depth with some notable exceptions. The survey noted that there is very little coarse woody debris in the stream. Even in the best reaches it does not exceed eight pieces per 100 meters, and most of it is small diameter material. Substrate material is 20 to 30 percent silt. Many reaches have a high percentage of bedrock (up to 40 percent), with the remainder primarily composed of gravel and cobble. The entire survey section is well shaded (75-80 percent).

More detailed ODFW stream survey data is provided in Appendix J for Sampson Creek and upper

Emigrant Creek. Appendix J, Figure J-1 shows percent of pool, glide, riffle, and rapid areas, while Figure J-2 is a graph depicting residual pool depth. Appendix J, Figure J-3 shows wood volume and number of pieces per 100 meters and Figure J-4 shows wood diameter per 100 meters. Gradient for the surveyed sections of upper Emigrant and Sampson Creeks is depicted in Appendix J, Figures J-5 and J-6, respectively. Percent substrate in upper Emigrant Creek is given in Figure J-7 and the percent substrate in Sampson Creek is displayed in Figure J-8. The final graphs in Appendix J show the percent of open sky in upper Emigrant Creek (Figure J-9) and Sampson Creek (Figure J-10).

Major tributaries in this subwatershed have not been surveyed. Carter Creek is the first major tributary to Emigrant Creek above its confluence with Emigrant Reservoir. This tributary terminates in a narrow valley where the primary use is agriculture. Headwater reaches are steep and confined to V-shaped valleys with steep hillslopes. Approximately one mile of the lower reach is a Rosgen type B channel and all upper reaches have channels that are described as types A or Aa+.

The other major tributaries in the Upper Emigrant Creek subwatershed have gradients that are steep, usually greater than 10 percent, and channels are entrenched with steep hillslopes. Most of these stream channels are Rosgen type Aa+. Transported material is quickly moved through these reaches, and what is not deposited in upper Emigrant Creek or along its limited floodplain ends up in Emigrant Reservoir. Substrate in these upper tributaries is mostly bedrock and cobble. There is little woody material in most of these streams, but shading is fairly good.

Stream Channel Trend

The trend for stream channel condition on BLM-managed land should improve over the long term as conifers and hardwoods in riparian areas increase in size and have greater potential to provide shade and ample quantities of downed woody material. An increase in instream woody material will capture flood born material, create meander, and improve other aspects of stream morphology such as pool/riffle relationship, and hiding cover and spawning gravels for native fish. As sources of sediment and causes of bank disturbance are better identified and corrected there will be less sediment released into streams and disturbed streambanks will become more stable and vegetated.

WATER QUALITY

Section 303(d) of the Clean Water Act requires each state to identify streams, rivers, and lakes that do not meet water quality standards even after the implementation of technology-based controls. These waters are referred to as "water quality limited" and states are required to submit 303(d) lists to the Environmental Protection Agency every two years. Water quality limited waters require the application of total maximum daily loads (TMDLs) which is a strategy for improving water quality to the point where recognized beneficial uses of the waters are fully supported. A TMDL addresses pollution problems by identifying those problems, linking them to watershed characteristics and management practices, establishing objectives for water quality improvement, and identifying and implementing new or altered management measures designed to achieve those objectives (ODEQ 1997). A Water Quality Management Plan (WQMP) that will serve as a TMDL to address nonpoint sources will be prepared for Bear Creek in 2000. Agencies involved in developing the WQMP include the Oregon Department of Environmental Quality (ODEQ), Oregon Department of Agriculture (ODA), Oregon Department of Forestry (ODF), the U.S. Forest Service (Rogue River National Forest), and the BLM (Medford District).

The Oregon Department of Environmental Quality's 1998 list of water quality limited streams includes streams within the Upper Bear Creek Watershed Analysis Area (Table 22, Map 23).

Table 22. Water Quality Limited Streams

Stream Name	Description	Parameter
Baldy Creek	Mouth to headwaters	Temperature - summer
Carter Creek	Mouth to headwaters	Temperature - summer
Emigrant Creek	Mouth to Emigrant Reservoir	Nutrients (TMDL approved 12/92) Temperature - summer
Emigrant Creek	Emigrant Reservoir to Green Mountain Creek	Temperature - summer
Hobart Creek	Mouth to headwaters	Temperature - summer
Tyler Creek	Mouth to headwaters	Temperature - summer
Walker Creek	Mouth to headwaters	Temperature - summer

Source: ODEQ 1999

The ODEQ's 1988 Oregon Statewide Assessment of Nonpoint Sources of Water Pollution (NPS Assessment) identifies three stream segments in the analysis area that are impacted by nonpoint source pollution. Table 23 identifies the impacted beneficial uses in each stream segment and Table 24 lists the probable causes and associated land uses.

Table 23. Waterbodies Included in ODEQ's Nonpoint Source Assessment

Stream Name	ODEQ Segment ID	Segment Location	Parameter of Concern
Emigrant Lake	285	Reservoir	Aquatic weeds or algae Nutrients Sedimentation Turbidity
Emigrant Creek	286	Emigrant Reservoir to headwaters	Flow modification Sedimentation
Walker Creek	405	Mouth to headwaters	Aquatic weeds or algae Bacteria Nutrients

Source: ODEQ 1988

Table 24. Probable Causes and Land Use Associated with Nonpoint Source Pollution

ODEQ Segment ID[1]	Probable Cause of Nonpoint Source Pollution	Land Use Associated with Nonpoint Source Pollution
285	Landslides, surface erosion, traffic, and vegetation removal	Non-irrigated cropland/pastureland, livestock grazing, boating, camping, storm/flood, drought, and geologic hazards
286	Surface erosion and water withdrawal	Irrigated cropland/pastureland
405	None listed	None listed

1/ See Table 23 for segment location.
Source: ODEQ 1988

Water quality parameters most critical to the beneficial uses (Characterization section, Water Quality) in the Upper Bear Creek Watershed Analysis Area are: flow modifications, temperature, dissolved oxygen, pH, bacteria/pathogens, algal growth, turbidity, sedimentation and habitat modifications. Flow and habitat modifications are discussed in Hydrology and Aquatic Wildlife, respectively. The processes and disturbances affecting the other critical water quality parameters and current conditions are described below.

Temperature

Many factors contribute to elevated stream temperatures in the analysis area. Low summer streamflows, hot summer air temperatures, low gradient valley bottoms, lack of riparian vegetation, and high channel width-to-depth ratios result in stream temperatures that can stress aquatic life. Natural disturbances that can affect stream temperature are climate (high air temperatures), below normal precipitation (low flows), wildfires (loss of riparian vegetation), and floods (loss of riparian vegetation). Human-caused disturbances having the potential to affect stream temperatures include water withdrawals, channel alterations, reservoirs, and removal of riparian vegetation through logging, grazing, or residential clearing.

The State water quality criteria for temperature is established to protect resident fish and aquatic life, and salmonid fish spawning and rearing. The temperature standard for summer temperatures in the Rogue Basin was revised in January 1996. The standard now states that the seven day moving average of the daily maximum shall not exceed 64ºF. Streams in the analysis area that exceed the temperature standard are listed in Table 22 as water quality limited.

Continuous summer stream temperatures have been measured by Friends of the Greensprings (FOG) since 1996 at many locations within the analysis area. Table 25 lists the temperature site locations, the seven day average maximum temperatures, and the number of times that the seven day average maximum temperature exceeded the State temperature standard.

Table 25. Stream Temperature Monitoring Data

Site Location	1996		1997		1998	
	7 Day Ave. Max. Temp.	# Times 7 Day Ave. Max. > 64ºF	7 Day Ave. Max. Temp.	# Times 7 Day Ave. Max. > 64ºF	7 Day Ave. Max. Temp.	# Times 7 Day Ave. Max. > 64ºF
Baldy Cr @ Emigrant Cr	--	--	65.3	20	--	--
Carter Cr @ Emigrant Cr	71.6	11	66.6	26	--	--
Carter Cr @ Sec. 3 SENE	--	--	74.8	61	78.0	62
Emigrant Cr abv Baldy Cr	67.5	24	68.9	46	--	--
Emigrant Cr abv Carter Cr	67.9	20	66.5	52	65.3	38
Emigrant Cr @ Hwy 66	72.2	--	67.5	51	66.1	43
Emigrant Cr @ Pwr Plant	80.5	--	--	--	76.0	77
Emigrant Cr @ Sec 13 SESW	--	--	66.7	21	--	--
Emigrant Cr @ Sec 35 SWNW	--	--	55.3	0	--	--
Hobart Cr @ Tyler Cr	68.6	26	--	--	68.3	35
Schoolhouse Cr @ Tyler Cr	--	--	--	--	73.6	77
Tyler Cr abv Hobart Cr	68.6	33	--	--	70.1	55
Tyler Cr @ Buckhorn Road	--	--	78.1	34	81.5	79

Source: Friends of the Greenspring (1996, 1997, and 1998) and Brazier (1998)

Dissolved Oxygen

Dissolved oxygen concentration refers to the amount of oxygen dissolved in water. Dissolved oxygen is critical to the biological community in the stream and to the breakdown of organic material (MacDonald et al. 1991). Dissolved oxygen concentrations are primarily related to water temperature (MacDonald et al. 1991). When water temperatures increase, oxygen concentrations decrease. Oregon's dissolved oxygen standard was revised in January 1996. The new standard describes the minimum amount of dissolved oxygen required for different water bodies (i.e., waters that support salmonid spawning until fry emergence from the gravels, waters providing cold water aquatic resources, waters providing cool-water aquatic resources, etc.).

Several sites on Emigrant Creek, above and below the reservoir, were monitored for dissolved oxygen concentration during 1975 and 1976 (USDI, GS 1980). None of these samples exceeded the State dissolved oxygen criteria existing at that time. The Rogue Valley Council of Governments (RVCOG) has been monitoring water quality on Walker Creek just above the confluence with Emigrant Creek once or twice a month for the past two years. Provisional monitoring data from RVCOG show dissolved oxygen levels measured during the period from January 1997 to February 1999 range from 7.3 to 11.9 mg/l (RVCOG 1999). Low dissolved oxygen levels occur during the summer months when water temperatures are high and streamflows are low. No streams within the analysis area have been listed as water quality limited for dissolved oxygen or having it as a parameter of concern. Friends of the Greensprings (FOG) plan to conduct dissolved oxygen monitoring at many stream locations within the analysis area during 1999.

pH

pH is defined as the logarithmic concentration of hydrogen ions in water in moles per liter. pH can have direct and indirect effects on stream water chemistry and the biota of aquatic ecosystems. pH varies inversely with water temperature and shows a weak inverse relationship to discharge. Forest management activities can indirectly increase pH through the introduction of large amounts of organic debris and by increasing light to streams (MacDonald et al. 1991). State water quality criterion for pH in the Rogue Basin ranges from 6.5 to 8.5.

Water samples were measured for pH at several sites on Emigrant Creek (above the reservoir, at Emigrant Road, and above the Walker Creek confluence) during 1975 and 1976 for two of the sites and during 1972-1974 for the site above Walker Creek (USDI, GS 1980). Four of the seven samples taken at the Emigrant Road site exceeded the State pH criterion; pH measured at the other two sites did not exceed the State criterion. Provisional data results from RVCOG's water quality monitoring in Walker Creek above the confluence of Emigrant Creek show pH levels ranging from 7.7 to 8.44 during the period from January 1997 to February 1999 (RVCOG 1999). No streams within the analysis area are on the 303(d) list for pH or have it identified as a parameter of concern.

Bacteria/Pathogens

Waterborne pathogens include bacteria, viruses, protozoa, and other microbes that can cause skin and respiratory ailments, gastroenteritis, and other illnesses. Most drinking and recreational waters are routinely tested for certain bacteria that have been correlated with human health risk. If the average concentration of these bacteria falls below the designated standard, it is assumed that the water is safe for that use and that there are no other pathogenic bacteria that represent a significant hazard to human health (MacDonald et al. 1991). The four groups of bacteria most commonly monitored are total coliforms, fecal coliforms, fecal streptococci, and enterococci. Fecal coliform bacteria are mostly those coliform bacteria that are present in the gut and feces of warm-blooded animals. They can be directly linked to sanitary water quality and human health risks.

State water quality criteria for bacteria states that for a 30-day log mean of 126 *Escherichia coli* (a species of fecal coliform) organisms per 100 ml, based on a minimum of five samples, no single sample shall exceed 406 *E. coli* organisms per 100 ml (ODEQ 1996). The purpose of the bacterial water quality standard is to protect the most sensitive designated beneficial use, which has been identified as water contact recreation.

ODEQ's NPS Assessment (1988) identified bacteria as a parameter of concern in Walker Creek. This was based on observation with no supporting data. RVCOG's provisional fecal coliform monitoring data from Walker Creek above the confluence of Emigrant Creek varies from 0 to 1,600 organisms per 100 ml between January 1997 and February 1999 (RVCOG 1999).

Aquatic Weeds or Algae

Benthic algae is an important component of the overall food web, particularly in gravel-bedded headwater streams. Increased benthic algal production is linked to increased production of benthic invertebrates and fish in streams (MacDonald et al.1991). However, nocturnal respiration can cause oxygen depletion in waters with high primary production and low reaeration rates. Development of anaerobic conditions will alter a wide range of chemical equilibria, and may mobilize certain chemical pollutants as well as generate noxious odors Aquatic weeds or algae in lakes can be ecologically important habitats, but can also adversely impact recreational uses such as swimming and boating, and also degrade the esthetic value. Algae can also influence the color and taste of water (MacDonald et al. 1991).

The principal factors having the potential to contribute to algal growth include direct solar radiation, and the availability of nitrogen and phosphorous. Removal of riparian canopy will increase direct solar radiation and may result in increased benthic algal growth. Human-caused increases in nitrogen concentrations include logging, prescribed fire, fertilization, inadequate human waste disposal, and livestock. Phosphorus concentrations in the aquatic ecosystem can be increased through human-caused actions such as phosphate fertilizers, human waste, and livestock.

The State water quality criterion for aquatic weeds or algae is “the development of fungi or other growths having a deleterious effect on stream bottoms, fish, or other aquatic life, or which are injurious to health, recreation, or industry shall not be allowed.” Beneficial uses affected include water contact recreation, aesthetics, and fishing (ODEQ 1998). The State water quality criterion for phosphorus in Bear Creek is 0.08 mg/l of total phosphorus from May 1 thru Nov. 30.

Emigrant Lake and Walker Creek have been identified as having aquatic weeds or algae in ODEQ’s NPS Assessment (ODEQ 1988). Provisional results from total phosphorus monitoring by RVCOG between May 1 and Nov. 30, 1997 ranged from 0.062 to 0.427 mg/l and between May 1 and Nov. 30 1998 samples ranged from 0.101 to 0.264 mg/l (RVCOG 1999). Friends of the Greensprings (FOG) plan to conduct phosphorus monitoring at many stream locations within the analysis area during 1999.

Sediment and Turbidity

Sedimentation is the natural process of sediment entering a stream channel. However, an excess of fine sediments (sand-size and smaller) can cause problems such as turbidity (the presence of suspended solids) or embeddedness (buried gravels and cobbles). Sedimentation is generally associated with storm runoff and is highest during fall and winter. Natural processes occurring in the analysis area such as landslides, surface erosion, wildfire, and flood events contribute to increased sedimentation.

Accelerated rates of upland erosion in the analysis area are primarily caused by logging and road building. Clearcuts in unstable areas are prone to landslide activity. Older roads with poor locations, inadequate drainage control and maintenance, and no surfacing are more likely to erode and cause the sedimentation of stream habitats.

Concentrated livestock grazing in riparian zones, residential clearing of riparian zones, irrigation ditch blowouts, and poor irrigation practices all contribute to sedimentation. Streambank erosion is accelerated by riparian vegetation removal. Annual maintenance of many diversion structures (especially push-up gravel dams) and irrigation return flows also cause sedimentation.

During stream surveys in 1997, Oregon Department of Fish and Wildlife (ODFW) measured a high percentage of fine sediment in Emigrant Creek from Tyler Creek to just above Porcupine Creek (ODFW 1997). Low to moderate amounts of bank erosion were observed by the stream survey crew and attributed to high winter flows. A major hillslope failure and several active landslides were observed by ODFW in the reach from Tyler to Baldy Creeks. Sediment delivered to upper Emigrant Creek generally ends up in Emigrant Reservoir.

The ODFW 1997 stream survey also covered approximately one mile of Sampson Creek just over a mile above the confluence with Emigrant Lake. This reach was observed to have a high percentage of fines (32 percent). A high percentage (99.5) of the reach was noted as having actively eroding stream banks.

Severe channel erosion has occurred in Schoolhouse Creek, a tributary to Tyler Creek, when it is used as an alternate diversion channel for water transported from Howard Prairie Reservoir (Edwards 1999).

The State water quality criterion for sedimentation states that "the formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious to fish or other aquatic life or injurious to public health, recreation, or industry shall not be allowed." Beneficial uses affected include resident fish and aquatic life, and salmonid fish spawning and rearing (ODEQ 1998). The State water quality criterion for turbidity states "no more than ten percent cumulative increase in natural stream turbidities shall be allowed, as measured relative to a control point immediately upstream of the turbidity causing activities." Beneficial uses affected are resident fish and aquatic life, water supply and aesthetics.

Provisional data results from RVCOG's water quality monitoring in Walker Creek above the confluence of Emigrant Creek show turbidity levels ranging from 0.96 to 161 NTUs during the period from January 1997 to February 1999 (RVCOG 1999).

ODEQ's NPS Assessment (1988) identified sedimentation as a parameter of concern in Emigrant Lake and Emigrant Creek and turbidity as a parameter of concern in Emigrant Lake.

Trend

Water temperatures in the headwaters may show some improvement in the long term as the Northwest Forest Plan is implemented on federal lands and riparian vegetation recovers along the tributary streams. However, high stream temperatures will likely persist on the lower reaches due to water withdrawals, high width-to-depth ratios, and lack of riparian cover.

The dissolved oxygen, pH, bacteria, and algae levels are not expected to change in the future within the analysis area. Sedimentation and turbidity will vary depending on the amount of soil disturbing activity in the analysis area. Timber harvest and road construction in unstable areas will likely result in additional sediment delivery to nearby streams. New road construction will likely result in increased surface erosion while road decommissioning should decrease sediment and turbidity levels.

RIPARIAN AREAS

Stream side vegetation varies considerably in the Upper Bear Creek Watershed Analysis Area depending on aspect and elevation. Oak savannah plant communities extend into the riparian zone in most lower reaches of the analysis area. Emigrant Creek up to the mouth of Tyler Creek, the lower 2.5 miles of Walker Creek, and lower reaches of Sampson and Carter Creeks fall under this dry-land influence. California black oak, Oregon white oak, and Oregon Ash are common components of overstory riparian vegetation. Other deciduous trees, most commonly red alder, provide a discontinuous diversity. Big-leaf maple, black cottonwood, Ponderosa pine, Douglas-fir, and incense cedar, while not common, are also present. Common understory plants are poison oak, manzanita, wedgeleaf ceanothus, and willow. A mixture of native and introduced grasses and yellow starthistle provide much of the ground cover in these lower reaches. This variety of trees and shrubs provides remarkably good shading, however there are short interruptions in riparian cover due to agricultural and urban development.

Riparian growth in drainages flowing from the east exhibits a pronounced influence from aspect. South facing slopes have dryland plant components while north facing slopes are covered with a mixture of coniferous and deciduous vegetation.

Douglas-fir and red alder provide good stream shading along Emigrant Creek above the mouth of Tyler Creek. This combination gives way to a white fir dominated plant community near the highest elevations in the analysis area.

Interim Riparian Reserve widths from the Northwest Forest Plan Standards and Guidelines (USDA and USDI 1994a:C-30) are recommended for the Upper Bear Creek Watershed. Map 15 shows Riparian Reserves in the analysis area.

Riparian Areas Trend

Implementation of Aquatic Conservation Strategy Objectives (USDA and USDI 1994a:B-11) and establishment of Riparian Reserves on BLM-administered lands will result in protected and improved riparian habitat over the long period. The use of silvicultural treatments within riparian stands could improve the health, vigor, and diversity of these areas. Stream shading will improve and the potential for use by wildlife should increase.

AQUATIC WILDLIFE SPECIES AND HABITATS

Fishery resources in the Upper Bear Creek Watershed Analysis Area include an assortment of resident and introduced fish. The lower 2.5 miles of Walker Creek and the lower 0.75 mile of Cove Creek are important spawning habitat for summer steelhead. Winter steelhead are known to spawn in Emigrant Creek downstream of Bounds Reservoir. The periodic watering and drying of this portion of stream due to regulated streamflow at Emigrant Dam may result in failure of spawned fish eggs to hatch successfully. Even if spawning is successful, rearing of juvenile fish may be threatened by manipulation of streamflow. Summer and winter steelhead and coho may have migrated some distance up Emigrant Creek before Emigrant Dam was constructed in 1924. Emigrant Creek contains suitable spawning and rearing habitat for these fish up to the mouth of Green Mountain Creek.

Both resident rainbow and cutthroat trout reside in the analysis area, but reports of species distribution were sketchy prior to 1999. The 1997 ODFW stream survey of Emigrant Creek noted trout upstream to the mouth of Porcupine Creek, but apparently no effort was made to identify them as to species. A BLM fishery biologist confirmed the presence of cutthroat trout in Porcupine Creek (Bessey 1999). The *Draft Medford Grazing Management Program Environmental Impact Statement* (USDI, BLM 1983:24) lists cutthroat trout in 0.75 miles of Emigrant Creek, 1.35 miles of Tyler Creek, 0.50 miles of Baldy Creek, 0.30 miles of Green Mountain Creek, and 1.00 mile of Porcupine Creek. This information was based on some early surveys that determined fish presence in streams without attempting to find upstream limits.

Additional information regarding fish resources in the Upper Bear Creek Watershed was obtained in 1999. An electrofishing survey conducted by BLM in January 1999 in the lower 0.25 mile of Tyler Creek revealed the presence of native rainbow trout. Friends of the Greensprings observed trout in Tyler Creek near the mouth of Schoolhouse Creek in August 1999 (Prince 1999). This agrees with previous records. In July, BLM fisheries biologists electrofished a 0.5 mile section of upper Cove Creek, tributary to Walker Creek, and found a healthy population of rainbow trout above a 30 foot waterfall. Fish in this portion of stream had been previously reported as summer steelhead.

Other electrofishing sampling was done by ODFW in the spring of 1999 to determine upstream limits of fish and included many streams not previously sampled or surveyed. Table 26 summarizes ODFW's electrofishing results in the Upper Bear Creek Watershed Analysis Area. Resident trout were found in over 21 miles of stream.

Table 26. Results of ODFW 1999 Electrofishing Surveys (ODFW 1999)

Stream	Approximate Miles of Fish Bearing	Aquatic Species Found[1]
Sampson Creek	4.8	Rb
East Fork Sampson Creek	0.3	Rb
West Fork Sampson Creek	0.2	Rb
Unnamed tributary #1	0.1	Rb
Hill Creek		
Cougar Gulch	0.5	Rb
Emigrant Lake		
Unnamed tributary #1	0.03	Salmonids
Unnamed tributary #2	0.02	Salmonids
Carter Creek	3.6	Rb; Sc
Steinman Creek	0.15	Rb
Emigrant Creek (Above Emigrant Lake)	7.5	Ct
Tyler Creek	0.4	Rb; Sc
Buckhorn Springs Creek	0.07	Rb
Baldy Creek	1.7	Rb; Ct
Unnamed tributary	0.05	Ct
Unnamed tributary	0.03	Rb
Green Mountain Creek	1.2	Rb; Ct
Porcupine Creek	0.15	Sc; PGS
Spring Creek	0.5	Ct; PGS
Unnamed tributary	0.2	Ct
Total miles of fish bearing streams	21.5	

1/ Rb = Rainbow Trout; Ct = Cutthroat Trout; Sc = Reticulate Sculpin; PGS = Pacific Giant Salamander.

Suitable spawning and rearing habitat for resident trout is in short supply throughout much of the analysis area. There are very few deep pools, over a meter, that can be used for resting and rearing. Fine gravel, used for spawning, is limited to small deposits in many stream reaches. Bedrock areas are extensive and lack hiding cover.

The Oregon Department of Fish and Wildlife annually releases hatchery-reared rainbow trout into Emigrant Reservoir, and has released steelhead and coho in the past. In the spring these trout accumulate at the inflow of Emigrant Creek, and some fish move into the stream above the lake. A fishery has developed around this activity. It is unknown how far upstream these non-native fish go, but it is assumed that they have altered the genetic integrity of native fish in a portion of this stream.

The reticulate sculpin is the only native non-game fish known to reside in the analysis area. BLM and ODFW sampling efforts found this species in lower Tyler Creek and Porcupine Creek, but it is suspected to be as widespread as trout species. It is assumed this fish resides in Walker Creek and Emigrant Creek downstream of Emigrant Dam as well.

In addition to introduced trout, Emigrant Reservoir supports populations of several warm-water fish species. Included are largemouth bass, smallmouth bass, bluegill sunfish, pumpkinseed sunfish, yellow perch, black crappie, and brown bullhead. A channel catfish was netted in the lake by ODFW in 1996. It is unknown if this species is reproducing in the lake. In the 1970s, golden shiners were illegally introduced into Emigrant Reservoir as well as several other lakes in southwestern Oregon. This member of the minnow family is native to eastern United States.

There is little information available about other aquatic resources in the analysis area. Pacific tree frog and Pacific giant salamander are present, and rough-skinned newts and foothill yellow-legged frog suspected residents because of the close proximity to populations known to exist in the Jenny Creek and Klamath-Iron Gate Watersheds. No in-depth surveys have been conducted on macroinvertebrates, so the composition of this resource is unknown. Perennial springs in the Upper Bear Creek Watershed Analysis Area were surveyed for aquatic mollusks in 1998. The Fredenberg pebblesnail (*Fluminicola n. sp. 17),* a survey and manage species, was found in two springs located high up in the Sampson Creek drainage.

Aquatic Wildlife Species and Habitats Trends

On BLM-administered land, populations of fish, other aquatic organisms, and riparian dependent wildlife and their habitats should show continued improvement in most stream segments in the analysis area. Improvements in watershed conditions should moderate stream flow and temperature, create more shading, produce greater stream channel complexity, and reduce introduction of sediment. These improvements are expected to increase potential for production of fish and other aquatic organisms and for birds, mammals and herptiles using riparian habitat.

Generally, no changes are anticipated for aquatic resources in Emigrant Reservoir, however, additional exotic species, such as channel catfish, may become established in the lake.

Anadromous fish in lower Emigrant Creek, below Emigrant Dam, will continue to suffer from periodic de-watering unless a minimum flow is established.

REFERENCE CONDITIONS

The purpose of the reference conditions section is to explain how ecological conditions have changed over time as a result of human influences and natural disturbances. This section provides a reference for comparison with current conditions.

HUMAN USES

Introduction

This brief environmental history traces the major interactions of past human inhabitants with the land, and suggests some effects of these interactions upon the land. Historic information is always incomplete, often anecdotal, and rarely quantifiable. Yet the story presented here provides some glimpses into the past, and something of a road map to the conditions we now face as we enter a new century.

Prior to describing this history, very brief review of the climate history of the last 10,000 years is presented as part of the long story of the environment of the Upper Bear Creek Watershed Analysis Area.

Paleoclimates

A recent analysis of a pollen core from Bluff Lake in California provides a record of long-term climate change in this region for over 10,000 years (Mohr 1997). Bluff Lake is located about 40 miles south of the California state line (near Mt. Shasta) at an elevation of about 6,300 feet, in Township 40 South, Range 6 West, Section 9, Mt. Diablo Meridian. A long core was taken from the lake and pollen counts from the core were used to reconstruct the surrounding vegetation. Past vegetation patterns were then used to infer past climates. The study yielded the following sequence.

> 13,500 BP (Before Present): cooler and wetter than present; relatively closed pine and fir forest.
>
> 10,000 - 7,500 BP: warm, dry conditions prevail; fir and subalpine taxa disappear, open forests of oak and juniper appear, and mid-elevation conifers become established, along with a montane chaparral-type shrub understory; fire becomes an important element in maintaining xerophytic ("dry-loving") vegetation.
>
> 7,000 BP: slightly cooler, though conditions remain warmer and drier than at present.
>
> After 4,000 BP: the climate becomes increasingly cooler and wetter; fir and pine become more abundant and oak declines; fire intervals become less frequent.
>
> 2,000 BP: forests of modern composition become established after 2,000 years ago; fire

frequencies increase slightly, possibly due to burning by native peoples.

Native Inhabitants and the Land

Archaeological evidence indicates that people have inhabited the region for about 10,000 years. During the first several thousand years of human occupation, until about 7,000 years ago, human populations were very low and very mobile. People lived in small bands, and hunted and gathered throughout the landscape.

After about 7,000 years ago populations began to increase, and regular camps appear in the archaeological record in the analysis area. For the next 5,000 years people living in this region followed a remarkably stable pattern of existence, though towards the end of this period changes began to take place. During this time, native peoples lived in small bands, moving themselves seasonally about the countryside in search of valued resources, in increasingly well-defined group territories. Hunting was important, as was gathering root and seed crops. Archaeological sites dating throughout this period attest to the use of the Upper Bear Creek Watershed Analysis Area during this time. By the end of this period, however, significant changes appear in the archaeological record, signifying changes in the native way of life (Winthrop 1993).

This new way of life was well established after 2,000 years ago. It was characterized by larger populations, well-defined group territories, and a higher degree of sedentism than existed previously. Permanent villages, inhabited for at least part of the year, appear in the archaeological record. These villages were usually situated at lower elevations near major rivers and streams, reflecting a stronger emphasis on fish resources. Group interactions also intensified, evident in an increase in trade and warfare. Social hierarchies developed, with wealth items representing higher status among individuals or families. This way of life continued until the coming of Euro-Americans to this region.

The native people known as the Shasta were living in numerous villages in the Shasta Valley to the south and also inhabited the upper part of the Bear Creek Valley at the time of contact with Euro-Americans in the nineteenth century (Theodoratus 1984, Gray 1993). The Shasta, as well as the Klamath tribe from the Klamath River Basin to the east, used the uplands east of the Bear Creek Valley for a variety of resources, and there are numerous archaeological sites reflecting this use (Medford District archaeological site and survey files).

The Shasta, like other native peoples in the region, had developed a highly sophisticated understanding of the environment in which they lived and the resources on which they depended. As hunters/gatherers/fishers, they interacted with the environment to promote and enhance those foods and materials of most benefit to them. Roots and bulbs, such as camas and various forms of *perideridia* (e.g. ipos) provided starchy staples. Fish, especially anadromous fish such as salmon, and major ungulates (deer, elk) provided essential protein. Acorns from oak trees were another nutritious food. In addition, a wide variety of berries, nuts, seeds (e.g. tarweed seeds), fowl, and other game augmented the diet. Other plants and animals were used for a wide variety of necessary materials, for basketry, fiber, tools, clothing, and medicines.

Native peoples throughout the region employed a number of techniques to manage their environment. Their most important tool was fire. Fire was probably used by the Shasta for thousands of years but became a major tool for resource management during the last two thousand years, coinciding with expanding human populations and the advent of a cooler and wetter climate.

Fire was used for a variety of purposes (LaLande and Pullen 1999). Fire was used in hunting to drive game animals to the kill, and for the longer-term goal of improving and maintaining wildlife habitat. Open, park-like forests were also a goal, because they made hunting easier. Fire assisted in promoting and maintaining staple crops, such as acorns from oak trees. Fire maintained open meadows and prairies, both in the uplands and valleys, which were crucial locations for subsistence resources including game, roots, bulbs, berry patches, and grass seeds.

Native peoples used fire for specific purposes and carefully regulated its use. Burning took place at certain times (mainly spring and fall) and at specific intervals, and contributed to the development of the prairies and savannahs of the valleys, oak and oak/pine woodlands of the foothills, and the meadows of the uplands.

Archaeological and historic evidence documents a substantial native presence in the upper Bear Creek Valley. Archaeological evidence also documents use of the upland meadows and plateaus, such as in the Soda Mountain area. These areas would have been subject to those techniques the native peoples employed to enhance the resources present, and fire was a significant factor affecting the landscape in the valleys and in the uplands.

Early Explorers

Early explorers and traders began passing through the area in the nineteenth century. Beginning with Peter Skene Ogden in 1827, these people left occasional descriptions of the world through which they passed. These descriptions provide the earliest historic evidence we have of the environment.

Ogden was an employee of the British Hudson's Bay Company, which had a base along the Columbia River to the north. Sent out on a mission to discover and deplete the beaver of the southern Oregon country, Ogden followed the Klamath River, coming from the Klamath Basin into what is now northern California in 1827 (LaLande 1984:40-43).

Ogden continued on to the Shasta Valley, then turned north to cross the Siskiyous in the vicinity of present-day Interstate 5. He entered the Bear Creek Valley, following Hill Creek, and camped near today's Emigrant Lake. His descriptions of the landscape are glowing (LaLande 1984:52-55):

> "...all here looks like summer...green grass and four inches in length and from the size of the wood the Oaks here being nearly double the size of any I have seen this season induces me to suppose that the Climate is milder...Shortly after we were encamped an Indian came boldly to my tent and presented me with two fresh salmon".

According to LaLande, the oaks were probably California black oak, and Ogden had entered the oak savannah of the southern part of Bear Creek. The mention of fish is the earliest reference to salmon in this watershed, and probably indicates their presence in local streams at that time.

Ogden continued on through the area of present-day Ashland and Talent, where his descriptions of the environment grew even more appreciative:

> "..we encamped on a large Fork form'd by a number of small Streams which we crossed in our travels this day... and in many of them not long since there were beaver...this is certainly a fine Country and probably no Climate in any Country equal to it...from the singing of Birds of all kinds, grass green and at its full growth Flowers in Blossom...at present it is certainly a country well adapted from its Soil and timber (Oaks and Pine) for cultivation. The natives inform us that Deer are abundant in the hills and Mountains...from their being all well clad in Leather I can well believe them....Arrow quivers made of Beaver Skins also their Caps...Racoons are certainly numerous in this Country...The croaking of Frogs last night certainly surprised me...field mice are numerous all over the Plains.

These statements, taken from various passages of Ogden's journal (LaLande 1984:59-64), describe a few warm days in February, and give an brief view of the landscape through which he passed. Beaver were abundant in the streams, which followed meandering courses through the valley, hosting numerous frogs and providing good habitat for birds and raccoons. Oak and pine dotted the landscape, with lush native grasses carpeting the hills and valley. Field mice attest to an open, lightly wooded environment (LaLande 1984:64), and deer were plentiful in the hills.

Many others would follow in Ogden's footsteps over the next few decades (Dillon 1975). The trappers would deplete the beaver in the streams, following the Hudson's Bay Company policy of creating a "fur desert" to discourage competition from Americans; explorers and other travelers would also spread disease and engage in hostile actions with the local peoples. Some would also comment on the environmental conditions along the trail.

Lieutenant Emmons, a member of the U.S. Navy Exploring Expedition (the Wilkes Expedition) was one such commentator. Traveling south through the Rogue and Shasta valleys in late September and early October of 1841, he noted large prairies south of the Rogue River with deer, bear, camas roots, rabbits, antelope and coyotes, and a few frightened Indian women digging roots. He also noted an Indian woman setting fire to the prairie somewhere near today's Ashland (Dillon 1975:316), and complained frequently of the parched earth and smokey air. He noted ridges burning on the Rogue-Klamath divide to the south, and the barren plains of the Shasta valley to the south, blackened by recent grass fires (Dillon 1975:320).

Lindsay Applegate camped at Emigrant Creek in July of 1846, on an expedition to open a new road to the Willamette Valley. He recorded his impressions of the valley at that time:

> "It seemed like a great meadow interspersed with oaks which appeared like vast orchards. All day long we traveled over rich, black soil covered with rank grass, clover and peavine..." (quoted in O'Harra 1985:17).

A few other early descriptions of the environment come from the first surveyors to enter this country shortly after Euro-American settlement in the 1850s. Records from an 1855 railroad survey noted that the summit of the trail crossing the Siskiyous was densely timbered, but that as the trail headed south there were comparatively few trees near the base of the mountains (Webber 1985:235).

These early travelers, of whom Ogden and Emmons were but a few, came through the Upper Bear Creek Watershed Analysis Area on their way to other places. None, before the discovery of gold in the early 1850s, came to stay. Yet these people brought a new way of interacting with the land, and their actions affected the landscapes through which they passed.

All of the travelers lived off the land as they passed through. Trappers also removed many beaver, with the intent of hunting them to extinction. Removal of these animals may have affected the watercourses within which they lived, as beaver dams decayed and stream courses became more channeled.

Perhaps more importantly, these early travelers spread disease and pillaged the resources of the native peoples through whose lands they passed. The resulting ill-will culminated in a series of brutal battles during the period of pioneer settlement in the 1850s, known as the Rogue River Indian Wars. At the end of the wars in 1856, surviving native people from the Rogue Valley were removed to distant reservations, and the way of life of those Shasta left in the Shasta Valley was radically changed. The carefully maintained prairies, meadows, and woodlands of the native landscape began to disappear.

After the wars, the Shasta managed to maintain a presence in the Shasta valley. Today Shasta descendants still use portions of the area to gather various traditional materials, such as basketry materials and medicinal plants. Certain parts of the landscape, such as Pilot Rock and Sentinel Rock retain sacred significance for the Shasta. Well into the twentieth century, Shasta traveled from the Shasta Valley to upper Bear Creek, in the vicinity of Emigrant Lake, to gather traditional foodstuffs such as acorns, berries, and wild plums, and to fish for trout (Morse 1993).

Early Historic Period (1850 - 1900)

Although the analysis area does not contain a major settlement, it is tied to the towns and cities (Ashland and Medford) nearby, and development in the adjacent Rogue Valley affected use of the land in the analysis area. Settlement of the valley occurred in the 1850s following the discovery of gold in mountains west of the watersheds, and the consequent influx of miners and settlers during that period. (Despite some exploratory work in the 20th century, there has been virtually no mining in the analysis area (Pickthorn et al. 1990:C3)). The Oregon Donation Land Claim Act of 1850 also stimulated settlement; by the middle of the 1850s most of the valley land within the upper Bear Creek Valley (in the vicinity Ashland) was claimed and settled (Fagan 1994:3-13). Around the turn of the century, a second wave of homesteaders attempted to settle marginal lands, some of these in the eastern part of the Upper Bear Creek Watershed Analysis Area.

In the decades following the removal of the native peoples, the major activities characterizing the new human interactions with the landscape developed. By the turn of the century, these interactions had already brought significant changes to the land. These actions included ranching, logging, and agriculture. All involved some degree of resource extraction for economic benefit, and all depended upon the development of a sufficient infrastructure for movement of goods and information throughout the region.

Transportation and Communication

Most of the main routes through the area have a long history, and all were well established by the end of the nineteenth century (Fagan 1994; LaLande 1980; Klamath National Forest map archives). Early constructed roads were usually built on the flatter ground along streams and rivers where road construction was easier and access more important for homesteading, ranching, and mining.

Interstate 5: When Peter Skene Ogden came through in the 1820s he was following a well-established Indian trail. Over the next several decades, numerous others passed along this route, known as the Siskiyou Trail, from Oregon to California. In 1859, it was improved as a toll road for wagon travel. With the advent of the auto in the early twentieth century, the route was improved again as Highway 99. Today, Interstate 5 follows the ancient trail (Dillon 1975).

Highway 66: This route was opened by Willamette Valley settlers in 1846, and was known as the Applegate Trail. The route was improved as the Southern Oregon Wagon Road in 1872-73, and improved again in 1919 as Highway 66, for auto travel.

Dead Indian Memorial Road: This route followed an Indian trail over the Cascades. In 1867, Klamath Indians built a wagon road under the direction of O.C. Applegate. In the twentieth century, it was improved for auto travel.

Soda Mt. (Bald Mt.) Road: This road was built in 1927 to follow the power lines coming from Copco dam; it followed an old horse trail (Wright 1954).

Railroad: The north/south railroad connecting the Shasta and Rogue valleys to other major urban centers was completed in 1887. This development brought a huge boost to the region's economy, providing access to markets for timber, cattle, and agricultural produce (Jones 1980:247-251).

Communication developments were also critical. Local newspapers and regional road networks all appeared during this period, as did the telegraph in the 1880s.

As part of the process of incorporating the landscape into the new society, the federal government sent surveyors to map and record the newly acquired lands. These maps provide some brief descriptions of the land at the beginning of significant Euro-American use, and after the demise of the native way of life.

> In T40S/R3E, Willamette Meridian (WM) for example, the 1894 survey notes that the area around Soda Mt. and Little Pilot Rock is covered in dense brush and a scattering of timber.
>
> In T41S/R2E (WM), the 1856 survey noted the area around Pilot Rock as having a scattering of fir, pine, cedar, and oak, and good grazing.

Ranching and Agriculture

Ranching has been an important economic activity and way of life in the analysis area for almost 150 years. Demand from the miners provided local markets for ranchers in the Bear Creek Valley as early as the 1850s. Despite a slump in mining in the 1860s, local and regional markets led to further development of the industry in the 1860-70s, tied in part to the growing agricultural and timber economy. With the advent of the railroad in the 1880s, ranchers also had greater access to distant markets.

In the Upper Bear Creek Watershed Analysis Area, ranchers followed a migratory pattern, wintering cattle and sheep in the valley and driving them to the meadows and prairies of the Dead Indian Plateau in the spring (LaLande 1980:132). The eastern part of the analysis area--the foothills of the Bear Creek Valley--were used as pasture from the earliest days, and the uplands were used increasingly after the 1860s. In the 1870s-80s the expansion of local and regional markets led to the uncontrolled expansion of sheep and cattle grazing throughout the analysis area. Woolen mills in Ashland lasted until the 1930s, when the economic troubles of that era led to their closing. Sheep were largely gone from the ranching economy by the 1940s.

Although agriculture has not been as significant in the analysis area as it has been elsewhere in the region, developments in agriculture affected the area. Flour mills, established in Ashland in the 1850s, provided a market for wheat from local farmers in the analysis area. Irrigation accompanied the earliest settlement in the Bear Creek Valley and the earliest water rights to Bear Creek and its tributaries date from the 1850s and 60s (State of Oregon 1919). Most of these efforts were small in scale, with ditches leading from local streams to local farms.

In the 1870s the growth of the orchard industry in the Rogue Valley led to several significant effects (LaLande 1980). Major irrigation works expanded, although this expansion did not affect the Upper Bear Creek Watershed Analysis Area until the twentieth century. The orchard boom also led to a high demand for wood for crates, fueling the growing timber industry in the region. Both the orchard and logging industries, in turn, increased the demand for beef, with local ranchers provisioning loggers in the region (Hessig 1978).

Timber

Logging in the analysis area was a minor enterprise from the 1850-80s, spurred by the local needs of miners and settlers. Logging took place mainly at lower elevations. Sugar pine was a major target, and milling was done at small, local mills (LaLande 1980:135). Development of the railroad in the 1880s increased access both to markets and to timberlands.

In 1905 Weyerhaeuser acquired the railroad and timber company, and logged in the area until 1912 (Oetting 1996). Although these companies' major operations took place just outside the Upper Bear Creek Watershed Analysis Area, between about 1890 - 1915, various logging operations east of the analysis area may well have stimulated logging in the eastern part of the watershed. By the end of the nineteenth century, however, access still prevented logging in the higher and more mountainous portions of the analysis area.

Hunting and Recreation

Throughout the nineteenth century hunting and trapping continued intensively within the analysis area. There was an active market for deer hides and pelts (beaver and other types) (LaLande 1980:132; Hessig 1978:22). Hunting for sport continued, and ranchers sought to eliminate predators, especially cougars and grizzly bears, dangerous to their stock. Mountain sheep disappeared in the Shasta Valley in the 1880s (Hamusek et al. 1997:32), and the last grizzly bear--old "Reelfoot" was killed just south of Pilot Rock in 1890 (Wright 1954).

With the development of transportation networks and the settlement of the countryside, recreational pastimes became part of the pattern of land use as well. Mineral waters promoted the development of a hotel and other facilities at Colestein, located on the Siskiyou divide, and at Buckhorn Springs in the analysis area.

Effects Upon the Land

By the turn of the century, the new way of life introduced by Euro-American settlers was well entrenched and had brought significant changes to the land. The native peoples had been removed, and the careful caretaking philosophy that motivated their interactions with the landscape was also gone. Interestingly, the changes brought by the new way of life were not specifically linked to major changes in population; there were probably about as many people actually living within the analysis area before and after the shift from a native to a Euro-American way of life. The major changes were due in part to radical differences in economy and technology. These differences were reflected in early development of the infrastructure--roads and communication networks--which facilitated a market economy and the ranching, logging, and agricultural industries which depended upon it.

The Euro-American way of life brought rapid change to certain elements of the local environment. Major predators were hunted down or removed, as were major game animals. The absence of native burning began to change the character of the vegetation, especially of the meadows, prairies and grasslands, and oak and pine woodlands. Grazing, especially the unregulated grazing of the nineteenth century, affected native bunchgrasses. Ranchers burned to promote forage for their stock, but their burning was less discriminate than that of their native predecessors, and often escaped into major fires in the timberlands. Logging began to take out major timber reserves, especially sugar pine, where accessible (LaLande 1980). Agriculture introduced new species to the land, and roads and trails increased traffic of all kinds throughout the area.

There are several testimonies to these changes, written around the turn of the century. A study done in conjunction with the establishment of the national Forest Reserves (precursor to the National Forests), gives a brief, township-by-township description of the lands within part of the analysis area (Leiberg 1900). In this study the author frequently notes that fires have ravaged much of the timber, that the glades are badly overgrazed, and that some timbered areas have already been culled of their best portions.

Early Twentieth Century (c. 1900 - World War II)

The basic patterns for settlement within the analysis area remained largely unchanged during the first half of this century. A few small communities developed, such as Klamath Junction at the intersection of Highway 66 and Highway 99, in the analysis area (now under Emigrant Lake). A few get-rich-quick schemes also left their mark upon the land, such as the work at Shale City, promoted in the 1920s as a shale-oil venture in the analysis area (O'Harra 1985:155).

Ranching, Agriculture, Timber

Ranching and agriculture continued to be significant activities in the region. Ranching was primarily affected by the development of government regulations, which were instituted in response to the excesses of the late 19th century and to the continuous conflict among users over the range (Brown n.d.:41; LaLande 1980:140). The formation of cattle associations helped resolve some of these problems, and the Pilot Rock Grazing District was formed in 1934 to coordinate grazing issues across the California/Oregon border (USDI, BLM n.d.).

Agriculture continued strong in the Rogue Valley and was reflected in the Upper Bear Creek Watershed Analysis Area by the development of major irrigation networks. The Talent Irrigation District (TID) was formed in 1916. Emigrant Dam was built in 1924, and enlarged in 1960 (Galm 1993:30). The initial development inundated a number of historic ranches and earlier Shasta habitation sites; the town of Klamath Junction was covered by the 1960 reservoir enlargement. Hyatt Reservoir, immediately east of the analysis area, was constructed in 1923. These waterworks served to take water from and through the watershed, altering the natural hydrology of the region.

Major logging was already declining along the north rim of the Klamath River in the early part of this century. Weyerhaeuser pulled tracks in this area in 1912 and the mill at Pokegama closed (anon.,n.d.). After the First World War, however, technological and transportation improvements led to the establishment of several small mills along the Greensprings, just east of the Upper Bear Creek Watershed Analysis Area, which began drawing upon the timber reserves in that area (Foley 1994). In 1929, the Henry Lumber Mill opened on the Greensprings, built by John Higgins Henry and his son John Baldwin Henry. They also built the town of Lincoln in order to house the mill workers. Just after the mill opened, the Great Depression hit and the mill was forced to shut down until 1935 (Foley 1994:19-21).

Weyerhaeuser restarted operations in 1934 with a major mill east of the analysis area in Klamath Falls. As elsewhere in the country, however, the Depression of the 1930s served to dampen economic development, and the timber industry slumped until the demand of the Second World War brought new growth to the industry.

New Players in the Watersheds

The early decades of this century also witnessed the arrival of another significant force to the region: the federal government, in the form of land management agencies.

Partly in response to growing national concern over environmental degradation caused by land use practices of the nineteenth century, and partly out of concern over the loss of economic resources, the federal government instituted a system of federal reserves around the turn of the century. In Oregon, the Cascade Forest Reserve stretched almost to the California border, encompassing lands within the analysis area. These lands soon became part of the Crater National Forest, precursor to the Rogue River National Forest, and eventually those portions within the analysis area passed to management by the BLM. In the early part of the century, the failure of the O & C Railroad to comply with terms and conditions of their land grant resulted in the return of unsold sections of their land to the government. Most of the BLM-managed lands within the Upper Bear Creek Watershed Analysis Area came back to the government through this process.

Government management in these early days emphasized the regulation of hunting and grazing, and regeneration of the range. Fire suppression and timber management also received a high priority. Fire suppression especially became a mission, particularly in the Forest Service, with long-term consequences to the land. This perspective is eloquently expressed in the following quotes from a 1936 Klamath National Forest brochure:

> "The fire-protection policy of the Forest Service seeks to prevent fires from starting and to suppress quickly those that may start. This established policy is criticized by those who hold that the deliberate and repeated burning of forest lands offers the best method of protecting those lands from the devastation of summer fires. Because prior to the inauguration of systematic protection California timberlands were repeatedly burned over without the complete destruction of the forest, many people have reached the untenable conclusion that the methods of Indian days are the best that can be devised for the present...
>
> The stock argument of those who advocate the 'light burning' of forests is that fire exclusion ultimately leads to the building up of supplies of inflammable material to such an extent that the uncontrollable and completely destroying fire is certain to occur. The experience of the Forest Service in California, after 15 years or more of fire fighting, does not lead to any such conclusion...
>
> Fire exclusion is the only practical principle on which our forests can be handled, if we are to protect what we have and to insure new and more fully stocked forests for the future.."

Fire suppression was taken seriously in the area, and a fire lookout was established on Soda Mountain in 1933, and on Parker Mountain in 1943.

Effects Upon the Land

Land use practices in the first half of this century continued to foster changes begun in the nineteenth century, although government regulations served to improve some situations. Hunting regulations led to some regeneration of game species, and grazing regulations assisted in slowing the degeneration of the range and in regenerating some lands. However, native grasslands and meadows continued to be transformed. Among the factors affecting this transformation was the introduction of invasive weeds; one local resident remembered starthistle first appearing in the range east of Ashland in the 1930s (Jones 1990:8). Fire suppression policies began to affect the composition of local forests and to further the demise of the more fire resistant oak and pine woodlands. Water and fish resources were affected by the development of major irrigation and hydroelectric facilities.

Late 20th Century

During the second half of the twentieth century, developments in transportation and logging technology, as well as increased demand and substantial increases in prices (from $2.00 to $22.50/million board feet in 1951; Foley 1994:32) made logging possible and profitable throughout the analysis area. World War II spurred the economy and the lumber business worked at full production after 1942. Weyerhauser had completed a mill at Klamath Falls in 1929, and dove into production during the war years. Camp Four near the Greensprings Highway, which replaced the earlier Pokegama Camp, provided timber for the Klamath Falls mill. At this time, they began experimenting with sustained-yield management on their Oregon lands.

The main species targeted were sugar and yellow pine. The logging and reforestation practices differed between operators (Foley 1994:33). Some selectively cut, targeting diseased and dying or over-mature trees, leaving enough to reseed areas. Others clearcut and then left without planting, or clear-cut, burned the slash, then replanted the area with two-year old seedlings, depending on the economics of the situation.

Growing demand due to increasing local and distant populations also has brought greater recreational development to the area, stimulated in part by access made easy by more roads. Federal land use priorities are reflected in the land use policies of the government, which continues to manage significant portions of the analysis area.

EROSION PROCESSES

Historical erosion processes in the Upper Bear Creek Watershed Analysis Area were very similar to current day processes, but total volumes of sediment produced and delivered to streams were somewhat less. The mountainous sideslopes were the most erodible terrain of the analysis area. This landform generally has had, and continues to have, the steepest and most incised slopes of the analysis area. Types of historical erosion have been mainly sheet, ravel and minor gully erosion. A large volume of sediment has been transported to area streams via sheet erosion and raveling of materials over long periods of time.

The mountainous sideslopes also contained the most unstable terrain of the analysis area. Large earthflow landslides and smaller slumps and debris slides have continued over very long periods of time. Mass wasting helped shape today's topography; landslides are especially common in the upper portions of Walker, Frog (especially near Sharon’s Fen), and Emigrant Creeks. Slightly larger volumes of sediment and debris were produced from these processes than from surface erosion. A century ago there were fewer active landslides, because human activities were very minimal when compared to activities of the middle to late twentieth century.

The only other area with considerable erosion activity over time is in the southwestern portion of the analysis area where the granitic material of the Klamath Mountains is located. This parent material was very incompetent and highly erodible by water. This type of erosion has continued for several million years in this area. Stream channels were undermined by high flows during storm events and these processes continue to form highly incised stream channels. Larger streambank failures adjacent to steep slopes were common. Active channel erosion was also a common feature during the past three large floods and caused numerous problems downstream. This process was responsible for transporting large woody material from channel sideslopes into streams. This movement of woody material and sediment caused large changes in the stream channel and subsequent streambank erosion particularly in the lower portion of the analysis area.

Historically, the main natural agents capable of removing extensive soil cover in the analysis area were wildfires and floods. Throughout the late nineteenth and early twentieth centuries, large wildfires occurred periodically in the analysis area (see Human Uses). These large wildfires were often very detrimental to water quality and fisheries due to the surface erosion and mass wasting that occurred for the following one or two years. The highest erosion rates occurred when there was an intense storm event immediately following intense wildfires on erosive soils.

Due to fire suppression activities, topsoil loss has probably been reduced over the past 70 years since there have been fewer natural fires exposing soils. However, this situation sets up a higher risk that a hot burning wildfire might occur, causing severe soil erosion and landslide problems.

Slope instability and erosion processes have increased over time as a result of human influences in addition to the natural disturbances in the Upper Bear Creek Watershed Analysis Area (see Current Conditions, Erosion Processes for human impacts).

SOIL PRODUCTIVITY

Historic soil productivity conditions were much the same as they are today in areas that have not had much human disturbance. Productivity in the analysis area varies by elevation, aspect, topography, and bedrock. On the lava plateau, along the eastern edge of the analysis area, soils were inherently deep with fine to moderate textures. Topsoils were mainly thick and soils had a high porosity. Soil organic matter, duff, litter, as well as large woody material were abundant on most sites. These soil properties, along with the mild summer temperatures at these elevations, created site conditions of high productivity in the historic past.

Along the ridges, where soils are shallow and rocky, site productivity was very low. One of the primary reasons for this was the lack of adequate soil moisture holding capacity and lack of soil development, especially the development of a very thick topsoil. The parent material for many of these soils was very young, originating from volcanic activity that occurred in very recent geologic time. Drying winds and exposure to extreme cold temperatures was another major reason for the low site productivity.

The older soils of the mountainous sideslopes were relatively productive on the north aspects where the soils were deep. Many of these areas were associated with old landslides. On south slopes, however, productivity was low due to high evapotranspiration demands. Many of the south slopes had shallow, rocky soils that dried out early in the spring. Many of these sites supported only dry meadows or oak woodland.

LANDSCAPE VEGETATION PATTERN

The vegetation native to the Upper Bear Creek Watershed Analysis Area is a result of time and the unique geology of the area. Over the last 60 million years, vegetation has migrated into this area from six different directions: the Oregon and California coast ranges via the Siskiyou Mountains (red alder, Pacific madrone and bigleaf maple); the Sierras and Cascades (baneberry, Shasta red fir, sugar pine, manzanita spp. and California black oak); the Klamath River corridor, and lowland chaparral area (juniper and mountain mahogany) (Atzet 1994).

Natural change in landscape pattern is inherent; natural succession is continuously changing the vegetation and there is no single stage of a forest that can be considered to be the only natural stage. Leiberg (1900) wrote that prior to 1855, the Native Americans were responsible for frequent, small circumscribed fires which resulted in forest stands with diverse age classes. Leiberg also notes that T.38S., R.2E.; T.39S., R.2E.; and T.40S., R.2E. were badly burned throughout. He notes that burned tracts in T.38S., R.3E. do not reforest easily, but had become covered with dense brush. Grazing also prevents reforestation. In T.39S., R.3E. a large quantity of Douglas-fir, small in growth and badly damaged by numerous fires have overrun the township in recent times. Therefore, the Native Americans also created forest stands with various patch sizes.

After Euro-Americans arrived, the forest stands became more open (fewer vegetation stems on a unit of size basis) and the forest patch size increased because of logging and the more frequent use of fire for various reasons. Because of the frequent disturbance, there was more vegetation in the early and mid-seral stages of development. Mature and old-growth fire resistant trees species, such as pine species, Douglas-fir, and incense cedar with thick bark survived the fires.

Historic vegetation patterns are difficult to confirm because only government lands were mapped. According to the 1947 forest type map created by the Pacific Northwest Forest and Range Experiment Station (USDA 1947), the forests within the analysis area were predominantly composed of Douglas-fir, pine and hardwood mixtures. However, the historic vegetation matrix was probably grasslands. The northern half was mapped as Douglas-fir and ponderosa pine. There were larger expanses of grasslands scattered across the landscape as well. The higher elevations to the east and south were composed of small patches of large diameter Douglas-fir, pine, and white fir.

Fire was the primary biotic process influencing the vegetation landscape pattern. Dense patches of trees were probably subject to bark beetle attack when high stocking levels were present in conjunction with periods of drought. Pathogens were probably less noticeable because of a higher diversity of species making up the forest stands.

PLANT SPECIES AND HABITATS

Non-Native Plant Species and Noxious Weeds

Historically, herbaceous vegetation layers at all elevations in all habitats were composed of native plants. Herbaceous vegetation layers at lower elevations stayed greener later in the summer and probably produced less yearly flashy fuels. This presumably helped to keep wildfires at lower intensities. Native plant species diversity was higher in open areas at lower elevations. Pioneer native plant species colonized disturbed areas more readily than non-natives species.

A list of historically introduced plant species that commonly occur on rangelands within the analysis area appears in Appendix I. Little is known about the points of origin and distribution of these plants, a few of which are designated noxious weeds by the Oregon Department of Agriculture. Logical speculation favors assumptions that these weeds, as well as less pernicious species, were intentionally brought in by settlers for inclusion in gardens and then escaped, or were carried into the analysis area by animals or transport conveyances in early days as is known to be typical today. Long established non-native plant species in the analysis area include: softchess, orchard grass, cheatgrass, ripgut brome, medusahead wildrye, hegehog dogtail, bulbous bluegrass, St. Johnswort (Klamath weed), yellow starthistle, and spotted knapweed.

Special Status Plant Species and Habitats
Survey and Manage Plant Species and Habitats

In 1841, the United States Exploring Expedition probably passed through the southwest edge of the analysis area. This early scientific expedition included two botanists and several naturalists. These botanists collected specimens of vascular plants, fungi, mosses, algae, and lichens that were later identified by leading scientists specializing in these groups (Wilkes 1862; McKelvey 1956).

A review of the species lists from 1841 showed none of the species currently on either the Special Status Species list or the Survey and Manage Species list. Specific population and distribution data for this time does not exist, but the data suggests that these species were uncommon prior to Euro-American settlement.

Habitats that support the known species of rare plants in the analysis area have declined in area and in condition. Historical accounts of explorers and early forest inventories indicate more large diameter coniferous forests with different overstory and understory composition and structure. Also, much of the valleys were indicated to have been open oak woodlands and savannahs. The shrublands were maintained in a more open state.

Special Areas with Botanical Resources

Pilot Rock Area of Critical Environmental Concern (ACEC)

The Pilot Rock ACEC is largely unchanged from its pre-Euro-American condition. Structural and compositional changes to vegetation communities have occurred in all vegetation types because of road building, quarry development, fire suppression, and grazing. Forested stands are becoming overly dense at the understory level with white fir (*Abies concolor*). Oak woodlands, shrublands, and savannahs are also becoming overly dense and over-mature. Also, these communities have become dominated with weedy species at the forb level.

Cascade/Siskiyou Ecological Emphasis Area

Structural and compositional changes to vegetation communities have occurred in all vegetation types because of Euro-American uses and activities. Forested stands are becoming overly dense at the understory level with white fir (*Abies concolor*). Oak woodlands, shrublands, and savannahs are also becoming overly dense and overmature. Also, these communities have become dominated with weedy species at the forb level.

FOREST DENSITY AND VIGOR

Core samples from ponderosa pine and white fir between the ages of 187 and 280 years indicate that these present day, large diameter trees were free to grow when they first became established (USDI, BLM 1998a). This indicates low stocking levels or more open growing conditions. Sample trees grew 2 to 3 inches per decade in diameter and the diameter growth rate gradually decreased to 1.5 inches per decade over a period of 40 to 80 years. None of the sample trees were suppressed at the time of establishment. Tree diameter growth has been below 1.5 inches per decade since 1898.

Historical information is somewhat misleading in regard to actual tree stocking levels early in the 1900s. Although forest mapping indicated that there were few large trees on a per acre basis, natural regeneration was abundant. There were probably thousands of seedlings per acre. The 1947 USDA maps indicate that beneath the large diameter pine trees, there was a white fir and Douglas-fir understory.

As tree growth and vigor declined late in the 1800s, bark beetles probably started to become an important factor in changing the height and size class structure of the forests. The western pine bark beetle caused mortality in the large diameter ponderosa pine, the mountain pine beetle in patches of small diameter pine species, and the Douglas-fir bark beetle in suppressed Douglas-fir trees. Pathogens (root rot diseases) probably became more apparent as more even-aged stands became established and matured.

Forest stands are dynamic in nature and will continue to change in stocking levels and species composition over time.

FIRE AND AIR QUALITY

The historical fire regime of the Upper Bear Creek Watershed Analysis Area was characterized by frequent (1 to 25 years) and widespread fires resulting from the hot, dry summers. Accounts documented by early settlers of Oregon indicate that wildfires were common, widespread, and produced substantial amounts of smoke which impacted visibility and the health of local residents (Morris 1934). These periodic fires consumed understory and ground fuels thus leaving a large gap between the overstory and ground. This in turn reduced the probability of a crown fire. Typically, fire intensity was low because frequent fires limited the time for fuel accumulation. Consequently, the effects of individual fires on flora, fuels, and fauna were minor, creating a more stable ecosystem.

Fires maintained most valley bottomlands and foothills as grasslands or open savannas. Forests created from frequent, low intensity fires have been described as open and park-like, uneven-aged stands characterized by a mosaic of even-aged groups. Ponderosa pine, Douglas-fir, sugar pine, and white fir were the most common species. Depending on understory vegetation conditions, these species have some resistance to fire as mature trees. As saplings, ponderosa pine is the most resistant followed by sugar pine, Douglas-fir, and white fir. Frequent fires had major structural effects on young trees, favoring ponderosa pine as a dominant species and white fir as the least dominant in this forest type. Without fire, Douglas-fir and white fir became the dominant species because these species are more tolerant of understory competition than the pine species.

Wildfires were likely the primary emissions source that influenced air quality. During summer and early fall, ongoing wildfires, ignited by lightning, would flare up as weather conditions allowed. This likely caused intermittent smoke episodes throughout the region.

TERRESTRIAL WILDLIFE SPECIES AND HABITATS

Wildlife - General

Prior to Euro-American contact, Native Americans influenced habitat conditions in much of the analysis area through burning. The natives routinely burned areas to maintain conditions suitable for the plants and animals they relied upon for their subsistence, including roots, tarweed, deer, and elk. The native burning maintained an early seral condition in the grasslands, shrublands, mountain meadows and probably some of the forested areas. Due to these habitat conditions, deer and other species preferring these early seral conditions were probably quite abundant.

Grizzly bear, gray wolf, and other carnivores were likely found from the valley floor up and into the plateau. Healthy populations of beaver were likely present in the low gradient portions of most rivers and streams in the analysis area. Beaver populations, however, were probably decimated in the early and mid-1800s by Euro-American trappers.

Although it is impossible to discern the acreage and distribution of reference condition vegetation, it is likely that the forested land base is approximately what it was prior to the historic (1850) period. Oak-woodlands have probably declined, due primarily to development. Grasslands have likely decreased due to the encroachment of shrubs and trees, and shrublands have probably increased. In the forest and shrub plant communities, there has been a seral stage shift due to human intervention. In the forested areas there is probably more early and mid-seral habitat due to logging. Late seral conditions dominate the shrub habitat due to fire suppression. Grasslands are in generally poor condition due to noxious weed invasion.

Wildlife species currently present in the analysis area were likely present in the early to mid-1800s with the exception of introduced species such as starling and Virginia opossum and some of those species closely associated with Emigrant Reservoir, e.g., double-crested cormorant. Some species that were present then but have now been extirpated include pronghorn, grizzly bear, and gray wolf. Of the large predators that once roamed freely, only cougar, coyote, and black bear remain.

Threatened/Endangered Species

The northern spotted owl and bald eagle, both threatened species, are currently present in the analysis area. Although the presence of the northern spotted owl prior to the historic period could not be confirmed, they were likely present since the forested portions of the analysis area probably provided some suitable habitat. The presence of the bald eagle is less likely since they have been documented only since the establishment of Emigrant Reservoir. It is possible, however, that bald eagles may have foraged for spawning salmon and steelhead in Bear Creek.

Northern Spotted Owl Critical Habitat

Reference conditions for northern spotted owl critical habitat will be addressed on the basis for its designation in 1992 since critical habitat did not exist in the early to mid-1800s. Critical habitat is designated under the auspices of the Endangered Species Act of 1973. The designated critical habitat in the analysis area was established to provide for nesting, roosting, and foraging habitat in an area of high habitat fragmentation and to help in providing a habitat link between the Western Cascade and Klamath Mountains physiographic provinces (USDI, FWS 1994).

Special Status Species

Based on the habitat associations assumed to be present in the analysis area in the early to mid-1800s, all currently designated special status species were likely present at that time (see Current Conditions, Terrestrial Wildlife Species and Habitats). Since many of the threats associated with their current status were generally of no consequence prior to Euro-American presence, populations of the various species were probably greater and more stable.

Survey and Manage Species and Protection Buffer Species

As with the special status species, it can be assumed that the survey and manage species known or believed to be present in the analysis area (see Current Conditions, Terrestrial Wildlife Species and Habitats) were present in the analysis area when Euro-Americans arrived. All of these species appear to be positively associated with mature/old-growth conifer forest. Since threats to the species were minimal, populations were probably greater and more stable than today.

HYDROLOGY

Prior to the introduction of irrigation and water impoundments in the Upper Bear Creek Watershed Analysis Area, summer streamflows were directly related to the amount and timing of precipitation events. Years of high rainfall and large spring snow packs resulted in summer flows that provided adequate water supplies for aquatic dependent species. Drought years produced low flows and likely there were some dry stream channels by the end of the summer.

Irrigation withdrawals that began in the 1850s and became more extensive by the early 1900s greatly reduced summer streamflows throughout the analysis area. Historic low flows in the analysis area were associated with years of low precipitation. Drought conditions for southwestern Oregon were noted in 1841, 1864, 1869-1874, 1882-1885, 1889, 1892, 1902, 1905, 1910, 1914-1917, 1928-1935, 1946-1947, 1949, 1959, 1967-1968, 1985-1988, 1990-1992, and 1994 (LaLande 1995; NOAA 1996). The interbasin transfer of water from Jenny Creek (Klamath Basin) to Emigrant Creek (Rogue Basin) and storage in Emigrant Lake greatly increased the summer water availability downstream of the dam. However, irrigation withdrawals downstream of Emigrant Lake still result in depleted summer streamflows in Bear Creek.

Historically, major flood events were generally the result of rain-on-snow events. The most severe floods in southwestern Oregon took place in 1853, 1861, 1890, 1927, 1948, 1955, 1964, and 1974 (LaLande 1995) and 1997. The extreme flow recorded at the Emigrant Creek gaging station below the dam occurred on February 20, 1927. The completion of Emigrant Lake dam in 1924 modified the winter streamflow regime in Emigrant Creek. Emigrant Lake stored the winter runoff and moderated the peak flows occurring downstream in Bear Creek.

Prior to the advent of Euro-American settlers, extensive wildfires were the primary upland disturbance capable of creating large openings in the rain-on-snow zone. Starting in the late 1800s, land development and timber harvest became major factors affecting vegetation removal in the rain-on-snow zone. These disturbances could potentially have affected the frequency and magnitude of peak flows resulting from rain-on-snow events.

The uncontrolled grazing of sheep and cattle in the late 1800s and early 1900s probably resulted in extensive upland soil compaction. The decreased infiltration caused by soil compaction would likely have affected runoff patterns and changed the routing time, magnitude, and frequency of peak flows.

Land development and road construction that began after Euro-American settlement in the mid 1800s disrupted the hydrologic network and affected the timing, magnitude, and frequency of peak flows.

STREAM CHANNEL

Prior to Euro-American influences, the Upper Bear Creek Watershed Analysis Area consisted of free flowing streams that experienced normal events of flooding and drought. Bedload materials originating from upper reaches moved through the area, or were deposited on the floodplain. The analysis area likely had adequate amounts of large woody material to provide channel structure and dissipate the energy of peak flows. Even the valley bottom streams contained woody material washed downstream from the headwaters. Additional material was contributed by streamside woodlands. Lower reaches of Emigrant, Walker, and Carter Creeks probably had greater sinuosities, side channels, some braiding, lower width/depth ratios, as well as an ample amount of large woody material. They easily accessed their floodplains except where confined by natural restrictions. Floodplain and meander widths were likely somewhat wider than they are today. Beavers occupied these streams prior to the advent of fur-trappers (around 1830) and built dams that added woody material to systems. The woody material trapped and stored fine sediments, and reduced water velocities. Fur trapping in the 1830s to 1840s resulted in a substantial decrease in the beaver population and the associated loss of beaver dams. The loss of beaver dams likely resulted in scouring of channel beds and banks, increased width/depth ratios, and fine sediment deposition in pools.

There have been some significant changes in stream morphology in the Upper Bear Creek Watershed Analysis Area since the arrival of Euro-Americans. Activities such as fur trapping, grazing, conversion of riparian zones to agricultural pastures, stream channelization, logging, and road building were the major human-caused disturbances that affected the stream channels. The most significant change in this analysis area, however, was the construction of Emigrant Dam and Reservoir which inundated segments of several streams, and blocked the transport of streambed material from continuing downstream and onto the floodplains.

Large numbers of cattle and sheep were introduced in the analysis area in the mid-1800s and heavy livestock use continued until the early 1900s. They tended to concentrate along stream courses and likely caused streambank deterioration as they moved in and out of channels.

Logging and land clearing for agricultural use resulted in the removal of large woody material from stream channels in addition to removal of streamside trees. This depleted the existing large wood and sources for future large wood recruitment. Floods became more destructive without sufficient instream structure to slow the high stream energy. As more streambank erosion occurred, the channels widened, and as the streams downcut, the channels became entrenched.

Roads were constructed adjacent to streams, and some streams were channelized or straightened to facilitate road construction. These channel-confining actions restricted the natural tendency of streams to move laterally. Channelization of some reaches occurred to prevent the loss of agricultural lands to flood damage. Lower gradient streams in valley bottoms became entrenched and were not able to access the adjacent floodplain except during major peak flow events. Channel width/depth ratios increased and sinuosities were lowered as stream gradients increased. Stream velocity decreased along with a decrease in bedload transport capability which lead to increased sediment deposition.

Ground disturbing activities have resulted in more sediment being introduced into streams in the analysis area. The amount of sediment in these streams exceeded the stream's capability to transport it downstream and resulted in filling pools and degrading aquatic habitat.

WATER QUALITY

Water quality in the Upper Bear Creek Watershed Analysis Area was probably very good prior to Euro-American settlement: low summer water temperatures, acceptable chemical and biological parameters, and low sediment/turbidity levels. This was due to the wide, diverse riparian zones, low width/depth ratios, greater summer flows, and low sediment input. However, the historic range of natural variability included drought periods that adversely affected stream temperatures and other water quality parameters, major storm events that resulted in increased sediment being transported to streams, and major floods that caused increased erosion from channel cutting. Higher fire frequencies prior to fire suppression may have resulted in periodic episodes of sparse riparian vegetation along some stream reaches and subsequent higher stream temperatures until the riparian vegetation became established.

Land clearing activities in the late 1800s and early 1900s resulted in a reduction of riparian vegetation allowing more solar radiation to reach the streams. Increased water temperatures were likely a result of this activity. Intense streamside sheep and cattle grazing during the turn of the century may have contributed to a loss in vegetative cover and subsequent heating of the streams. Irrigation withdrawals during this same time period lowered streamflows and contributed to increased stream temperatures. Logging in the mid-1900s contributed to increased water temperatures as trees within the riparian zones were harvested. Logging also resulted in less large woody material in the stream channels. Road construction adjacent to streams resulted in reduced riparian vegetation and channelization. Loss of large wood and stream channelization resulted in greater width/depth ratios. Wide, shallow streams tend to have higher stream temperatures.

Ground-disturbing activities such as road building, logging, land clearing, agriculture, and unmanaged livestock grazing contributed sediment to streams. Sediment and turbidity levels increased substantially after extensive logging and associated road building occurred, especially on steep slopes.

Unmanaged livestock concentrations adjacent to and in streams likely resulted in increased fecal coliform levels.

RIPARIAN AREAS

Historically, the species composition of riparian vegetation along ephemeral and intermittent streams was presumably similar to what is seen today except the stream corridors had more oaks and conifers in older age groups, and the corridors were wider and generally continuous. Wildfire has had some affect on portions of the upland and riparian vegetation in the last century, but that frequency and intensity has not been as pronounced as historic fire events resulting from lightning and Native American induced fires. Fires resulted in a variety of tree age classes that were scattered about in small patches, thus providing diverse vertical stand structure. A portion of Emigrant Creek above the mouth of Tyler Creek has riparian vegetation that is predominately dense, small diameter Douglas-fir. There is evidence that this is a fire replacement stand and that the previous stand consisted more of mature and late seral stage Ponderosa pine, Douglas-fir and white oak.

Emigrant Reservoir inundated a portion of Emigrant Creek as well as portions of several tributaries. These areas presumably had riparian growths consisting of oaks, willow, alder, Oregon ash, Douglas-fir, Ponderosa pine and incense cedar, similar to what is now seen in those reaches immediately above and below the reservoir.

The activities that affected the stream channels also affected riparian vegetation. In some areas, roads and clearing for agriculture reduced riparian width and early livestock grazing, and logging altered the diversity of age and species composition of brush and trees. In other areas, the present day age and species composition are probably quite similar to historical conditions of the 1800s. Early settlers most likely harvested the readily available confers in the riparian zones which left a higher percentage of hardwoods.

Intense streamside sheep and cattle grazing during the turn of the century may have been a contributing cause of historic changes in riparian area structure. In this area particularly, sheep had an enormous impact on lands in the analysis area. Early accounts report the presence of over ten thousand head of sheep during the operation of the Ashland Woolen Mills from the 1860s to the 1930s. In addition to this, there were thousands of head of cattle roaming the valleys. During this early period, streams, ponds, and other wetlands had concentrations of livestock, that may have contributed to a loss in vegetative cover and erosion near streams and on steep slopes.

With the beginning of early settlement, the combination of homesteading, unmanaged livestock grazing, logging, road construction, and the loss of beavers and their dams had dramatic affect on riparian vegetation. The width of the riparian corridors narrowed and became discontinuous with the development of agricultural lands and residential construction. Some stream corridors were channelized to reduce flood effects, or were crowded by road construction. Excessive livestock use resulted in unstable stream banks, which caused the destruction of riparian vegetation. Logging in riparian areas and elsewhere in the analysis area resulted in accelerated snow melt and heavier spring runoff. This caused additional bank erosion. The cumulative effect was a net loss of trees and shrubs along stream banks.

AQUATIC WILDLIFE SPECIES AND HABITATS

Habitat for aquatic resources has become less complex as a result of developments in the analysis area, and there have been significant changes in species composition and perhaps changes in abundance.

Changes in the upland and channel stability, along with reduction in riparian habitat, had direct affects on aquatic habitats. Changes in pool/riffle relationships affected spawning and rearing habitat. The loss of woody debris diminished the channels' ability to retain substrate material including spawning gravel and cobble that housed insects and other aquatic life. Erosion-caused sedimentation resulted in the compaction of remaining gravel deposits. In some instances, reduction of riparian habitat resulted in increased water temperature. This may have resulted in loss or reduction in populations of some aquatic wildlife species that require cooler water.

The greatest change in the composition of aquatic resources came about with the construction of Emigrant Dam and Reservoir. In 1827, Peter Skene Ogden and his exploration party camped along the lower reach of Hill Creek above today's Emigrant Dam (Human Uses section). Ogden's diary records the event. "Shortly after we were encamped an Indian came boldly to my tent and presented me with two fresh salmon..." The date was February 8, so the fish were more likely steelhead, but the occurrence indicates that anadromous fish had access to these upper Bear Creek tributaries. It is possible that in addition to native trout, summer steelhead, winter steelhead and coho used upper reaches of Emigrant Creek for spawning and rearing, and that lower reaches of Sampson, Carter, Tyler and Baldy Creeks were used as well. Emigrant Creek, above the reservoir, now supports a population of salmonids that may be influenced by non-native salmonid introductions in the reservoir which migrate up the stream to spawn and rear. The genetic makeup of resident trout in Emigrant Creek above the reservoir may be considerably different from that of the historical population.

Emigrant Reservoir not only supports non-native salmonids, but provides habitat for a variety of introduced warm-water game fish and golden shiners, a transplant from the eastern United States. The historic channels, now inundated by the reservoir, were home to native resident trout and anadromous fish.

Native rainbow and cutthroat trout still exist in upper Bear Creek tributaries, including Tyler, Baldy, Green Mountain and Porcupine Creeks. There is good information on their distribution and some data on abundance, but there is no historical data with which to make a comparison. It is assumed that the apparent decline in fish habitat has resulted in a decline in aquatic resources as well.

SYNTHESIS AND INTERPRETATION

The purpose of the Synthesis and Interpretation section is to compare current and reference conditions of specific ecosystem elements and to explain significant differences, similarities, or trends and their causes.

HUMAN USES

History

Two radically different patterns have characterized land use in the Upper Bear Creek Watershed Analysis Area. For thousands of years, indigenous people followed a hunting-fishing-gathering way of life, based on a small-scale, subsistence-oriented economy. Approximately 150 years ago, the advent of Euro-American settlement brought fundamentally different land use patterns based on complex technologies and an economic system connected to global markets.

Prior to this change, native people managed the land by working with natural processes, such as fire, to enhance a broad spectrum of resources important to them. Indigenous technologies combined the use of simple tools with a sophisticated understanding of the landscape to promote habitat for game animals and abundant vegetable products needed for food and materials. This way of life promoted an open landscape, with grasslands and prairies at lower elevations, oak and oak-pine savannahs in the foothills, and meadows in the forested uplands.

This pattern of resource enhancement gave way to patterns of resource extraction, beginning with the actions of the first fur trappers in the early nineteenth century. Following the removal of native people in the 1850s, the analysis area became home to settlers who brought with them increasingly powerful technologies, as well as attitudes that promoted the transformation of the native environment through a wide variety of actions.

Farming, ranching, and logging generally characterized the economy of the analysis area in the late nineteenth century, with these activities stimulated by the advent of the railroad in the late nineteenth century. Subsequent improvements in local transportation in the twentieth century have brought all parts of the analysis area into increased economic production. These changes have perhaps been most effective in bringing the upper regions of the analysis area into the logging economy, and in promoting recreational activities in the analysis area.

Major Changes

The last 150 years have contributed to substantial changes in the landscape of the analysis area. In the nineteenth century, newcomers cleared land for ranches and for fuelwood; introduced a host of new plant (agricultural crops and weeds) and animal (farm and ranch animals) species; plowed under native meadows for farms; dammed, diverted, and channelized streams; and hunted unwanted predators (grizzly bears and wolves) and other species (antelope and bighorn sheep) to local extinction. In the twentieth century logging has expanded with the post-World War II explosion of roads and improvements in transportation; fire suppression has affected the local vegetation; and a host of state, federal, and local policies guide human operations on both public and private lands.

The effects of these actions are written on the land: the hydrology of the analysis area has been altered through irrigation, water withdrawals, dams, roads, channelization, and other actions; erosion is more severe in some places than in the past; soil productivity has been affected in some areas by compaction, hot fires, and changes in vegetation patterns; vegetation patterns have been altered through agriculture, fire suppression, grazing, and other actions; topography has changed in places through the construction of quarries and roads, and stream alterations; and native species (plants and animals) have disappeared or become reduced through a number of human actions or through competition with non-native species.

Roads contribute the greatest amount of sediment to streams in the analysis area. Roads located in unstable areas and adjacent to streams, as well as those with inadequate drainage control and maintenance and no surfacing are most likely to cause sedimentation of stream habitats. Stream-adjacent roads confine the channel and restrict the natural tendency of streams to move laterally. Roads crossing through riparian areas have fragmented riparian habitat connectivity. Some culverts impede or prevent fish passage.

Forest roads diminish soil productivity simply by taking the area they occupy out of production. Traditionally, this has been viewed as “the cost of doing business.” There is no natural occurrence that can be compared to road construction. A maintained road surface is out of production as long as it is maintained. Vegetation may fill in the road surface when maintenance is stopped, but the growth rate is far less than for undisturbed soil. Four miles of road per square mile is roughly equivalent to 16 acres per square mile that is taken out of production.

Roads affect wildlife in two primary ways: habitat removal and altered behavioral patterns. Construction of roads inevitably removes habitat for various wildlife species. Vehicles using roads disturb wildlife and change behavioral patterns. Habitat within varying distances of roads is not used to the extent it would be if the roads were not present. This may have a far greater impact on wildlife than the immediate loss of habitat. There is little disturbance to wildlife from roads that are totally closed to vehicles.

Trends

Regarding the future, local demographic trends indicate continued population growth within the analysis area. Logging and recreation will probably remain significant human uses in the analysis area. Issues regarding grazing, logging, water, recreation, fire, and ecosystem health and diversity are likely to continue to be important. The advent of ecosystem management suggests a shift from an extractive perspective to one combining economic concerns with stewardship practices. Given the percentage of analysis area land under federal management, federal land management policies will continue to have a significant effect in the analysis area.

Policy Implementation

The twentieth century has witnessed the advent of federal land management policies that affect a portion of the analysis area's lands. Fire suppression policies have operated with timber harvest to change the character of the forests in the analysis area, and numerous laws and regulations now guide human actions on these federal lands.

EROSION PROCESSES

Natural erosion processes have been altered and/or accelerated by human management and activities such as road building, timber harvest, grazing, wildfire, and prescribed burning.

Major storms like the one on New Year's Day 1997 and recent wetter than normal winters have caused both natural and management related slides to transport sediment to nearby streams. Hillslope slumping and minor earth flows were reactivated mainly in the upper portions of Emigrant, Baldy, Walker, and Frog Creeks. Most of these events appeared to be natural with past management playing only a minor role. Some of the minor slumping along the hillsides may be associated with annual grasses displacing the more deeply rooted native vegetation.

Roads have had the biggest impact on the amount of sediments reaching the stream. There have been hundreds of miles of roads and trails built in the analysis area over the last century. Many of the roads are maintained throughout the year but still yield sediments higher than natural levels.

Past timber harvesting greatly increased soil erosion rates over natural levels, particularly clearcut logging. Although the ground disturbing affects decrease rapidly the first few years after logging, it takes several years for erosion rates to return to near natural levels. This is particularly the case where logging slash is broadcast burned immediately after logging has occurred.

The increase in fuel loading due to fire suppression in the Upper Bear Creek Watershed Analysis Area has increased the potential for a high intensity wildfire. High intensity fires can burn off the duff layers that protect soils from erosive and gravitational forces. These fires may also cause soils to become hydrophobic (soils that do not allow penetration of rainfall and snow melt), which results in much less infiltration and a higher risk for soil erosion and topsoil loss. A high intensity wildfire along the steep, stream-adjacent sideslopes would increase the potential for landsliding and severe erosion for at least one to two years following a fire.

Concentrations of cattle and sheep along streams, ponds, and other wetlands may have contributed to a loss of vegetative cover and subsequent erosion in the riparian areas. Erosion from grazing is most severe near streams and on steep slopes. Severe problems as a result of grazing in this analysis area have not been documented.

SOIL PRODUCTIVITY

Clearcutting, burning, and historical over-grazing may have contributed to diminished soil productivity by increasing erosion rates and reducing native vegetative cover and plant material that would otherwise be recycled into the soil. Timber harvest and associated burning has also reduced the amount of coarse woody material across the landscape. There is usually a high amount of insect and small mammal activity associated with large logs on the ground in the forest. Additionally, coarse woody material and surrounding soil retains moisture longer into the summer providing a refugia for insects and soil microbes that decompose organic matter into plant nutrients. Although individual occurrences may not be significant, cumulative effects to the soil could be very limiting over a long period. The trend for more coarse woody material on the landscape is upwards as clearcutting no longer is practiced on BLM-managed lands. Natural levels of soil productivity have been reduced where ground-based logging has occurred. Tractor logged areas with designated skid roads have soil productivity losses ranging from 5 to 10 percent, while areas with unrestricted tractor logging have soil productivity losses near 20 percent.

Road building has taken land out of production and has indirectly reduced soil productivity by increasing landslides and slumping in some areas. A maintained road surface is out of production as long as it is maintained. Vegetation may fill in the road surface when maintenance is stopped, but the growth rate is far less than for undisturbed soil. On average, approximately 4 acres of road is taken out of production for every one mile of road built.

Livestock have minimal influence on reducing soil productivity through compaction, except in areas where they concentrate such as water sources.

The biggest threat to soil productivity in this analysis area is the potential of a long-duration, intense wildfire that would drastically reduce vegetative cover and increase soil erosion.

LANDSCAPE VEGETATION PATTERN

Fire suppression, plant succession, and logging are the main processes that have designed the landscape since the turn of the century. In the White Fir, White Fir and Douglas-fir, and Ponderosa Pine Zones, the forest land matrix has become more contiguous and larger in size because of the lack of fire disturbance and the process of plant succession (Franklin and Dyrness 1973). These two processes have allowed high stocking levels of trees and shrubs to become established. Forest management selection methods and small sized patch cuts have allowed for the creation of distinct patches within the matrix and have simulated fire in regard to maintaining open patches in the landscape pattern, but have not lowered vegetation densities in the remainder of the forest.

Within the White Fir Zone, clearcut harvests (less than 40 acres) have interrupted the continuous forest matrix by creating a pattern of dispersed openings across the landscape. The present day clearcut openings are more uniform than the variable patchiness created by historic fires. Clearcutting may have also resulted in the creation of more shrublands.

Within the Mixed Conifer and Mixed Evergreen Zones, the grassland matrix has been maintained because of agriculture, land development, and grazing.

Although there are more non-native species present today and their abundance is greater than in historic times, these species have not influenced the vegetation pattern across the landscape to any large extent. Since these non-native species are herbaceous in form they are commonly found in the grasslands, shrublands, and agricultural areas, and may tend to maintain the openness of these areas. The effects of non-native species are more subtle. In general, natural succession of native species is usually retarded by the non-native species invading their habitat and out-competing them for nutrients, water, and light. Suitability decreases as native species decrease in abundance and decreases the quality of wildlife habitat, agricultural productivity, and recreation areas. The effects of the loss of native species is probably not yet realized.

PLANT SPECIES AND HABITATS

Non-Native Plant Species and Noxious Weeds

Noxious weed populations appear to be increasing in the analysis area. The economical and ecological elimination of some species such as yellow starthistle is unlikely. If present trends continue, the ability to control other species will also diminish.

Noxious weed populations must be located quickly to increase the effectiveness of control efforts. The Oregon Department of Agriculture is focusing research on identifying biological control agents. Biological control agents are successful at controlling some species. This control method appears promising for several species, although, it is still too early to draw any definitive conclusions.

Most of the problem species are strong colonizers and persistent once established. Any disturbance event such as poorly managed livestock grazing, fire, earth-moving and soil-exposing activities is an opportunity for these species to spread. A number of them will spread into suitable habitats without disturbance. Interactions in some lower elevation plant communities that were once maintained by fire have probably changed. The presence and dominance of non-native annual grasses may now be a controlling influence on plant community development following a fire or other disturbance event.

Deliberate introductions of non-native forage grasses has occurred in some high elevation moist meadows in this analysis area. Erosion control seeding has introduced some permanent and aggressive exotics in the uplands.

Carefully designed grazing systems and certain kinds of prescribed fire may be less damaging or even beneficial to native plant communities. Implementation of these types of management actions may have economic constraints.

Special Status Plant Species and Habitats

For the special status species known to occur in the analysis area, habitat condition of hardwood and conifer forests, shrublands, and savannahs is critical. Since Euro-American settlement, most habitats have been altered directly or indirectly. Often these alterations would be considered as having negative effects on rare plant habitat. Commonly, for plants that have very specific habitat requirements, alteration of site conditions results in an unsuitable environment.

Factors contributing directly to special status plant habitat alteration include timber harvest, vegetation conversion for agricultural uses, plant collection, woodcutting for fuel and other uses, urban and rural development, road building, rock source development, water impoundments and diversions. Factors contributing indirectly to oak woodland, shrubland, and savannah habitat alteration include fire suppression, introduction of non-native plants, distribution of native pollinators, plant community fragmentation, and over-grazing. Some of these habitat alterations should be considered irreversible for management purposes, such as, existing roads, quarries, water impoundments and diversions, and land converted for human uses.

Habitat conditions should improve on BLM-managed lands with the proposed management objectives and recommendations and current silviculture and prescribed fire techniques. Prescriptions designed to simulate or move a plant community toward pre Euro-American settlement conditions should be effective over time.

Survey and Manage Plant Species and Habitats

All Survey and Manage species known to occur in the analysis area are found in either hardwood or coniferous forests. These habitat types have been affected by past timber harvest, fire suppression, road building, wood chip material salvage, firewood cutting, introduction of non-native plants, decreased diversity, distribution of native pollinators, plant community fragmentation, and over-grazing.

Habitat conditions should improve with proposed management objectives and recommendations and current silviculture and prescribed fire techniques. Density management, hazard reduction, uneven-age management, patch treatments, species composition manipulation, etc. should direct the plant community to a pre Euro-American settlement condition.

Special Areas with Botanical Resources

Pilot Rock Area of Environmental Concern (ACEC) and Cascade/Siskiyou Ecological Emphasis Area

Factors contributing to coniferous forest habitat alteration include timber harvesting, fire suppression, vegetation conversion, and rural development.

Factors contributing directly to oak woodland, shrubland, and savannah habitat alteration include: vegetation conversion for agricultural uses, plant collection, woodcutting for fuel and other uses, urban and rural development, road building, rock source development, and water impoundments and diversions. Factors contributing indirectly to oak woodland, shrubland, and savannah habitat alteration include fire suppression, introduction of non-native plants, distribution of native pollinators, plant community fragmentation, and over-grazing. Some of these habitat alterations should be considered irreversible for management purposes, such as, existing roads, quarries, water impoundments and diversions, and land converted for human uses.

Habitat conditions within the BLM-managed special areas should move toward a more natural state with the proposed management objectives and recommendations and current silviculture and prescribed fire techniques. Prescriptions designed to simulate ecological conditions and events of a pre Euro-American settlement condition should be effective over time.

FOREST DENSITY AND VIGOR

Core samples from 187 to 280 year-old trees of the Ponderosa Pine Zone (trees that became established in the 1700s and 1800s) show they were growing at least 1.5 inches in diameter every decade for 4 to 8 decades before a decline in diameter growth started (USDI, BLM 1998a). This indicates that these trees that are now considered to have late-successional characteristics, grew with no or little surrounding tree competition. Frequent fires kept tree stocking levels low. The present day, younger tree age classes, which became established in the late 1800s or early 1900s and now predominate the landscape, grew under maximum stocking conditions and do not show periods of rapid diameter growth. High tree stocking levels have been maintained since Native Americans stopped using fire across the landscape and fire suppression was initiated. As a result, there are more uniform forest stands in all of the forest zones (Franklin and Dyrness 1973).

The species composition of the present day forests is also different from the forests of the 1700s and 1800s. Historically, forests had a higher composition of pine species, incense cedar, and oak species. With the reduction in fire frequency, natural plant succession has allowed more shade tolerant species such as Douglas-fir and true fir to dominate the species composition of the forests, including some dry sites. This is not desirable because the pine species and incense cedar have better drought resistant characteristics that can influence tree vigor.

The decrease in fire frequency has also allowed natural plant succession to change the species composition and structure of grasslands, shrublands, and woodlands. Shrubs and trees have invaded grasslands, decreasing the size of these open, native grass communities. The historic, relatively open, shrublands have become overstocked, more uniform in structure, and present a severe fire danger today. The open oak woodlands that were managed for acorns by the Native Americans have also changed dramatically. Shrub species have invaded the woodlands because of fire suppression; more oaks became established and Douglas-fir is prevalent in the overstory and understory. These factors have resulted in the decline of oak tree vigor and acorn production.

The conifer forests and their various stages of development are also influenced by numerous ecological and physical processes. Coarse woody material (CWM) appears to be the heart of numerous ecosystem processes and it is a vital part of forest productivity. CWM is defined as fallen trees and tree pieces, fallen branches larger than 1 inch in diameter, dead roots, and standing dead trees. As a general rule, CWM decreases from high to low elevations. West and south aspects have smaller amounts also because of drier conditions. In the lower elevations, CWM is usually less than 10 tons per acre. The more moist, higher elevations have approximately 15 to 20 tons of CWM per acre (USDI, BLM 1998a). The more moist sites have larger diameter trees so amounts of CWM tend to be greater.

In the historic forests, bark beetles and pathogens were probably more benign due to low tree stocking levels. The present day overstocked forests have allowed for a decline in forest growth and vigor resulting in the dramatic increase of bark beetle populations and increasing tree mortality. The various bark beetles throughout the analysis area that are causing extensive tree mortality on the drier sites are moving the forest stands to a more open condition. Where the Douglas-fir trees are dying adjacent to shrublands and woodlands and on dry ridge-tops, there is an opportunity to reestablish drought tolerant species such as ponderosa pine and incense cedar. Root rot diseases, especially in the White Fir Zone, are also functioning in the same manner. Forest stands that were predominantly Douglas-fir, pine species, and incense cedar historically and are now predominantly true fir species, are reverting back to the early seral species. Where white fir is dying because of laminated root rot, disease tolerant pine species and incense cedar can once again be reintroduced. Dwarf mistletoe species are also causing tree mortality on a small scale.

As forest stands increase in age, there is a higher probability of some type of disturbance. Since many of the predominant, mature second growth forest stands in the analysis area are approximately 100 years of age, they are currently more susceptible to disturbance. Some stands are still in the stem exclusion stage of development, but many stands are entering the understory reinitiation stage because of the ecological processes discussed (Oliver and Larson 1990). These processes are also part of the formation of late-successional forests by creating multi-cohort, multi-storied forests. Wind damage is another important process in mature forests for creating openings and the reintroduction of a new forest age class and seedlings of the desired species.

These various ecosystem processes must be monitored carefully if fire suppression across the landscape continues. Natural vegetation succession may not be desired everywhere. Without large openings in forest stands, shade tolerant species such as true fir species and Douglas-fir will predominate most forest stands, and early seral species will continue to decline. Silvicultural methods will be necessary to maintain and manipulate the structure and species composition of the forest stands if fire does not. Reduction of vegetation stocking levels is also needed if individual tree and forest vigor is to be maintained.

In summary a few conclusions are apparent:

1. Forests in the lower elevations where annual rainfall is below 30 inches should not be expected to develop into large continuous matrix areas of dense, lush late-successional forests (Franklin and Dyrness 1973). These dry, low elevation forests must be maintained at lower stocking levels with drought resistant species predominating. Openings are essential for maintaining the drought resistant early seral species. If the stocking levels of the vegetation are not managed, physical and ecological processes will continue to naturally thin the vegetation and the species composition of the early seral species may continue to decline.

2. It must be recognized that mature, overstocked forest stands across the landscape are being observed at one point in time. Numerous processes will continue to affect the forest stands' stocking levels and structure. As small scale, physical and ecological processes continue to create openings in the present day forest stands, more diverse stand structure will develop

over time. With these processes and silvicultural treatments to control stocking levels, the potential exists for more forests with late-successional characteristics in the future.

3. Without vegetation stocking level management or low intensity fire, individual shrub and tree vigor will remain low and high levels of vegetation mortality may occur. Large stand replacement fires are also probable without stocking level management. Grasslands will continue to decrease in size, and open, park-like oak woodlands will disappear.

FIRE AND AIR QUALITY

Historically, frequent, low intensity fires maintained most valley bottomlands and foothills as grasslands or open savannas. Forests fashioned from frequent, low intensity fires have been described as open and park-like, uneven-aged stands, characterized by a mosaic of even-aged groups. Douglas-fir, ponderosa pine, sugar pine, and white fir were the most common species. Depending on understory vegetation conditions, these species have some resistance to fire as mature trees. As saplings, ponderosa pine is the most resistant followed by sugar pine, Douglas-fir, and white fir. Frequent fires had major structural effects on young trees favoring ponderosa pine as a dominant species and white fir as the least dominant in this forest type.

Fire suppression over the past century has effectively eliminated five fire cycles in southwest Oregon mixed conifer forests (Thomas and Agee 1986). The absence of fire has converted open savannas and grasslands to woodlands and initiated the recruitment of conifers. Oregon white oak is now a declining species largely due to fire suppression and its replacement by Douglas-fir on most sites.

Fire-intolerant, shade-tolerant conifers have increased and species such as ponderosa pine and sugar pine have declined. This conversion from pine to true fir has created stands that are subject to stress, making them susceptible to accelerated insect and disease problems (Williams et al. 1980).

The horizontal and vertical structure of the forest has also changed. Surface fuels and the laddering effect of fuels have increased and this increases the threat of crown fires, which were historically rare (Lotan et al. 1981). Fire exclusion has caused a shift from low-severity fire regimes to a high severity regimes. This is characterized by infrequent, high intensity, stand replacement fires. Fire is now an agent of ecosystem instability as it creates major shifts in forest structure and function on a large scale.

In summary, the fire hazard for this analysis area has increased over time. Focus of fire hazard reduction projects on the low severity fire regime areas can help restore these areas. Further changes in how wildfire is managed across the landscape may be needed for maintenance. These changes may include management of wildfire for resource benefit as opposed to the current direction for full suppression. However, full suppression strategy will always be a major part of fire management within this analysis area due to the top priorities of protecting life, resources and property.

Air quality can be adversely effected by prescribed burning and wildfires. Prescribed burning conducted in compliance with federal, state, and local smoke management regulations should minimize adverse effects to populated areas. Furthermore, specific burning and mop-up strategies and tactics can be employed to reduce emissions. Fire hazard reduction projects, over time, should affect the long-term emissions from wildfires within the analysis area. This effect should be a reduction of emissions as lighter fuel loads are consumed as the fire intensities over time are reduced through fuels management.

TERRESTRIAL WILDLIFE SPECIES AND HABITATS

Wildlife - General

Vegetative conditions are the primary influence on terrestrial wildlife/animal populations and their distribution within the Upper Bear Creek Watershed Analysis Area and across the greater landscape. A variety of processes have changed the vegetation within the analysis area over time. These include natural and human-caused disturbances and natural succession. Current conditions of the analysis area differ from reference conditions primarily due to human-caused disturbances such as timber harvest, agriculture, fire suppression, introduction of exotic plant species, and residential development.

A direct comparison of the acreage of current and reference vegetative conditions is not possible. Some generalizations, however, can be made based on some of the processes known to have taken place in the analysis area. Mature/old-growth habitat has declined in the analysis area due to timber harvest. Therefore, it can be assumed that populations of the wildlife species preferring the structure and conditions provided by this habitat type have also declined.

The quality of the mid-seral conifer habitat has declined primarily as a result of fire suppression. Historically, much of this habitat was characterized by more open canopies (as a result of fire) and a healthy herbaceous and shrub component. This combination provided habitat for quite an array of species. Due to fire suppression, however, many of the mid-seral stands are now single-storied with a high degree of canopy closure and virtually no understory vegetation. In comparing wildlife use of dense-canopied single-storied stands to more open multiple-storied stands, data in Brown (1985) suggest that approximately twice as many vertebrate wildlife species prefer multiple-storied stands.

Much of the early seral conifer habitat (grass-forb, shrub and sapling/pole) is present as a result of timber harvest. Consequently, snags and large down woody material are probably deficient in these habitats, and this condition will persist as these stands mature. Thus, populations of those species requiring or preferring snags and large down woody material have likely declined, and will remain suppressed until there is recruitment of these habitat features as a result of ecological processes.

The absence of fire has allowed much of the oak and oak/pine woodlands to become over-dense and has also allowed conifer and shrub encroachment at greater than historic levels. The result is increased mortality, reduced growth, and diminished mast (acorn) production, particularly in the larger oaks. Because the large oaks provide both natural cavities and generally good acorn crops, they are important to a variety of wildlife species. Populations of those species that depend on these features of the oak and oak/pine woodlands have probably declined.

Like oak-savannah habitat, the quality of shrubland habitat has also declined due to fire suppression. Fire is the primary process in the development of early seral conditions in this plant community. In the absence of fire, much of the habitat has matured and early seral habitat is deficient. As a result, forage for overwintering deer is inadequate, and populations of other species that prefer the early seral conditions of this plant community are probably declining.

The quality and quantity of native grass/forb/herbaceous habitat have declined rather dramatically due to the invasion of noxious weeds, the planting of non-native grasses, and the encroachment of shrubs and conifers. Practically all non-agricultural grasslands in the lower elevations of the analysis area are now fields of noxious weeds and grasses (e.g., yellow starthistle and medusahead rye). The introduction of other non-native grasses has generally occurred as a result of well-meaning projects, but nevertheless has resulted in the decline of native grasses. Encroachment of trees and shrubs has primarily been the result of fire exclusion over the past century. This decline in quality and quantity of native grassland habitat has adversely impacted herbivores in the analysis area.

Threatened/Endangered Species

Northern spotted owls are highly associated with mature/old-growth forest habitat. A decrease in this habitat from historic to present levels as a result of logging is apparent. Due to the decrease in suitable habitat, it is reasonable to assume that the existing northern spotted owl population has declined from historic levels. The current population outside of the Late-Successional Reserve (LSR) will likely continue to decline because the sites are in the matrix land allocation, and future timber harvest will further deplete suitable habitat. However, the sites located in the LSR are expected to persist, and as late-successional conditions improve in the LSR the population is expected to increase.

Bald eagles undoubtedly foraged along Bear Creek, and may have nested in the analysis area prior to the development of Emigrant Lake. Presently, however, bald eagle activity is concentrated on Emigrant Lake, and the nesting eagles are sustained by the food base provided by the lake. Inconsistent nesting, though, indicates that either the food base or some other habitat component needed for successful nesting is marginal. Future successful nesting can not be assured, but implementation of the draft management plan for this site (Oregon Eagle Foundation 1995) would probably improve the likelihood of successful nesting in the future.

Northern Spotted Owl Critical Habitat

Northern spotted owl critical habitat was designated in 1992. Approximately 9,730 acres of Critical Habitat Unit (CHU) OR-38 are in the analysis area. When designated, the management emphasis in CHU OR-38 was to maintain and improve nesting, roosting, foraging and dispersal habitat. With the adoption of the Northwest Forest Plan in 1994 (USDA and USDI 1994a), approximately 5,740 acres of the CHU were included in the Jenny Creek LSR where the management emphasis is to maintain and improve late-successional forest habitat (essentially the same mandate). However, also with the adoption of the Northwest Forest Plan, the presumed function of those portions of the CHUs not included in LSRs, e.g., the matrix land allocation, is to facilitate spotted owl dispersal/connectivity between mapped LSRs. There are approximately 3,990 acres of CHU OR-38 in the matrix land allocation. Management emphasis in this area will be to maintain and/or develop adequate dispersal conditions for northern spotted owls.

Special Status Species

The decrease in mature/old-growth habitat is responsible for the listing of a number of the special status species found in the analysis area. These species prefer mature/old-growth mixed conifer forest for feeding, breeding, and/or sheltering, and, as in other areas, the decrease in late-successional habitat in the analysis area has likely caused a decline in the populations. These species are not expected to be extirpated from the analysis area, but recovery of the populations to pre-historic levels is not anticipated, since removal of this habitat on private and public land is expected to continue.

Some species have received special status designation due to habitat loss or degradation and/or other factors not related to the loss of late-successional habitat. For example, a contributing factor in designating the western pond turtle is predation by bullfrogs, an introduced species. As with the species designated due to late-successional habitat loss, these other species are not expected to be extirpated in the analysis area, but population recovery is not anticipated since the human-influenced processes that contributed to their designation will likely continue.

Other species are designated as special status simply because there is a general lack of life history data. As these data gaps are filled, it is possible these species could be removed from the special status species list.

Survey and Manage and Protection Buffer Species

All survey and manage and protection buffer species known or suspected to be present in the analysis area (see Current Conditions) are believed to be associated with and prefer late-successional habitat. Great gray owls use this habitat for nesting, but forage in meadows, agricultural land, and the early seral stages of mixed conifer forests. It is unknown how management in the analysis area has affected overall habitat for the great gray owl. Populations of the various bat species listed in the Northwest Forest Plan have likely declined as many are linked with the bark fissures of old-growth trees and the snag component of these stands. With so little understood about actual habitat requirements of many of the mollusk species, it is unknown how the change in vegetation patterns from reference to current conditions has affected these species.

The Northwest Forest Plan mandates that when survey and manage and protection buffer species are found on public lands they be afforded protective measures. This strategy should abate further major population declines on federal lands, and if employed over the long-term, populations could recover in some areas.

Black-Tailed Deer

The primary concern for the Emigrant Creek deer herd is the deteriorating forage conditions on the winter range. Good forage conditions on winter ranges are obviously important for winter survival. Before the historic period, winter forage was probably not a limiting factor for the Emigrant Creek deer herd because native burning maintained good forage conditions. However, as discussed in the Current Conditions section, winter forage conditions in the analysis area are currently poor due to the lack of regeneration in the mountain shrubland plant community and the encroachment of noxious grasses and forbs into the native grass-forb community. The poor forage conditions may limit the size of the deer herd, and if forage conditions worsen, the population will decrease further. Conversely, assuming summer range conditions remain stable, if forage conditions are improved on the winter range, herd size could increase.

HYDROLOGY

The streamflow regime in the Upper Bear Creek Watershed Analysis Area reflects human influences that have occurred since Euro-American settlers arrived. Road construction, timber harvest, land development, Emigrant Dam, and water withdrawals have the potential to adversely affect the timing and magnitude of both peak and low streamflows in the analysis area. Potential effects due to peak flows may include channel widening, bank erosion, channel scouring, landslides, and increased sediment loads. These are normal occurrences in a dynamic, properly functioning stream system; however, increases in the magnitude and frequency of peak flows due to human-caused factors can magnify the effects.

The dominant human-caused disturbances that have affected peak flow hydrologic processes in the analysis area are: extensive road building, timber harvest, and land clearing. Hydrologic processes affected include reduced infiltration (resulting from soil compaction), disruption of subsurface flow, and reduced evapotranspiration. These changes to the hydrologic regime have raised the potential for increasing the magnitude and frequency of peak flows in the tributaries and main stem. Openings in the transient snow zone are of particular concern as they tend to produce higher streamflows during rain-on-snow events. As vegetation planted in the harvested areas recovers, the increase in magnitude and frequency of peak flows will diminish. Permanent road systems intercept surface runoff and subsurface flow, which prevents the streamflow regime from returning to pre-disturbance levels.

Emigrant Dam has altered the winter and summer flow regime in Emigrant Creek below the dam. High flows have moderated along with associated sediment transport. Summer flows have increased due to influxes of irrigation water released from the reservoir.

Water withdrawals have had the greatest impact on summer streamflows in the analysis area and downstream in Bear Creek. The majority of water diverted from streams in the analysis area is used for irrigation. Transbasin diversions from Jenny Creek Watershed to Bear Creek Watershed produce dramatic fluctuations in Emigrant Creek streamflows below the Green Springs Power Plant and below Emigrant Dam during the irrigation and reservoir storage seasons.

STREAM CHANNEL

Channel conditions in the Upper Bear Creek Watershed Analysis Area have changed considerably in the last 150 years due to human activities. Logging, road building, channelization, beaver removal, poorly managed livestock grazing, irrigation development and land alteration for agriculture and residential developments have been the primary causes for change. Flooding and landslides, which are natural processes, have had more severe affects on stream channels. Stream channel changes began as early as 1830 when Hudson's Bay Company trappers began removing beavers from the stream systems. In the absence of beaver dams, faster runoff ensued, resulting in more stream scour and erosion. Bank stability was further reduced by concentrated livestock grazing along stream corridors and logging and road construction in riparian zones. Other resulting channel changes were increased width/depth ratios, channel incision, substrate scouring, and sediment deposition in pools, and decreased sinuosity.

Sediment is mainly transported to streams from landslides (natural and human-caused), road surfaces, fill slopes, and ditchlines. Human-caused landslides have mostly resulted from road building and clearcuts in unstable areas. Road stabilization, maintenance (including drainage improvements), and decommissioning would reduce the amount of sediment moving from the roads to the streams. Roads constructed adjacent to stream channels tend to confine the stream and restrict the natural tendency of streams to move laterally. This can lead to down-cutting of the stream bed and bank erosion. Obliteration of streamside roads would improve the situation, however, two notable examples of this circumstance are Highway 66 above Emigrant Reservoir, and Dead Indian Memorial Highway along lower Walker Creek, both well-established, paved public highways.

In some locations the removal of riparian vegetation has had a detrimental affect on channel stability and the amount of large woody material in the stream channels. Stream reaches lacking riparian vegetation are more susceptible to streambank erosion during peak flow events. There is a minimal amount of large woody material in stream channels in most stream segments, and many reaches lack the potential for short-term future recruitment. Large woody material is essential for reducing stream velocities during peak flows and for trapping and slowing the movement of sediment and organic matter through the stream system. It also provides diverse aquatic habitat. Riparian Reserves along intermittent, perennial nonfish-bearing and fish-bearing streams will eventually provide a long-term source of large wood recruitment for streams on federal land, however streams on federal lands comprise a small percentage of the analysis area.

WATER QUALITY

Changes in water quality from reference to current conditions are predominantly caused by riparian vegetation removal due to timber harvest and land development, water withdrawals, roads, and poorly managed grazing. Water quality parameters known to be affected the most by these human-caused disturbances are temperature, sediment, turbidity, and bacteria.

Lack of riparian vegetation and water withdrawals have contributed to increased stream temperatures that can stress aquatic life and limit the long-term sustainability of fish and other aquatic species. Summer water temperatures for Baldy, Carter, Emigrant, Hobart, Tyler, and Walker Creeks exceed the state temperature criteria. These streams are designated as water quality limited and are on Oregon's 303(d) list.

Surface erosion and mass wasting from roads, timber harvest, and riparian vegetation removal are the primary causes of stream sedimentation in the analysis area. High sediment levels in Sampson Creek and Emigrant Creek from Tyler Creek to Porcupine Creek have been noted by Oregon Fish and Wildlife Department stream survey crews. Another sediment source is the channel erosion in Schoolhouse Creek resulting from using the channel to transport water from Howard Prairie Reservoir to the Green Springs Power Plant. Sediment transported downstream in Emigrant Creek and its tributaries is deposited in Emigrant Lake. Emigrant Lake and Emigrant Creek are identified by the Oregon Department of Environmental Quality (ODEQ 1988) as a potential concern for sediment.

When cattle are not properly managed, concentrated livestock grazing near streams can contribute to increased levels of fecal coliform. Walker Creek from the mouth to the headwaters is identified as a potential concern due to bacteria.

Emigrant Creek from the mouth to Emigrant Lake is identified by ODEQ as water quality limited due to nutrients. A total maximum daily load (TMDL) allocation was approved in 1992 for nutrients in Emigrant Creek.

Riparian Reserves should promote the maintenance and improvement of riparian vegetation on BLM-administered lands. The riparian areas on private lands will need to be protected from road building, timber harvest, land development, and poorly managed cattle grazing in order to improve water quality. Protection of vegetation providing stream shade and recovery of riparian vegetation should bring about some reduction of stream temperatures in Baldy, Carter, Emigrant, Hobart, Tyler, and Walker Creeks. Road stabilization, maintenance, and decommissioning and avoiding timber harvest in unstable areas would decrease sedimentation and turbidity in the analysis area.

RIPARIAN AREAS

The human-caused and natural events that have altered stream channels have affected riparian habitat as well. Roads, timber harvesting, agricultural and rural development, irrigation development, and poorly managed livestock grazing have impacted riparian and aquatic habitat. Some of the results have been fragmented connectivity of riparian habitat; reduced quantity of snags and coarse woody material; reduced streambank stability; increased sediment production to streams; and reduced stream shading with an added impact of higher stream temperature.

Implementation of Aquatic Conservation Strategy Objectives (USDA and USDI 1994a:B-11) and establishment of Riparian Reserves on BLM-administered lands will result in protected and improved riparian habitat over the long term. The use of silvicultural treatments within riparian stands could improve the health, vigor, and diversity of these areas. Stream shading will improve and the potential for use by wildlife should increase.

AQUATIC WILDLIFE SPECIES AND HABITATS

Since the construction of Emigrant Dam, anadromous fish habitat in the analysis area is limited to Emigrant Creek downstream of the dam and in lower portions of Walker and Cove Creeks. Summer and winter run steelhead are the only migratory fish that are currently known to exist in these streams. Steelhead attempting to spawn in Emigrant Creek between the Walker Creek confluence and Emigrant Dam are subject to unnatural stream fluctuation and de-watering after the irrigation season begins.

Resident trout have greater access and use of the analysis area, but many of the upper tributaries are steep and lack suitable habitat to support healthy populations. Because of the loss of stream channel complexity, trout and other aquatic resources are presumably less plentiful and confined to fewer reaches than prior to these changes.

Overall, the interrelated aquatic and riparian habitats in the Upper Bear Creek Watershed Analysis Area are in marginal to poor condition and are below their potential for trout production. Much of the habitat lacks quality pools and large woody material necessary for maintenance of pools, cover, spawning material, and bank stability.

Upland areas and streams within the analysis area were heavily impacted by the 1997 New Year's Day flood. Streambank scouring, loss of woody material, substrate displacement in some reaches, and compaction of gravels in other reaches were some of the impacts noted.

MANAGEMENT OBJECTIVES AND RECOMMENDATIONS FOR BLM-ADMINISTERED LANDS

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
HUMAN USES			
Economic Development	Encourage opportunities for local contractors to compete effectively on contracts for projects in the analysis area.	1. Promote small-scale projects in forest, range, riparian, and other resources suitable for local administration and contractors.	High
	Produce a sustainable timber supply and other forest commodities on Matrix lands to provide jobs and contribute to community stability.	1. Conduct timber harvest and other silvicultural activities in that portion of Matrix lands with suitable forest lands.	High
	Maintain and develop opportunities for special forest products to facilitate community economic development consistent with other resource objectives.	1. Work with local groups to develop opportunities to harvest and sell special forest products.	Medium
Public Involvement	Maintain and promote contacts with local groups, landowners, community leaders, tribal and public agencies to facilitate continuing dialogue on the management of public lands in the Upper Bear Creek Watershed Analysis Area.	1. Maintain and expand contacts with local groups, such as the Bear Creek Watershed Council, the Friends of the Greensprings (FOG), and other local groups.	High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Public Involvement	Provide opportunities for public and private entities to exchange information and develop consensus concerning land management actions within the analysis area, and to enhance awareness of local public concerns and issues affecting management of the analysis area's ecosystem.	1. Utilize local avenues of communication, such as the Ashland Daily Tidings newspaper, local newsletters and bulletin boards, and the Bear Creek Watershed Council's announcements. 2. Identify and incorporate tribal representation into all public involvement, and keep them informed of land management activities in the analysis area.	High High
Archaeology	Assess archaeological sites to determine their scientific and heritage values and protect or recover those values as necessary.	1. Work through partnerships with Southern Oregon University and the Southern Oregon Historical Society and other local groups to promote appreciation and understanding of the analysis area's cultural resources. 2. Define the types of historic and American Indian archaeological sites that are likely to occur within the analysis area.	High Medium
	Conserve and protect archaeological/historical sites within the analysis area.	1. Use careful land use planning to avoid impacts to these resources. 2. Monitor resources to control threats (such as erosion, vandalism) to them.	High Medium
	Consider the concerns of Native American groups regarding cultural resources, including traditional cultural properties, within the watershed.	1. Consult concerned Native American groups early in the planning stages of any project in the analysis area.	High
Transportation	Manage the transportation system to serve the needs of the users and meet the needs identified under other resource programs.	1. Implement the Transportation Management Plan (TMP). 2. Implement Transportation Management Objectives (TMOs) for individual roads. a. Maintain the road closure system. b. Maintain all roads for the target vehicles and users. c. Provide for initial fire suppression access. d. Maintain a safe transportation system by removing hazards (e.g., hazard trees).	High High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Transportation	Maintain a transportation system (including trails, landings, and skid roads) that meets the Aquatic Conservation Strategy and Riparian Reserve objectives.	1. Implement the Northwest Forest Plan Standards and Guidelines for Roads Management (USDA and USDI 1994a:C-32-33).	High
		2. Follow the Best Management Practices for Roads in the Medford District Resource Management Plan (USDI, BLM 1995a:155-165).	High
		3. Assess all roads, especially in Riparian Reserves, and identify those in unstable and slide-prone areas, those with potential erosion/drainage problems, and those that are encroaching on a stream channel. Update the TMOs based on the findings.	High
		4. Develop and implement plans for decommissioning, obliterating, upgrading (i.e., improve drainage, surface and stabilize) or rerouting the roads identified in recommendation #3 to protect Riparian Reserves, stream channels and water quality and meet TMOs. Replant obliterated road corridors to native tree and other native plant species.	High
		5. Prioritize watershed restoration projects for roads in Riparian Reserves and areas where roads accelerate landslides and erosion, especially where they contribute large amounts of sediment to streams.	High
		6. Minimize soil compaction due to existing roads or skid trails in meadows and wetlands by decommissioning or obliterating roads and ripping skid trails. Where it is not feasible to close these roads, they should be improved to restrict traffic to the road prism.	High
		7. Close natural surface roads during the wet season.	High
		8. Maintain a minimum of four inches of rock surfacing on all BLM-maintained roads open for administrative access during the wet season.	High
		9. Provide vegetative cover (native grass and conifers) on natural surface roads that are closed year-round.	High
		10. Ensure that road stream crossings and cross drains are functioning as designed, especially following major storm events. Replace culverts that are improperly designed.	High
		11. Minimize any increases in road mileage.	High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Transportation	(Continued)	(Continued) 12. Use an interdisciplinary team to perform a project level, site-specific analysis for any proposed road construction. Avoid new road construction or landings within Riparian Reserves, wetlands, and unstable areas unless approved by an interdisciplinary team that includes a fisheries biologist, hydrologist, and soil scientist. 13. Maintain a natural stream bed for fish passage wherever feasible and economical. 14. Identify skid roads and landings that are not critical for future management activities and decommission or obliterate them. Skid roads and landings in Riparian Reserves or unstable areas should be the highest priority for removal.	High High High
	Maintain a transportation system that meets the objectives of the Cascade/Siskiyou Ecological Emphasis Area (CSEEA) Management Plan and the Jenny Creek Late-Successional Reserve Assessment.	1. Implement the recommendations identified in the CSEEA Management Plan when it is completed (USDI, BLM 2000b) and the Jenny Creek Late-Successional Reserve Assessment (USDI, BLM 1999).	High
	Maintain or enhance current native terrestrial wildlife populations and distribution.	1. Close roads during critical periods (generally November 15 to April 15) in subwatersheds where densities are greater than 1.5 miles per square mile of land. 2. Close roads that are not needed for administrative access or management activities.	High High
	Restore land that has been taken out of production.	1. Consider decommissioning or obliterating roads based on TMOs in order to put land back into plant production.	Medium

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Road Rights-of-way	Cooperate with individuals, companies, counties, the state, and federal agencies to achieve consistency in road location, design, use, and maintenance.	1. Maintain and implement reciprocal road right-of-way agreements. 2. Implement road use and maintenance agreements. 3. Evaluate and provide road right-of-way grants. 4. Obtain road easements for the public and resource management. 5. Work with other parties to stabilize roads and remove unneeded roads.	High High High High High
Other Rights-of-way and Authorizations	Coordinate with individuals, companies, nonprofit groups, counties, state, and other federal agencies on all inquiries/applications for non-road rights-of-way, leases, permits, and exchanges on federally managed lands.	1. Review each request on its own merits. 2. Respond to all requests in a timely manner. 3. Ensure consistency, fairness, and legal/environmental compliance in all decisions. 4. Monitor implementation of rights-of-ways and authorizations.	High High High High
Grazing	Manage livestock in a manner that maintains or improves Riparian Reserves to meet the goals of the Aquatic Conservation Strategy.	1. Stress the importance of properly functioning riparian areas in the issuance of grazing authorizations. 2. Implement Best Management Practices (USDI, BLM 1995:172) and the Northwest Forest Plan (USDA and USDI 1994a:C33-34) to ensure movement toward land use objectives.	High High
	Continue to provide livestock forage on designated allotments to meet societal needs, without compromising the ecological integrity of the uplands.	1. Develop management strategies in consultation with the permittee to resolve resource conflicts that arise. 2. Update allotment plans as needed. 3. Control noxious weeds. 4. Maintain a list of vacant allotments, including specific management constraints and concerns, for future inquiries.	High High High Medium
Minerals	Continue to coordinate with individuals, companies, counties, state, and other federal agencies on all inquiries/applications for mineral exploration and development.	1. Respond to all inquiries/applications in a timely manner.	High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Minerals	Rehabilitate areas disturbed due to past mineral activity. On disturbed sites, ensure public safety and enhance other resources values such as riparian or fisheries habitat.	1. Evaluate and prioritize known disturbed areas for rehabilitation. 2. Develop rehabilitation plans including a budget for targeted areas. Do this through an interdisciplinary effort. 3. Implement plans in a timely manner.	Low Low Low
	Provide for federal and public use of mineral materials consistent with National Environmental Policy Act (NEPA) requirements.	1. Monitor pit development use during extraction. 2. Coordinate with local watershed councils and state agencies in developing new rock sources in the analysis area. 3. Prepare, or where existing, update long-term rock quarry management plans to ensure quality rock material is economically available for the future. 4. Develop mineral sources as necessary for public use	High Medium Low Low
	Reduce sediments and pollutants from rock quarries.	1. Avoid developing rock quarries in Riparian Reserves. 2. Rehabilitate abandoned rock sources to reduce sediments and pollutants.	High Medium
Recreation	Maintain dispersed recreational opportunities. Utilize public input for planning priorities.	1. Continue to encourage dispersed recreational opportunities that are compatible with other resource values within the analysis area. 2. Continue to manage the Pacific Crest National Scenic Trail according to the comprehensive management plan and the Medford District's management plan for the Trail. 3. Implement Off-Highway Vehicle designations contained in the Medford District Resource Management Plan.	High High High
Unauthorized Use	Minimize and/or reduce unauthorized use including dumping on BLM-managed lands.	1. Continue coordination with state/county agencies to ensure that resource needs on adjacent public lands are considered and accommodated in private actions. Utilize law enforcement resources when appropriate. 2. Review and prioritize backlog cases and take steps to resolve in a timely manner.	High Medium

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
EROSION PROCESSES			
Erosion	Protect active and potentially active landslides and severely eroding areas.	1. Designate Riparian Reserves to include unstable and potentially unstable landslides. Buffer unstable and potentially unstable landslide areas from management activities that could cause further instability. The size of the buffer will be based on site specific analysis to ensure further movement does not occur.	High
		2. Restore recent or active landslides in or near Riparian Reserves.	High
		3. Restore active landslides and eroded terrain that contribute sediments to streams by planting conifers, installing retaining structures or other stabilizing material.	High
		4. Inventory all BLM-administered unstable lands to identify and prioritize potential restoration projects.	High
		5. Avoid regeneration harvest treatments in steep, unstable sideslopes adjacent to Riparian Reserves.	High
SOIL PRODUCTIVITY			
Soil Productivity	Minimize the effects of fire to the soil.	1. Avoid prescribed burning in areas where severe erosion and/or landslides may occur.	High
		2. Implement cool prescribed burns to maintain 50 percent duff and litter on site. Consider aspect, slope steepness, soil depth, and duff/litter cover when writing burn plans.	High
	Minimize soil productivity losses due to compaction.	1. Limit tractor skid roads to less than 12 percent of the harvest area with less than 6 percent loss in soil productivity.	High
		2. Accomplish skidding when soil moisture levels are low (less than 15 percent) in areas with fine-textured soils or areas that have fine-textured soils with high rock content where mitigation efforts are difficult. Skidding could be accomplished during the winter when a minimum 12 inch snowpack exists and temperatures are below freezing the entire day.	High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Soil Productivity	Minimize loss of topsoil.	1. Maintain a vegetative cover on the soil across the landscape throughout most of the year. 2. Minimize and mitigate bare soil areas caused by logging, road building, burning, and overgrazing.	High Medium
PLANT SPECIES AND HABITAT			
Non-Native Plant Species and Noxious Weeds	Prevent or discourage the spread of non-native plant species and noxious weeds. Prevent or discourage any increase in abundance of these species where they currently exist in the analysis area.	1. Emphasize prevention activities: a. Minimize ground disturbing activities in the analysis area. b. Use native species from local gene pools when plant materials are needed for project use. If the native species are unavailable or unsatisfactory, use non-invasive or non-persistent non-native species. c. Clean vehicles and equipment after being in known noxious weed infestation areas. 2. Use integrated pest management and appropriate research recommendations for control and/or eradication of noxious weeds. (See recommendations for noxious weed prevention listed under Vegetation). 3. Continue cooperation with Oregon Department of Agriculture for species identification and tracking. 4. Promote cooperation with local landowners and other government agencies. 5. Use grazing systems and best management practices designed to encourage native grasses and discourage non-native annual grasses on upland ranges. 6. Increase public awareness of noxious weed species and their management. 7. Consider the use of sterile and/or adapted competitive grass species on disturbed sites to prevent the encroachment of noxious weed species, especially on low elevation sites. These grasses should improve nutrient cycling and reduce noxious weed seeds in the soil. As appropriate, convert these sites to native species.	High High High High High High High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Special Status Plant Species and Habitats	Manage special status plant species and their habitats so as not to contribute to the need to list as threatened or endangered with the U. S. Fish and Wildlife Service.	1. Mitigate impacts of management activities to special status plants. 2. Monitor impacts of management activities and effectiveness of mitigation measures on special status plants. 3. Survey the entire analysis area for special status plant occurrence. 4. Develop and implement conservation strategies for Federal listed, candidate, and Bureau sensitive plant species. 5. Work with other agencies, universities, and private groups on monitoring and research projects for special status plants.	High High Medium Medium Medium
	Maintain and enhance special status plant populations, habitats, distribution and viability.	1. Identify and map potential habitat for special status plants found in the analysis area. 2. Identify important habitat characteristics of special status plants found in the analysis area and design management activities that will duplicate these characteristics. 3. Monitor special status plant populations to gain data on biology, phenology, demography, and ecology.	Medium Medium Medium
	Preserve, protect, and restore species composition and ecological processes of natural plant communities.	1. Control noxious weeds and other exotic species. 2. Develop a sustainable and economical local native seed source for future reseeding efforts. 3. Use, when available, native species for all vegetation and revegetation projects. 4. Avoid the use of native species from non-local sources that may be a threat to local genetic diversity.	High High High High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Survey and Manage Plant Species and Habitats	Maintain and enhance survey and manage populations, habitats, distribution and viability.	1. Implement survey protocols and management recommendations as they are developed. 2. Maintain adequate down coarse woody material, an important habitat component for survey and manage fungi and bryophytes. 3. Maintain the *Abies* component of the large diameter forests as habitat for rare cup fungi. 4. Minimize soil compaction and humus layer disturbance, important site characteristics for survey and manage fungi. 5. Monitor known sites to assess compliance with management guidelines and evaluate impacts of management actions. 6. Monitor populations of survey and manage species to address identified data gaps.	High High High High High Medium
VEGETATION			
Seedlings through Poles, Mid-Seral, and Mature/Old Growth Vegetation Classes	Increase growth, quality, and vigor of individual trees to prevent mortality of additional trees. Manage the stocking level of Douglas-fir in the Mixed Conifer and Mixed Evergreen, White Fir and Douglas-fir, and Ponderosa Pine Zones. Manage the stocking level of white fir in the White Fir Zone (See Map 9).	1. Reduce timber stand densities when the stands have a relative density index of 0.55 or greater by using appropriate silvicultural prescriptions to decrease the number of trees per acre (or basal area), to a relative density index of approximately 0.30 to 0.40. 2. Manage for species composition by aspect (pine on south and west aspects; Douglas-fir on east and north, etc.). 3. Use pruning as an option for improving wood quality in fast-growing pole stands.	High High Low

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Seedlings through Poles, Mid-Seral, and Mature/Old Growth Vegetation Classes	Design and develop a diverse landscape pattern and contiguous areas of multi-layered, late-successional forest (timber stands with diversified stand structure in regard to tree height, age, diameter classes, and species composition through uneven-aged management) over time. To meet the retention requirement on federal forest lands (USDA and USDI 1994a:C-44), no less than 15 percent would be in a late-successional class (Appendix K). Additional late-successional stands will be present outside of Riparian Reserves and areas of connectivity, most likely as isolated pockets of refugia. The remainder of the forest lands would be in earlier stages of seral development.	1. Prescribe silvicultural treatments that promote contiguous areas of mature and late-successional forest land. 2. Use single tree selection, group selection, irregular uneven-aged and intermediate cutting treatments (thinning and release) methods, in combination or singly, when necessary to create diversified stand structure of varying seral stage development and create late-successional stand characteristics. 3. Commercial thin even-aged, single-story canopy stands that are within the designated 15 percent late-successional retention areas. 4. Consider selective harvest where dwarf mistletoe infestations have killed moderately sized patches of trees within the retention areas.	High High High High
	Treat low elevation pine stands selected to meet the 15 percent late-successional retention requirement as soon as possible to restore pine species as the dominant species.	1. Use the single tree selection and group selection methods to establish pine species regeneration on dry, ponderosa pine sites. Douglas-fir should be the species targeted for harvest from these sites. 2. Create open park-like pine stands over time that have diverse stand structure (many different age classes and canopy layers).	High High
	Create openings and suitable seedbeds to promote the establishment and growth of pine species (especially sugar pine), incense cedar, and Douglas-fir. Increase the species composition of these species in forest stands where they are under represented.	1. Use the group selection method to create openings of 0.25 to 2.0 acres. Approximately 5 to 20 percent of the commercial forest lands would receive the group selection method of harvest with a random pattern of group distribution across the landscape. 2. Create favorable seedbed conditions for ponderosa pine through prescribed burning or other methods that would reduce the thickness of the soil duff layer, especially around the pine trees. Plant trees in the openings to ensure adequate stocking of pine species.	High High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Seedlings through Poles, Mid-Seral, and Mature/Old Growth Vegetation Classes	Assure survival of individual trees with late-successional characteristics by reducing vegetation competition in second growth timber stands. This also preserves genetic material.	1. Reduce competition in Matrix lands by removing second growth trees that surround trees with late-successional characteristics. Create an approximate 25-foot crown space between the old tree and the remaining second growth trees. Cut only trees that are not associated (crowns entwined) with the late-successional tree.	High
	Design silvicultural prescriptions to manage dwarf mistletoe infestations (for Matrix lands, but may be applied to late-successional areas).	1. Use selection method, pruning, and prescribed burning methods to control the rate and intensity of the parasite. Keep the mistletoe in draws and off of ridges.	High
	Use selection silvicultural methods to manage for root rot (*Phellinus weirii*, *Armillaria mellea*, and *Fomes annosus*) where prevalent in forest stands (for Matrix lands, but may be applied to late-successional areas).	1. Use single tree and strip selection methods to control the spread of the root rot. 2. Plant resistant species in openings created by tree mortality. 3. Use the selection silvicultural methods to develop diverse stand structure and species composition over time in the infected areas.	High High High
	Reduce the fire hazard of the timber stands by decreasing the ladder fuels while meeting the needs identified under other resource programs (for Matrix lands, but may be applied to late-successional areas).	1. Decrease the ladder fuels in forest stands by cutting only dense patches of suppressed tree regeneration and shrub species, and the pruning of tree limbs. These treatments should eliminate fire fuels to a height of 6 to 12 feet above ground level. Cut tree limbs that extend into the pruning height area. 2. Form a mosaic of vegetative patterns by leaving untreated patches of vegetation scattered throughout the landscape.	High High
	Retain at least 15 percent of all project areas, distributed throughout the landscape in an untreated condition. Untreated areas should be a minimum of 2.5 acres in size and can be in any combination of vegetation condition classes.	1. Use landscape design to maintain designated patches of untreated vegetation in strategic locations (e.g., Riparian Reserves; critical habitat; wildlife corridors; areas between existing tree plantations, shrublands, woodlands, etc.).	High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Seedlings through Poles, Mid-Seral, and Mature/Old Growth Vegetation Classes	Provide for well distributed coarse woody material (CWM is any large piece of woody material on the ground having a diameter greater than 4 inches and a length greater than 39 inches) across the landscape for maintaining the ecological functions of the species dependent on coarse wood (USDI, BLM 1994). Protect the largest coarse woody material already on the ground from management activities to the greatest extent possible.	1. Leave a minimum of 120 linear feet of class 1 and 2 logs per acre greater than or equal to 16 inches in diameter at the large end and 16 feet in length in regeneration harvest areas as prescribed in the Standard and Guidelines for CWM listed in the Northwest Forest Plan (NFP) (USDA and USDI 1994a; USDI, BLM 1994).	High
		2. Modify amounts of CWM in areas of partial harvest to reflect the timing of stand development cycles that provide for snags and subsequent CWM from natural suppression and overstocking mortality. Assess the advantages of treatment to improve habitat conditions beyond natural conditions. The amount of CWM to leave should fall within a range of the average natural distribution. For projects in the analysis area, no less than 15 to 20 percent ground cover of CWM or less than 4.5 tons/acre will be acceptable. Smaller log pieces may be counted when they meet designated standards (USDI, BLM 1996). Leaving green trees and felling to provide a source of CWM well distributed across the landscape after harvesting should be part of the partial harvest prescription.	High
		3. Exceed the standards and guidelines of the NFP for CWM where forest stands are experiencing mortality and excess large CWM (16 inches or greater in diameter at the large end) is available, particularly in the Jenny Creek LSR. Girdle large diameter green trees in healthy stands to provide large diameter CWM for wildlife habitat and/or soil productivity.	High
		4. Perform surveys to determine average amounts of coarse woody material over the landscape for the commercial timber land base.	High
		5 Leave all trees that are providing shade for CWM that is 20 inches in diameter at the small end and a minimum of 8 feet long.	High
		6. Recruit CWM levels gradually over time in partial harvest areas that are appropriate for the site (for each respective vegetation zone). It may take two to three stand entries to acquire desired amounts of CWM especially in regard to large end log diameter requirements.	Medium
		7. Avoid consumption of CWM during prescribed burning activities.	Medium

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Early Seral and Seedlings Vegetation Classes	Enhance structural diversity of existing, young even-aged forest stands.	1. Enhance the structural diversity of these vegetation classes by precommercial thinning treatments at staggered intervals and favoring trees of different heights and species at the time of treatment. 2. Perform release treatments as needed.	Medium Medium
Hardwood Vegetation Class	Maintain or improve the natural functions and processes of the native grass/oak woodlands plant associations where appropriate.	1. Manipulate vegetation species as necessary to maintain the natural functions and processes of the native grass/oak woodland plant associations. 2. Discourage high stocking densities of conifers by using manual treatments and prescribed burning. 3. Manage the abundance of shrub and noxious weed species. 4. Reduce the density of hardwoods to increase water and nutrient availability to the hardwoods for mast production where necessary. 5. Use prescribed burning and mechanical methods to accomplish recommendations 1 through 4. 6. Seed native grass species into areas of exposed, disturbed soil before noxious weeds become established. Under certain circumstances, desirable non-native grass species will be seeded (See Appendix L) where feasible.	High High High High High High
	Introduce a younger age class into the oak woodlands.	1. Cut suppressed and intermediate crown class trees to induce sprouting. Manage the sprout clumps to favor growth of the dominant sprouts. After the vigor is restored to the oak trees, acorn crops should provide for more natural regeneration. 2. Plant oak trees where appropriate.	Medium Low
Shrub Vegetation Class	Maintain the integrity of the shrublands.	1. Manage the density and species composition of the shrubs. 2. Concentrate density reduction efforts on the extremely dense shrublands on the south facing slopes and where there is big game habitat. 3. Control or retard the spread of non-native species, especially noxious weeds (see Non-native Noxious Weed recommendations).	High High High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Shrub Vegetation Class	(Continued)	(Continued) 4. Use prescribed burning and mechanical methods to accomplish recommendations 1 through 4. 5. Seed native grass species into areas of exposed, disturbed soil before noxious weeds become established. Under certain circumstances, desirable non-native grass species will be seeded where feasible (see Appendix L). 6. Manage tree species to maintain the dominance of the desired shrub species.	High High Medium
Grass Vegetation Class	Maintain and/or improve the species composition of the native grasslands.	1. Treat tree and shrub species with prescribed fire to maintain the dominance of native grasses. 2. Seed native grasses on recently disturbed areas to prevent the establishment of noxious weeds. Under certain circumstances, desirable non-native grass species will be seeded where feasible (see Appendix L). 3. Control or retard the spread of non-native species especially noxious weeds (see Non-native Noxious Weed recommendations). 4. Develop a native grass propagation program for grasses found in the analysis area.	High High High Medium
FIRE AND AIR QUALITY			
Safety	Provide for firefighter and public safety in all fire management activities (including wildfires) across the landscape. This objective is mandated by the Department of Interior as the first priority in every fire management activity (USDI and USDA 1995).	1. Treat high hazard areas around the rural interface areas. Reduce canopy closures, ground and ladder fuels in order to increase protection of private lands and structures. Treatment of fuels on private lands within the rural interface is mostly dependent on factors outside the control of the BLM. 2. Retain fire access routes based on transportation management objectives. These routes are needed to allow quick response times to wildfire starts and escape routes for the public and firefighters.	High High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Safety	(Continued)	(Continued) 3. Treat fuels adjacent to identified high values at risk such as recreation and historic sites. Treatments would include under-burning, slashing and brushing, lop and scatter, and hand-pile and burn. 4. Coordinate with adjacent private landowners to treat hazardous fuels on private lands.	High High
Resource Protection	Promote long-term resistance of the lower and mid-elevation areas to stand replacement wildfires by reducing the fuel hazard.	1. Treat areas of continuous high hazard fuels in order to help reduce the size and intensity of wildfires. High priority areas would be adjacent to the rural interface area and adjacent to high values at risk (listed in Table 15, Current Condition section). Treatments should include commercial thinning of overstocked stands and treatment of ground and ladder fuels in both commercial and noncommercial timber lands. 2. Develop overall project strategy to reduce fuel hazard resulting from land management activities. 3. Utilize prescribed burning to maintain plant communities such as grasslands and oak woodlands. Fire will not only maintain these communities but also reduce the fuel hazard of these areas.	High High High
Air Quality	Minimize adverse impacts to air quality from fire management activities and wildfires.	1. Conduct fire management activities in compliance with all federal, state, and local smoke management regulations. 2. Monitor particulate matter levels produced from fire management activities and wildfires to further refine smoke emission mitigation practices.	High High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
TERRESTRIAL WILDLIFE SPECIES AND HABITAT			
Terrestrial Wildlife Species and Habitat	Maintain or enhance current native terrestrial wildlife populations.	1. Develop and maintain an appropriate amount and distribution of seral stages of the various plant communities found in the analysis area. 2. Identify, protect, and where appropriate, enhance the special habitats identified in the Medford District Resource Management Plan (USDI, BLM 1995), such as caves/mines, talus, wetlands, and meadows. 3. Maintain adequate numbers of snags and amounts of coarse woody material (see Vegetation recommendations) for those species that require these special habitats for breeding, feeding, or sheltering. 4. Identify and protect, maintain, or improve dispersal corridors within the analysis area and between adjacent watersheds. 5. Adopt the management recommendations found in the *Draft Site-Specific Management Plan for the Emigrant Lake Bald Eagle Nest Site* (Oregon Eagle Foundation 1995) that pertain to BLM-managed lands. 6. Implement the Transportation recommendations that are specific to terrestrial wildlife. 7. Restore oak/pine woodlands through prescribed fire and appropriate silvicultural methods. 8. Rehabilitate/rejuvenate shrublands by using prescribed fire or other efficacious method. 9. Restore native grasslands.	High High High High High High High High High
	Ensure management activities do not lead to listing of special status species as threatened or endangered.	1. Inventory special status species suspected to occur in the analysis area. 2. Protect, maintain, or improve habitat conditions as necessary for those special status species found.	High High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
HYDROLOGY			
Hydrology	Maintain and enhance instream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. Protect the timing, magnitude, duration, and spatial distribution of peak, high, and low flows (Aquatic Conservation Strategy Objective #6; USDA and USDI 1994a:B-11).	1. Follow Transportation recommendations. 2. Manage vegetation within the transient snow zone to minimize large openings. Analyze site-specific projects for cumulative watershed effects on a drainage area (generally less than 6,000 acres) basis. Assess watershed conditions (e.g., riparian and stream channel condition, geomorphic landform, slope stability, precipitation, and compacted area) and reference conditions (including natural variability) to determine the percent hydrologic recovery that is appropriate for each drainage area. Use the following crown closure percentages (based on a combination of hardwoods and conifers), listed by tree species, and aspect, to represent full hydrologic recovery when conducting a site specific analysis. Series / Aspect / Canopy Closure (%) Pine / south, west / 40 Pine / north, east / 40-50 Douglas-fir / north / 70 Douglas-fir / south, west, east / 60 White fir / all / 70 These canopy closures reflect reference conditions when forest fires were more frequent and other biotic agents such as insects, disease, and wind-throw were not controlled. The range of natural variability for vegetation in the Upper Bear Creek Watershed Analysis Area includes canopy closures that would be greater than and less than full hydrologic recovery. A range of percentages would be more accurate to represent changing forest conditions over time. These canopy closures should not be misinterpreted as the canopy closures that must be maintained by silvicultural prescriptions. Silvicultural prescriptions may result in some of these percentages being as much as 10 to 15% lower for short periods of time within a portion of a forest zone. Use the appropriate range of natural variability to manage transient snow zone canopy closures.	High High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Hydrology	(continued)	(continued) 3. Reduce upland fire hazard to minimize potential for catastrophic wildfires. 4. Encourage spring protection and minimize surface/groundwater diversions on public lands to ensure attainment of the Aquatic Conservation Strategy Objectives. 5. Require compliance with State regulations and permit limitations for water diversions, ditches, and pipelines on public lands.	High High High
	Maintain and enhance the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands (Aquatic Conservation Strategy Objective #7; USDA and USDI 1994a:B-11).	1. Follow interim Riparian Reserve widths identified in the Northwest Forest Plan Standards and Guidelines for wetlands greater than one acre (USDA and USDI 1994a:C-30-31). Designate Riparian Reserve widths of 100 feet slope distance from the outer edge of wetlands less than one acre. 2. Follow Transportation recommendations that pertain to meadows and wetlands.	High High
STREAM CHANNEL			
Stream Channel	Maintain and enhance the natural channel stability by allowing streams to develop a stable dimension, pattern, and profile such that, over time, channel features are maintained and the sediment regime under which aquatic ecosystems evolved is maintained and enhanced.	1. Follow Transportation recommendations. 2. Encourage the Bureau of Reclamation to install a bypass for their pipeline to the Green Springs Powerplant to avoid releasing high flows in Schoolhouse Creek.	High Medium
	Maintain and enhance the physical integrity of the aquatic system, including stream banks and bottom configurations (Aquatic Conservation Strategy Objective # 3; USDA and USDI 1994a:B-11).	1. Promote growth of conifer and hardwood trees within Riparian Reserves, using silvicultural methods if necessary, to reach late-successional characteristics (where capable) for future large wood recruitment (see Riparian section). 2. Minimize activities that adversely affect streambanks and riparian vegetation.	High High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Stream Channel	(Continued)	(Continued) 3. Maintain or enhance the streams' ability to dissipate the energy from high stream flows. Assess need for energy dissipators in stream channels and consider adding energy dissipators, such as meanders, large woody material or boulders, and riparian vegetation where appropriate.	Medium
	Maintain and enhance the sediment regime under which the aquatic ecosystem evolved (Aquatic Conservation Strategy Objective # 5;USDA and USDI 1994a:B-11).	1. Follow Transportation and Erosion Processes recommendations. 2. Reduce the potential for altering the timing, magnitude, duration, frequency, and spatial distribution of peak flows (see Hydrology section). 3. Assess for eroding stream banks and stabilize where appropriate.	High High Medium
WATER QUALITY			
Water Quality	Maintain and enhance water quality necessary to support healthy riparian, aquatic, and wetland ecosystems (Aquatic Conservation Strategy Objective # 4; USDA and USDI 1994a:B-11). Achieve the principal water quality objectives in the Upper Bear Creek Watershed Analysis Area by increasing summer flows and reducing summer stream temperatures, sedimentation, and bacteria.	1. Apply appropriate Best Management Practices (BMPs) (USDI, BLM 1995:149-177) to minimize soil erosion and water quality degradation during management activities. 2. Follow Hydrology recommendations 4 and 5 to increase summer flows. 3. Plant or maintain native species (from local genetic stock) in riparian areas and wetlands to provide adequate stream shading. 4. Protect riparian vegetation that provides stream shading as specified in the Riparian Areas recommendations. 5. Follow Transportation and Erosion Processes recommendations to reduce stream sedimentation. 6. Survey and stabilize actively eroding landslide areas that are contributing sediment to streams. 7. Manage livestock grazing to avoid livestock concentrations in riparian areas, especially in the Walker Creek subwatershed, to reduce bacteria. 8. Assess stream width-to-depth ratios and determine if contributing to increased stream temperatures. Reduce width-to-depth ratios in appropriate stream reaches using methods such as promoting point bar development through riparian vegetation and other energy dissipators.	High High High High High High High Medium

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
RIPARIAN AREAS			
Riparian Reserves	Decrease fragmentation within Riparian Reserves and maintain or enhance connectivity between Riparian Reserves.	1. Follow Transportation recommendations. 2. Determine weaknesses in connectivity and plan management activities that enhance riparian habitat.	High Medium
	Give the highest priority for restoration to Riparian Reserves most impacted by road development and/or roads located in unstable upland and landslide bench terrain.	1. Follow the interim Riparian Reserve widths outlined in the Northwest Forest Plan (USDA and USDI 1994a:C-30-31). 2. Change or discontinue management activities that may prevent or retard restoration and/or enhancement of Riparian Reserve habitat. 3. Use an interdisciplinary process to design site-specific Riparian Reserve treatments if necessary to maintain and enhance riparian vegetation condition.	High High High
	Maintain and enhance the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration, and to supply amounts and distribution of large woody debris sufficient to sustain physical complexity and stability. Protect ground water flow. Protect riparian-dependent special status species.	1. Give Riparian Reserves located adjacent to fish-bearing streams the highest priority for restoration to late-successional characteristics. Implement riparian silviculture (density management) in Riparian Reserves to increase the large conifer component in fish-bearing streams, with early and mid-successional stands. 2. Implement riparian silviculture to reduce fire hazard especially where there are mid and-late successional conifer components within the Riparian Reserves of fish-bearing streams that are at risk of damage (or elimination) due to fire. 3. Identify specific grazing problems in Riparian Reserves, especially along wetlands and streambanks, and institute appropriate restoration measures.	High Medium Medium

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
AQUATIC WILDLIFE SPECIES AND HABITAT			
Aquatic Wildlife Species and Habitat	Maintain viable anadromous and resident salmonid fish and other aquatic wildlife populations with individuals of all life stages throughout their habitat.	1 Ensure that management activities on BLM-managed lands meet the Aquatic Conservation Strategy (ACS) Objectives (USDA and USDI 1994a:B-11), and the management actions/direction in the Medford BLM Resource Management Plan (USDI, BLM 1995), and Best Management Practices (USDI, BLM 1995:149-177).	High
	Restore and protect aquatic habitat for all anadromous and resident fish and other aquatic resources. Restore and protect spatial and temporal connectivity within and between watersheds.	1. Restore and/or diversify fish habitat and floodplain connectivity to maintain pool habitat, fish cover, spawning gravels, and bank stability.	High
		2. Promote future large wood recruitment in Riparian Reserves.	High
		3. Improve water quality and increase water quantity. Adhere to Water Quality and Hydrology recommendations.	High
		4. Avoid activities that degrade streambanks and riparian areas. Adhere to Riparian Area recommendations.	High
		5. Follow Transportation and Erosion Processes recommendations.	High
		6. Encourage ODFW to work with Talent Irrigation District to establish a perennial minimum flow in Emigrant Creek below Emigrant Dam.	Medium

LANDSCAPE PLANNING OBJECTIVES AND RECOMMENDATIONS FOR BLM-ADMINISTERED LANDS

Recognizing that the landscape of the Upper Bear Creek Watershed Analysis Area is a complex web of interacting ecosystems, the watershed analysis team blended individual resource information to develop a landscape picture for BLM-administered lands. The team looked at the current condition of the terrestrial and aquatic components of the landscape and synthesized the information to formulate landscape level objectives and recommendations. These landscape level objectives and recommendations provide valuable information for planning projects and making management decisions. Map 25 shows areas across the landscape that need special consideration prior to project planning.

LANDSCAPE AREA	OBJECTIVES	RECOMMENDATIONS
Riparian Reserves	Maintain and enhance Riparian Reserve habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependant species, especially taking into consideration long-term plant community changes.	1. Follow the interim Riparian Reserve widths identified in the Northwest Forest Plan (USDA and USDI 1994a:C-30-31) until site specific analysis occurs at the project level. 3. Follow Riparian Reserve module (USDA et al. 1997) to change boundary widths. 3. Use an interdisciplinary process to design site-specific silvicultural treatments as needed to meet Aquatic Conservation Strategy Objectives (USDA and USDI 1994a:B-11). 4. Evaluate roads, skid trails, and landings within Riparian Reserves and determine appropriate action, such as stabilize, improve drainage, decommission, etc. 5. Manage Riparian Reserves to improve riparian vegetation, stabilize streambanks, and reduce sediment.

LANDSCAPE AREA	OBJECTIVES	RECOMMENDATIONS
Unstable Areas Designated as Riparian Reserves	Protect unstable and potentially unstable areas.	1. Designate Riparian Reserves to include unstable and potentially unstable landslide areas. 2. Buffer management activities near unstable and potentially unstable landslides. The size of the buffer and extent of management activities will be based on site specific analysis to ensure further movement does not occur.
Late-Successional Reserve (LSR)	Protect and enhance conditions of late-successional and old-growth forest ecosystems, which serve as habitat for late-successional and old-growth forest related species including the northern spotted owl.	1. Follow the Jenny Creek LSR Assessment's (USDI, BLM 1999) desired conditions for amounts of coarse wood and number of snags per acre for LSR stands. 2. Implement silvicultural treatments as needed to attain desired levels of suitable late-successional habitat. 3. Assess connectivity within the LSR for late-successional dependent species. Target younger stands for conversion to late-seral stages which would increase connectivity across the landscape. 4. Reduce road density within the LSR by rerouting, obliterating, blocking, and/or decommissioning roads, skid trails, and landings based on Transportation Management Objectives (TMOs).
Special Recreation Management Area	Manage the Pacific Crest National Scenic Trail (PCNST) to protect its resource values and to maintain its natural conditions.	1. Continue to manage the Pacific Crest National Scenic Trail according to the comprehensive management plan and the Medford District's management plan for the Trail.
Special Areas	Manage Pilot Rock as an Area of Critical Environmental Concern for geologic, historic, scenic, wildlife, and botanical values. Manage the Cascade/Siskiyou Ecological Emphasis Area according to the management plan being developed (USDI, BLM 2000b).	1. Follow management specified in the BLM Medford District Resource Management Plan (USDI, BLM 1995) and specific management plans as they are developed.

LANDSCAPE AREA	OBJECTIVES	RECOMMENDATIONS
15 Percent Late-Successional Retention Areas	Meet or exceed the 15 percent late-successional retention requirement on federal forest lands (USDA and USDI 1994a:C-44) to provide habitat to function as refugia for old-growth associated species that have limited dispersal capabilities such as fungi, lichens, bryophytes and vascular plants (see Appendix K and Map 24).	1. Reserve late-successional stands in all vegetation zones. 2. Ensure that retained stands are distributed across the landscape. 3. Identify and treat target stands to speed development of late-successional or old-growth habitat that will support a more connected network of continuous habitat than currently exists. 4. Treat reserve stands where necessary to maintain and create late-successional components, such as canopy cover, snags, and class I and II coarse wood (see Management Objectives and Recommendations, Vegetation, for coarse woody material amounts). 5. Prescribe silvicultural treatments aimed at restoring and preserving late-successional pine characteristics in pine associated stands that have been identified for retention, but are overstocked with Douglas-fir and other species.
Matrix	Maintain the islolated (landlocked) parcels of matrix land in a mature/late-successional seral stage when possible, which would help meet the 15% late-successional retention requirement.	1. Use intermediate (commercial thinning) and selection harvest methods to achieve desired stand structure and species composition. 2. Consider regeneration harvest as an option when appropriate stand structures are retained, 16 to 25 large green trees per acre, and a minimum of 40 percent canopy closure (USDI, BLM 1995).
	Manage the larger, accessible parcels of matrix lands in a variety of vegetative seral stages according to Medford District Resource Management Plan (USDI, BLM 1995) guidelines.	1. Manage by appropriate trees series zones to provide for a variety of stand structures (early through late-successional seral stages) while maintaining all native species. A variety of silviculture prescriptions can be applied.

LANDSCAPE AREA	OBJECTIVES	RECOMMENDATIONS
Matrix	Provide general connectivity (along with other land use allocations such as Riparian Reserves) between late-successional reserves.	5. Provide a renewable supply of large live trees and snags well distributed across the land in a manner that provides habitat for cavity using birds, bats, and other species. Regeneration harvest is an option when appropriate stand structures are retained, 16 to 25 large green trees per acre, and a minimum of 40 percent canopy closure (USDI, BLM 1995). 6. Leave a minimum of 120 linear feet of logs per acre greater than or equal to 16 inches in diameter and 16-feet long. Retain coarse woody material already on the ground and protect it from disturbance during treatment.
High Fire Hazard Areas	Treat all vegetation condition classes in strategic locations, especially commercial forest stands, to ensure their survival from insects and fire, and enhance seral and structural development of the condition classes (see Map 19 for high fire hazard areas).	1. Develop prescriptions that reduce fire hazard and improve vegetation health to protect natural resources or sites of cultural value from biotic disturbances (fire and wind). 2. Manage vegetation density of all vegetation condition classes to accomplish this objective. 3. Use selection silvicultural harvest methods to create or enhance the development of late-successional forests. 4. Treat pine series forest in the commercial base to create open park-like structure. 5. Target Douglas-fir stands for density management adjacent to shrublands or woodlands on south and west slopes, or on ridges that receive sunlight for most of the day.
Northern Spotted Owl Critical Habitat Unit OR-38 (Matrix lands)	Provide nesting, roosting, foraging and dispersal habitat for the northern spotted owl.	1. Establish 100 acre late-successional reserves around all new nest sites found in the critical habitat unit. 2. Minimize the loss or degradation of suitable spotted owl habitat within 0.7 miles of known spotted owl nest sites.

LANDSCAPE AREA	OBJECTIVES	RECOMMENDATIONS
Wildlife Connectivity	Maintain connectivity between the Upper Bear Creek Watershed Analysis Area and adjacent watersheds.	1. Follow recommendations in the Jenny Creek Late-Successional Reserves Assessment (USDI, BLM 1999).
Emigrant Creek Deer Winter Range	Improve winter range habitat conditions.	1. Minimize vehicular disturbance during the winter period: November 15 - April 15. 2. Rejuvenate decadent brushlands. 3. Restore native grasslands. 4. Develop water sources as needed.
Grizzly Peak Elk Management Area	Improve habitat conditions for elk.	1. Manage forage and cover to provide Wisdom Elk Model habitat effectiveness indices of at least 0.6. 2. Create elk forage areas by burning, seeding, and fertilizing. 3. Close existing roads and minimize new construction. 4. Develop water sources as needed.
Roads of Concern	Reduce road density and road-caused erosion, stabilize roads that are unstable, and reduce wildlife disturbance.	1. Review roads of concern listed in Appendix M and consider stabilizing, closing, or decommissioning.

LANDSCAPE AREA	**OBJECTIVES**	**RECOMMENDATIONS**
Transient Snow Zone	Maintain the timing, magnitude, duration, and spatial distribution of peak streamflows within the range of natural variability.	1. Manage vegetation within the transient snow zone to minimize large openings. Analyze site-specific projects for cumulative watershed effects on a drainage area (generally less than 6,000 acres) basis. Assess watershed conditions (e.g. riparian and stream channel condition, geomorphic landform, slope stability, precipitation, and compacted area) and reference conditions (including natural variability) to determine the percent hydrologic recovery that is appropriate for each drainage area. Use the following crown closure percentages (based on a combination of hardwoods and conifers) listed by tree species, and aspect to represent full hydrologic recovery when conducting a site specific analysis. Series / Aspect / Canopy Closure (%) Pine / south, west / 40 Pine / north, east / 40-50 Douglas-fir / north / 70 Douglas-fir / south, west, east / 60 White fir / all / 70

DATA GAPS

This section identifies information that was not available for the Upper Bear Creek Watershed Analysis Area during the analysis. Items under each ecosystem element/subelement are listed in priority order if funding should become available for data collection.

Human Uses

Unauthorized Use

1. Property lines in locations where unauthorized use is suspected.

Transportation

1. Road condition surveys.

Grazing

1. Potential cooperative livestock related projects on private lands within the analysis area.

Archaeological Sites

1. Systematic archaeological survey.
2. Formal evaluation of known archaeological sites.

Erosion Processes

1. Field inventory and GIS mapping of all recent and active landslides and severely eroded terrain on BLM-administered lands.
2. Quantification of landslide and erosion rates accelerated by BLM-administered land (i.e., roads and clearcut harvesting) versus natural erosion rates.

Soil Productivity

1. Duff thickness for various vegetation types within the analysis area.
2. Extent of soil productivity reduction caused by wildfire.
3. Quantification of disturbance effects on long-term soil productivity.
4. Amount of coarse woody material (by decay class) across the landscape.

Plant Species and Habitats

Special Status Plant Species and Habitats

1. Inventory of special status plants.
2. Inventory and population data of non-native plant species, including noxious weeds.
3. Demographic data on known populations.
4. Species response to management practices.

Survey and Manage Plant Species and Habitats

1. Inventory for Survey and Manage lichens, bryophytes, and fungi.
2. Species distribution data.

Forest Density and Vigor

1. Comprehensive data on drought tolerance for tree and shrub species (in bars of water tension).
2. More statistical data regarding the historic range, frequency, and distribution of vegetation over the landscape (should include all pine species, incense cedar, oak species, black cottonwood, red alder, and Oregon ash).

Fire and Air Quality

1. Exact acreage and location of existing and past high hazard, medium hazard, and low hazard areas.
2. Data regarding the range, frequency, distribution, and interaction of insects, animals, vegetation and fire intensities.
3. Wildfire intensities and consumption rates over the landscape during differing climatic conditions through time.
4. Cultural understanding of fire use during prehistoric times.
5. Complete fire start information (e.g., location, cause, time) prior to 1969.
6. Classification of land by plant association within and outside fire regimes.
7. Utilizing above data to predict wildfire severity potential within the watershed through predictive models such as RERAP, and FARSITE.
8. Information regarding past and present trends in air quality due to fire management and wildfire activities.
9. Data regarding changes in populations of fire dependant plant and animals species.

Terrestrial Wildlife Species and Habitats

1. Prehistoric, existing and desired relative abundance and patch size distribution of the vegetation condition classes found in the analysis area.
2. Occurrence, distribution, and population data for special status, survey and manage, and protection buffer species found in the analysis area.
3. Snag and coarse woody material abundance by vegetation condition class.

Hydrology

1. Field surveys to identify stream categories for nonfish-bearing streams (permanently flowing or intermittent).
2. Soil compaction analysis for the analysis area.
3. On-the-ground wetland inventory.

Stream Channel

1. Sediment source locations in stream channels and upland areas, including roads.
2. Physical stream characteristics of stream reaches that have not been surveyed.

Water Quality

1. Water quality data for Emigrant and Walker Creeks and their tributaries (dissolved oxygen, pH, bacteria, sediment, turbidity, and nutrients).

Riparian Areas

1. Amount of large woody material in riparian areas.
2. Amount, diversity, and age of riparian vegetation.

Aquatic Wildlife Species and Habitats

1. Spawning escapement of steelhead trout in the Walker Creek system.
2. Species and genetic composition of resident trout in Emigrant Creek and tributaries.
3. Impacts of non-native salmonids in Emigrant Reservoir on native species in Emigrant Creek above the reservoir.
4. Distribution and relative abundance of non-salmonid fish species.
5. Species composition, distribution and relative abundance of macroinvertebrates and amphibians.
6. Habitat condition including percent of shading along streams, geomorphology, pool/riffle/ratios, pool depth, and substrate composition in non-surveyed tributaries.

MONITORING RECOMMENDATIONS

The following monitoring recommendations are made in order to gain a better understanding of the watershed processes and conditions within the Upper Bear Creek Watershed Analysis Area. Items under each ecosystem element are listed in priority order if funding should become available for monitoring.

Human Uses

1. Monitor cultural resource site conditions (looting and natural deterioration),
2. Monitor cultural resource effectiveness of past survey strategies to locate sites.
3. Monitor changing public opinions, values, and expectations regarding land management issues.

Transportation

1. Monitor roads to ensure that drainage structures are functioning as designed.
2. Monitor culverts on fishery streams to ensure that passage is adequate.
3. Monitor road blocks to ensure that they are effective.

Soil Productivity

1. Survey duff thickness for various vegetation types in the analysis area prior to and after management actions.
2. Survey the analysis area for coarse woody material (CWM), especially in various ecological and vegetative types, in order to adjust amount of CWM needed across the landscape.

Special Status Plant Species and Habitats/Survey and Manage Plant Species and Habitats

1. Population demographic monitoring to determine species biology, life history, ecological requirements, and population trends.
2. Monitor pre and post management to determine microclimate changes and effectiveness of mitigation design.
3. Long term monitoring to determine impacts of management actions.

Forest Density and Vigor

1. Monitor commercial forest stands for vigor by using relative density as an index.
2. Measure individual tree growth in commercial forest stands.
3. Analyze canopy closure before and after vegetation treatment.
4. Monitor amounts of coarse woody material before and after timber harvesting operations.
5. Monitor the number and quality of snags (and perhaps how the trees were killed: insects or pathogens).
6. Monitor acorn crops after oak woodland treatments.

7. Monitor the survival of individual pine trees after release treatments.
8. Measure humidity and air temperatures for pre-treatment and post treatment areas across the landscape to learn the effects of timber harvest.

Fire and Air Quality

1. Monitor changes in fire hazard over time as landscape fuel hazard reduction treatments are completed.
2. Monitor smoke emissions and impacts from wildfire and fuels management activities.
3. Monitor changes in populations of fire dependant plant and animal species over time.

Terrestrial Wildlife Species and Habitat

1. Monitor site occupancy, reproductive status and reproductive success of threatened/endangered species found in the analysis area.
2. Monitor habitat use and population trend of the special status and other priority species found in the analysis area.
3. Monitor rate of recruitment/loss of snags and coarse woody material.
4. Monitor rate of seral stage change in the vegetative communities found in the analysis area.

Hydrology

1. Monitor changes in transient snow zone openings.
2. Monitor changes in road density and soil compaction.

Stream Channel

1. Establish permanent monitoring monuments to determine changes in channel morphology resulting from specific stream improvement projects.
2. Monitor changes in channel stability and condition by conducting periodic physical stream surveys (such as10-year intervals).

Water Quality

1. Continue monitoring stream temperatures.
2. Monitor dissolved oxygen and pH on a regular basis at temperature sites.
3. Monitor sediment, nutrients, and bacteria at selected sites.

Riparian Areas

1. Assess the ability of the Aquatic Conservation Strategy and BLM Medford District Resource Management Plan's management direction to provide the anticipated level of protection to interim Riparian Reserves.
2. Monitor riparian habitat (i.e., large woody material, shading, microclimate) before and after implementing management prescriptions designed to improve riparian habitat.

3. Assess riparian species composition, age, density and health prior to and in conjunction with return intervals for timber harvest.

Aquatic Wildlife Species and Habitats

1. Monitor changes in aquatic/riparian habitats, stream temperatures, water quality and fish populations by conducting periodic physical stream surveys and population inventories (i.e. 10-year intervals).
2. In conjunction with Oregon Department of Fish and Wildlife (ODFW), monitor non-salmonid native fish populations and introduced fish populations in Emigrant Reservoir.
3. In conjunction with ODFW monitor spawning escapement of steelhead trout in Walker and Cove Creeks, and Emigrant Creek downstream of Emigrant Dam.
4. Collect baseline data on aquatic macroinvertebrate populations to determine the biotic integrity of stream habitat and trends in the analysis area.
5. Collect baseline data on amphibians such as foothill yellow-legged frog populations to determine the biotic integrity of stream habitat and trends in the analysis area.
6. In conjunction with ODFW, assess the impacts on steelhead spawn and juvenile survival by periodic de-watering of Emigrant Creek below Emigrant Dam.

RESEARCH RECOMMENDATIONS

The following research recommendations would provide additional understanding of ecosystem processes in the Upper Bear Creek Watershed Analysis Area. Items under each ecosystem element are listed in priority order should funding become available.

Plant Species and Habitats

Special Status Plant Species and Habitats

1. Determine ecological requirements.
2. Determine the effects of micro-climate changes due to management activities on individuals and the population.

Survey and Manage Plant Species and Habitats

1. Determine ecological requirements.
2. Determine the effects of micro-climate changes due to management activities on individuals and the population.
3. Determine relationship of stand age to population viability.
4. Determine the forest tree density level required to sustain population viability.

Forest Density and Vigor

1. Research the soil carbon/nitrogen ratios for various soils in the analysis area.
2. Study the available trace elements in the various soils of the analysis area and the requirements for the tree species.
3. Perform more comprehensive studies on the ecological requirements of Oregon white and California black oak to produce acorn crops, including optimum tree density (stems/acre), impact of competing vegetation (how much and which species can grow around the oaks?), and the occurrence, frequency, and intensity of fires needed to return nutrients to the soil to maintain healthy, productive oak woodlands.
4. Research how long conifer and hardwood trees can live on low elevation, drought-prone sites.
5. Determine the evapotranspiration rates for all endemic tree and shrub species (in inches of water).
6. Determine how many old-growth trees are needed on a per-acre basis to maintain ecosystem functions of late-successional forests.

7 Determine what the coarse woody material requirements of the analysis area are in order to maintain site productivity.

Terrestrial Wildlife Species and Habitat

1. Determine ecological requirements for the special status, survey and manage, and protection buffer species present in the analysis area.
2. Determine the optimum mix and distribution of seral stages of the vegetative communities found in the analysis area that would maximize the probability of persistence of all special status, survey and manage, and protection buffer species.

Stream Channel

1. Determine amounts of large woody material needed in steep headwater channels.

Water Quality

1. Determine potential for water quality limited streams to exceed state temperature criterion even with riparian canopy providing full shade to stream.

Aquatic Wildlife Species and Habitats

1. Study the impacts of introduced fish on native fish populations in the analysis area.
2. Determine impact of flow alteration from Emigrant Dam and water withdrawals on native fish habitat.

MAPS

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Team Member	Responsibility
Laurie Lindell	Team Leader, Facilitator, Editor, Climate, Hydrology, and Water Quality
Kate Winthrop	Cultural Resources and Environmental History
Joe Hoppe	Facilities, Lands, and Minerals
Chris Johnson	Fire and Air Quality
Ted Hass	Geology, Erosion Processes, and Soil Productivity
James Heffner and Tom Jacobs	Grazing, Non-native Plants, and Noxious Weeds
Scott Haupt	Landscape Vegetation Pattern and Forest Density
Brad Tong	Plants and Special Areas
Fred Tomlins	Recreation
Bill Haight	Stream Channels, Riparian Areas, and Aquatic Wildlife
George Arnold	Terrestrial Wildlife
John Samuelson	Transportation System
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Larry Zowada	GIS Maps and Information
Cori Frances	Logging Information
Frank Lang and Paul Hosten	Liaison with CSEEA Management Plan
David Leal	U.S. Fish and Wildlife Service Representative

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APPENDICES

APPENDIX A
Public Comments

Summary of Public Comments

Approximately 1,200 fliers were sent to residents and interested parties in the Upper Bear and Klamath-Iron Gate Analysis Areas announcing dates and places for open house meetings. The fliers also invited the recipients to send written comments to the BLM concerning issues and management direction.

The open house meeting for the Upper Bear Creek Watershed Analysis was held at the U.S. Forest Service Ashland Ranger District Office in Ashland on April 21, 1999. Thirty individuals registered at the meeting. BLM staff members recorded comments at the meeting, but attendees were encouraged to send written comments to BLM if additional issues and concerns came to mind. Many of those in attendance at the Ashland meeting had an interest in the Klamath-Iron Gate Watershed Analysis as well.

In addition to comments received at the open house, BLM received 83 letters with comments concerning the Upper Bear Creek Watershed Analysis Area. Most of the comments discussed roads and off-highway vehicle (OHV) use. Fifty nine letters, mostly from OHV club members, favored keeping roads open to OHV use. One writer wanted additional opportunities for OHV users. Another writer insisted there is a need to maintain roads for forest management and to control wild fire. Only one letter supported closing unsurfaced roads in the analysis area. The main reasons expressed were to protect water quality, prevent fires caused by OHVs, and protect wildlife. One person said BLM should protect the Pacific Crest Trail from OHVs and from logging.

Logging and grazing were the focus of a number of letters. A couple of people commenting blamed the two activities for damage to streams. Another insisted that cattle caused damage to private land. Two people who submitted comments wanted all cattle removed from public lands. At least five people commented that heavy logging is responsible for landslides on upper Emigrant and Baldy Creeks. One writer wants logging stopped in the watershed.

Other specifics brought forth in public comments suggested that the BLM should plant more trees, or remove dead trees adjacent to private lands to prevent spread of disease. One writer discussed the need to restore fisheries. Another wants the grizzly bear restored. One comment was specific concerning water quality in Hill Creek. Another letter requested BLM to preserve undeveloped areas for hiking, nature study, wildlife and viewing.

A number of comments discussed issues outside the authority of the BLM. Four letters complained about an instance when the Bureau of Reclamation diverted excessive flows down Schoolhouse Creek which resulted in severe erosion. One writer said there is a need to study impacts on hydrology in Emigrant Creek associated with irrigation flows. Another claimed that erratic flows in Emigrant Creek below the reservoir have eliminated fish. One person implied that misuse of (herbicide) spray and leakage from Talent Irrigation District canals impacts upper Bear

Creek. Another comment complained about the noise of speed boats on Emigrant Reservoir.

Two comments questioned the purpose of doing a watershed analysis. One stated that the process will not result in tangible work which is needed to improve the land from man's past impacts. The other commented that there is no need for recommendations for the Upper Bear Creek Watershed Analysis Area implying that conditions are fine the way they are.

The BLM appreciates those who took the time to write or to attend the open house. Public comments were shared with the team members who developed this document and were taken into consideration during the analysis process.

APPENDIX B
Description of Symbols Used on Geology Map (Map 7)

Map Symbol	Description of Map Units
KJg	Granitic rocks (Cretaceous and Jurassic) -- Mostly tonalite and quartz diorite but lesser amounts of other granitoid rocks.
Kc	Clastic sedimentary rocks (Cretaceous) -- Locally fossiliferous sandstone and conglomerate; marine fossils indicate early cretaceous age.
OW	Emigrant Lake
Qls	Landslide and debris flow deposits (holocene and Pleistocene) -- Unstratified mixtures of fragments of adjacent bedrock. Locally includes slope wash and colluvium.
Thi	Hybabyssal intrusive rocks (Miocene) -- Hypabyssal, medium-grained, hornblende diorite and quartz diorite in small stocks and large dikes.
Tib	Basalt and andesite intrusions (Pliocene and Miocene) -- Sills, plugs and dikes of basalt andesite, basalt, and andesite. Mostly represents feeders,exposed by erosion, for flows and flow breccias.
Tmv	Mafic vent complexes (Miocene) -- Intrusive plugs and dike swarms and related near-vent flows, breccias, cinders, and agglutinate of basalt andesite, basalt, and andesite.
Tn	Nonmarine sedimentary rocks (Eocene) -- Continentally derived conglomerate, pebble conglomerate, sandstone, siltstone, and mudstone containing abundant biotite and muscovite. Dominantly non-volcanic; clastic material derived from underlying older rocks.
Tu	Undifferentiated tuffaceous sedimentary rocks, tuffs, and basalt (Miocene and Oligocene) -- Heterogeneous assemblage of continental, largely volcanogenic deposits of basalt and basaltic andesite, including flows and breccia, complexly interstratified with epiclastic and volcanclastic deposits of basalt to rhyodactic composition.
Tub	Basaltic lavaflows -- Basaltic and basaltic andesite lavaflows and breccia; grades into rare bedded palagonitic tuff and breccia.
Tus	Sedimentary and volcaniclastic rocks -- Lapilli tuff, mudflow deposits (lahars), flow breccia, and volcanic conglomerate, mostly of basalt to dacitic composition.

APPENDIX C
General Soils Map Interpretations

Soils formed in material weathered from sedimentary and igneous rock and mixed alluvium on fan terraces, ridges, knolls, hillslopes and alluvial fans.

Brader-Debenger-Langellain
Shallow and moderately deep, well drained and moderately well drained soils that have a surface layer of Ioam; on ridges and knolls

The native vegetation on this map unit is mainly hardwoods and some conifers and an understory of grasses, shrubs, and forbs. Slopes generally are 1 to 40 percent. Elevation is 1,000 to 3,500 feet. The mean annual precipitation is about 18 to 40 inches, the mean annual temperature is 48 to 54 degrees F, and the average frost-free period is 130 to 180 days.

This unit is about 35 percent Brader soils, 20 percent Debenger soils, and 15 percent Langellain soils. The remaining 30 percent is Shefflein soils on alluvial fans; Kerby, Medford, and Gregory soils on stream terraces; Carney, Selmac, and Coker soils on concave slopes.

Brader and Debenger soils formed in colluvium derived from sedimentary rock. Brader soils are shallow and well drained. The surface layer and subsoil are loam. Debenger soils are moderately deep and well drained. The surface layer is loam. The subsoil is clay loam.
Langellain soils are moderately deep and moderately well drained. The surface layer is loam. The subsoil is clay. This unit is used mainly for hay and pasture or for livestock grazing. A few areas are used for homesite development or wildlife habitat.

The main limitations in the areas used for hay and pasture or for livestock grazing are wetness in winter and spring, the depth to bedrock, restricted permeability, droughtiness, and compaction. The slope also is a major limitation in some areas. The Langellain soils remain wet for long periods in spring. Grazing should be delayed until the soils are firm enough to withstand trampling by livestock. In summer, irrigation is needed for maximum forage production. Because of the layer of clay in the Langellain soils and the depth to bedrock in the Brader soils, over-irrigation can result in a perched water table.

Carney-Coker
Moderately deep and very deep, moderately well drained and somewhat poorly drained soils that have a surface layer of clay or cobbly clay,- on alluvial fans and hillslopes

The native vegetation on the Carney soils in this map unit is mainly scattered hardwoods and an understory of grasses, shrubs, and forbs. That on the Coker soils is mainly grasses, sedges, and forbs. Slopes generally are 0 to 35 percent. Elevation is 1,200 to 4,000 feet. The mean annual precipitation is about 18 to 35 inches, the mean annual temperature is 45 to 54 degrees F, and the average frost-free period is 120 to 180 days.

This unit is about 55 percent Carney soils and 10 percent Coker soils. The remaining 35 percent is Brader and Debenger soils on knolls; Heppsie and McMullin soils on hillslopes; Padigan and Phoenix soils on concave slopes; Cove soils in drainageways; and Darow, Medco, and Tablerock soils.

Carney soils formed in alluvium and colluvium derived from igneous rock. Coker soils formed in clayey alluvium derived from igneous rock. Carney soils are moderately deep and moderately well drained. The surface layer is clay or cobbly clay. The subsoil is clay. Coker soils are very deep and somewhat poorly drained. The surface layer and subsoil are clay.

This unit is used mainly for tree fruit, hay and pasture, homesite development, livestock grazing, or wildlife habitat. The main limitations in the areas used for hay and pasture or for tree fruit are the high content of clay, a slow rate of water intake, wetness in winter and spring, droughtiness in summer and fall, and the slope. The Coker soils remain wet for long periods in spring. Grazing should be delayed until the soils are firm enough to withstand trampling by livestock. In summer, irrigation is needed for the maximum production of forage crops and tree fruit. Because of very slow permeability, water applications should be regulated so that the water does not stand on the surface and damage the crops. Because of the slope in some areas, sprinkler and trickle irrigation systems are the best methods of applying water. The high content of clay severely limits tillage. The soils are well suited to permanent pasture. The more sloping areas of this unit are used for livestock grazing. The main limitations affecting livestock grazing are compaction, erosion, droughtiness, and the slope.

Soils formed in material weathered from Granodiorite on alluvial fans, ridges, and hillslopes.

Tallowbox-Shefflein

Moderately deep and deep, somewhat excessively drained and well drained soils that have a surface layer of gravelly sandy loam or loam and receive 25 to 40 inches of annual precipitation

This map unit is on hillslopes, ridges, and alluvial fans. The native vegetation is mainly conifers and hardwoods and an understory of grasses, shrubs, and forbs. Slopes generally are 2 to 70 percent. Elevation 1,000 to 4,000 feet. The mean annual precipitation about 25 to 40 inches, the mean annual temperature 46 to 54 degrees F, and the average frost-free period 100 to 160 days.

This unit is about 55 percent Tallowbox soils and 30 percent Shefflein soils. The remaining 15 percent is Barron soils on alluvial fans, Clawson soil on concave slopes, and Rogue soils at elevations of more than 4,000 feet. Tallowbox soils are moderately deep and some excessively drained. The surface layer and subsoil gravelly sandy loam. Shefflein soils are deep and well drained. The surface layer is loam. The subsoil is clay loam and sandy clay loam.

This unit is used mainly for timber production or wildlife habitat. A few of the more gently sloping are of the Shefflein soils are used for hay and pasture o homesite development. The main limitations affecting timber production are erosion, compaction, plant competition, and the slope. Seedling mortality also is a major management concern, particularly on south-facing slopes. Management minimizes erosion is essential when timber is harvested. Site preparation is needed to ensure adequate reforestation. High-lead or other cable systems should be used on the steeper slopes.

Soils formed in material weathered from igneous rock on plateaus and hillslopes

Medco-McMullin

Moderately deep and shallow, moderately well drained and well drained soils that have a surface layer of cobbly clay loam or gravelly loam.

This map unit is on hillslopes. The native vegetation on the Medco soils is mainly hardwoods, a few scattered conifers, and an understory of grasses, shrubs, and forbs. That on the McMullin soils is mainly grasses, shrubs, and forbs. Slopes generally are 3 to 60 percent. Elevation is 1,500 to 4,000 feet. The mean annual precipitation is about 20 to 35 inches, the mean annual temperature is 45 to 52 degrees F, and the average frost-free period is 100 to 160 days.

The unit is about 40 percent Medco soils and 35 percent McMullin soils. The remaining 25 percent is Heppsie soils on steep hillslopes, McNull and Carney soils, Coker soils on concave slopes, and Rock outcrop. Medco soils are moderately deep and moderately well drained. The surface layer is cobbly clay loam. The subsoil is clay. McMullin soils are shallow and well drained. The surface layer is gravelly loam. The subsoil is gravelly clay loam.

This unit is used mainly for livestock grazing or wildlife habitat. A few of the more gently sloping areas of the Medco soils are used for hay and pasture. A few areas of the Medco soils that receive enough precipitation are used for timber production. The main limitations affecting livestock grazing are compaction, erosion, the depth to bedrock, droughtiness, seasonal wetness, the Rock outcrop, stones and cobbles on the surface, and the slope. The use of ground equipment generally is not practical on the McMullin soils because of the stones on the surface, the Rock outcrop, and the slope. The Rock outcrop and the slope also limit access by livestock in some areas. The Medco soils remain wet for long periods in spring. Grazing should be delayed until the soils are firm enough to withstand trampling by livestock.

The main limitations in the areas used for hay and pasture are wetness in winter and spring, droughtiness in summer and fall, and very slow permeability in the subsoil. In summer, irrigation is needed for maximum forage production.

The main limitations affecting timber production are erosion, compaction, slumping, seasonal wetness, and plant competition. Seedling mortality also is a major management concern, particularly on south-facing slopes.

McNull-McMullin-Medco

Moderately deep and shallow, well drained and moderately well drained soils that have a surface layer of loam, gravelly loam, or cobbly clay loam

The map unit is on hillslopes. The native vegetation on the McNull and Medco soils is mainly conifers and hardwoods and an understory of grasses, shrubs, and forbs. That on the McMullin soils is mainly grasses, shrubs, and forbs. Slopes generally are 12 to 60 percent. Elevation is 1,500 to 4,000 feet. The mean annual precipitation is about 25 to 40 inches, the mean annual temperature is 45 to 52 degrees F, and the average frost-free period is 100 to 160 days.
It is about 45 percent McNull soils, 20 percent McMullin soils, and 20 percent Medco soils. The remaining 15 percent is Coker soils on concave slopes, Carney soils, and Rock outcrop.

McNull soils are moderately deep and well drained. The surface layer is loam. The subsoil is clay loam and cobbly clay. McMullin soils are shallow and well drained. The surface layer is gravelly loam. The subsoil is gravelly clay loam. Medco soils are moderately deep and moderately well drained. The surface layer is cobbly clay loam. The subsoil is clay.
This unit is used mainly for timber production, livestock grazing, or wildlife habitat. The McNull and Medco soils are used mainly for timber production or livestock grazing. The McMullin soils are used for livestock grazing.

The main limitations affecting timber production are erosion, compaction, slumping, plant competition, seasonal wetness, and the slope. Seedling mortality also is a major management concern, particularly on south-facing slopes. Site preparation is needed to ensure adequate reforestation. The Medco soils are subject to slumping. Road failure and landslides could occur after road construction or clearcutting. The seasonal water table in the Medco soils restricts the use of equipment. High-lead or other cable logging systems should be used on the steeper slopes.

The main limitations affecting livestock grazing are compaction, erosion, the depth to bedrock, droughtiness, the Rock outcrop, stones and cobbles on the surface, seasonal wetness, and the slope. The use of ground equipment generally is not practical on the McMullin soils because of the stones on the surface, the Rock outcrop, and the slope. The Rock outcrop and the slope also limit access by livestock in some areas. The Medco soils remain wet for long periods in spring. Grazing should be delayed until the soils are firm enough to withstand trampling by livestock.

Tatouche-Bybee

Very deep, well drained and somewhat poorly drained soils that have a surface layer of gravelly loam or loam.

This map unit is on hillslopes and plateaus. The native vegetation is mainly conifers and an understory of grasses, shrubs, and forbs. Slopes generally are 1 to 65 percent. Elevation is 3,600 to 5,500 feet. The mean annual precipitation is about 30 to 50 inches, the mean annual temperature is 40 to 45 degrees F, and the average frost-free period is less than 100 days.

This unit is about 45 percent Tatouche soils and 30 percent Bybee soils. The remaining 25 percent is Farva, Hobit, and Pinehurst soils; Woodseye soils on ridges and convex slopes; Kanutchan and Sibannac soils on concave slopes and near drainageways; and Rock outcrop.

Tatouche soils are well drained. The surface layer is gravelly loam. The subsoil is gravelly clay loam and clay. Bybee soils are somewhat poorly drained. The surface layer is loam. The subsoil and substratum are clay.

This unit is used mainly for timber production, livestock grazing, or wildlife habitat.
The main limitations affecting timber production are erosion, compaction, slumping, plant competition, seasonal wetness, and the slope. Seedling mortality also is a major management concern, particularly on south-facing slopes and in areas where air drainage is restricted. Site preparation is needed to ensure adequate reforestation. Air drainage is restricted in some areas. Proper timber harvesting methods can reduce the effects of frost on regeneration. The Bybee soils are subject to slumping. Road failure and landslides may occur on these soils after road construction or clearcutting. The seasonal high water table in the Bybee soils restricts the use of equipment. High-lead or other cable logging systems should be used on the steeper slopes.

The main limitations affecting livestock grazing are compaction, erosion, and the slope. The slope limits access by livestock in some areas.

Rustlerpeak-Farva

Moderately deep, well drained soils that have a surface layer of gravelly loam or very cobbly loam

This map unit is on plateaus and hillslopes. The native vegetation is mainly conifers and an understory of grasses, shrubs, and forbs. Slopes generally are 3 to 70 percent. Elevation is 3,600 to 6,1 00 feet. The mean annual precipitation is about 40 to 55 inches, the mean annual temperature is 40 to 45 degrees F, and the average frost-free period is less than 100 days.

This unit is about 40 percent Rustlerpeak soils and 35 percent Farva soils. The remaining 25 percent is Woodseye soils on ridges and convex slopes; Hobit, Pinehurst, and Snowlin soils; Sibannac soils on concave slopes and near drainageways; and Rock outcrop.

Rustlerpeak soils have a surface layer of gravelly loam. The subsoil is very cobbly clay loam. Farva soils have a surface layer of very cobbly loam. The subsoil and substratum are extremely cobbly loam.

This unit is used mainly for timber production, livestock grazing, or wildlife habitat. The main limitations affecting timber production are erosion, compaction, plant competition, and the slope. Seedling mortality also is a major management concern, particularly on south-facing slopes and in areas where air drainage is restricted. Site preparation is needed to ensure adequate reforestation. The large number of rock fragments in the soils increases the seedling mortality rate. Air drainage is restricted in some areas. Proper timber harvesting methods can reduce the effects of frost on regeneration. High-lead or other cable logging systems should be used on the steeper slopes. The main limitations affecting livestock grazing are compaction, erosion, and the slope. The slope limits access by livestock in some areas.

Vannoy-Caris-Offenbacher

Moderately deep, well drained soils that have a surface layer of silt loam or gravelly loam

This map unit is on hillslopes. The native vegetation is mainly conifers and hardwoods and an understory of grasses, shrubs, and forbs. Slopes generally are 12 to 80 percent. Elevation is 1,000 to 4,000 feet. The mean annual precipitation is about 20 to 40 inches, the mean annual temperature is 46 to 54 degrees F, and the average frost-free period is 100 to 160 days.

This unit makes up about 15 percent of the survey area. It is about 35 percent Vannoy soils, 25 percent Caris soils, and 10 percent Offenbacher soils. The remaining 30 percent is Camas, Evans, and Newberg soils on flood plains; Abegg and Ruch soils on alluvial fans; Selmac soils on concave slopes; Manita
and Shefflein soils on alluvial fans and gently sloping hillslopes; Dubakella soils, which formed in material derived from serpentinitic rock; McMullin soils on ridges and steep hillslopes; Tallowbox and Voorhies soils; and Jayar soils at elevations of more than 4,000 feet.

Vannoy soils have a surface layer of silt loam. The subsoil is clay loam, gravelly clay loam, and extremely gravelly clay loam. Caris soils have a surface layer of gravelly loam. Tne subsoil is very gravelly clay loam and extremely gravelly loam.

Offenbacher soils have a surface layer of gravelly loam. The subsoil is loam.

This unit is used mainly for timber production or wildlife habitat. A few of the more gently sloping areas of the Vannoy soils are used for pasture or homesite development.

The main limitations affecting timber production are erosion, compaction, plant competition and the slope. Seedling mortality also is a major management concern, particularly on south-facing slopes. Site preparation is needed to ensure adequate reforestation. The large number of rock fragments in the Caris soils increases the seedling mortality rate. High-lead or other cable logging systems should be used on the steeper slopes.

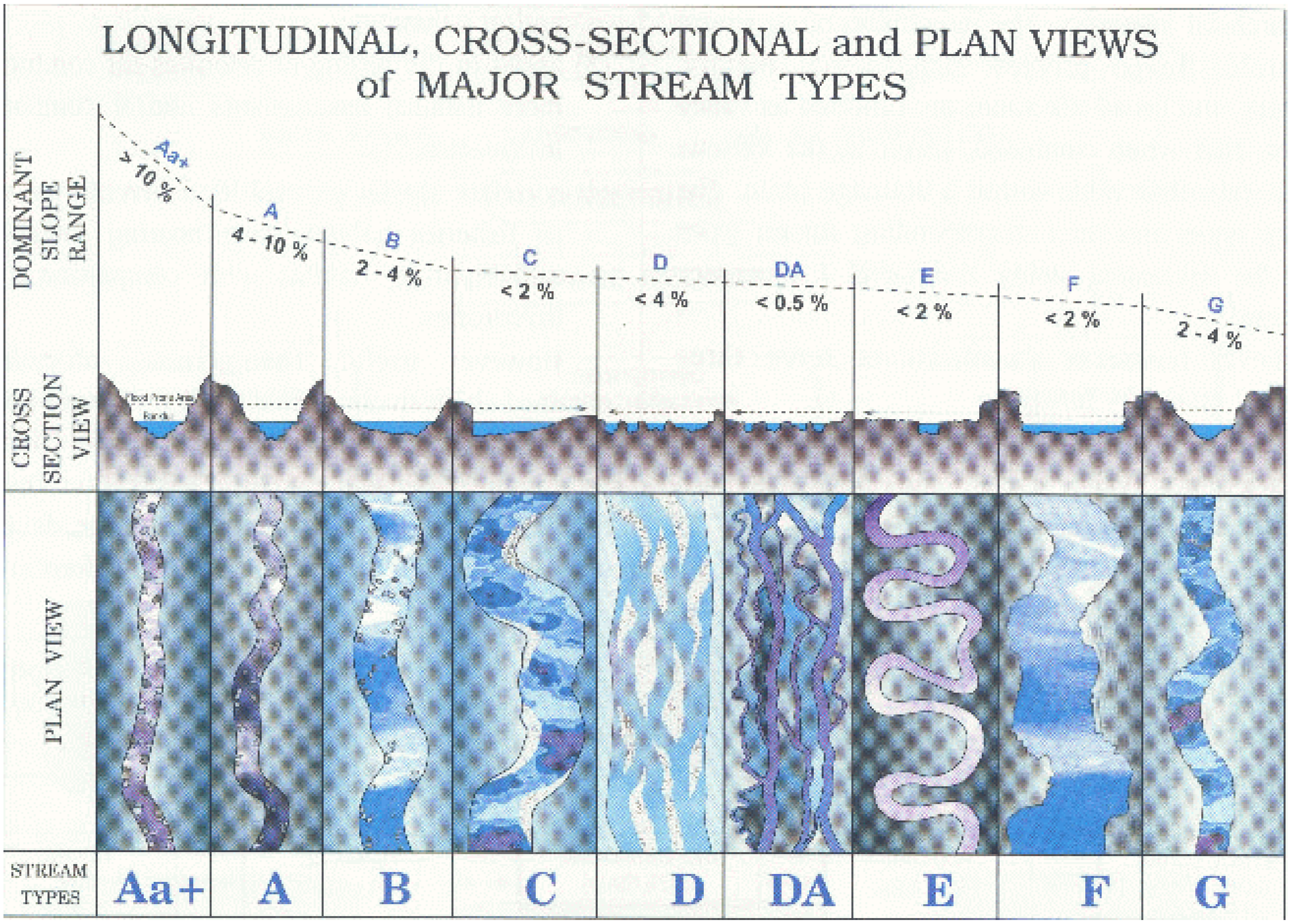
APPENDIX D
Noxious Weeds

Existing Noxious Weeds in Upper Bear Creek Watershed Analysis Area		
Common Name	**Scientific Name**	**Description**
Yellow starthistle	*Centaurea solstitialis*	Annual that will germinate in fall, spring, or winter. It blooms from July through September. This species is aggressive and spreads rapidly. Horses feeding on the plant can develop "chewing disease", which can be fatal. Biological agents have been released on the district: seed fly (*Urophora sirunaseva*) - 1985, seed weevil (*Bangasternus orientalis*) - 1987, and yellowstar flower weevil (*Laurinus curtus*) - 1998.
Canada thistle	*Cirsium arvense*	Creeping perennial that is difficult to control because of its aggressive nature and extensive root system, from which it can asexually reproduce. Canada thistle stems are smooth instead of spiny and "winged" as are the stems of Scotch or Bull thistles.
Spotted knapweed	*Centaurea maculosa*	Biennial. Introduced from Eurasia as a contaminant of alfalfa and clover seed. Readily colonizes disturbed soils.
St. Johnswort (Klamath Weed)	*Hypericum perforatum*	This plant causes photosensitization in light colored animals, with young being particularly susceptible. Although seldom fatal, economic losses can easily occur. Cattle and sheep normally will not consume this plant when mature, but young shoots in the spring may be eaten. Biological control agents have been very successful for this plant.
Medusahead wildrye	*Taeneatherum asperum*	Annual grass that can cause mechanical injury to grazing animals due to its stiff, sharp awns; and can form a carpet on the soil surface which can interfere with germination of perennial grasses.

Noxious Weeds in Adjacent Watersheds That Pose Threats to Upper Bear Creek Watershed Analysis Area		
Common Name	**Scientific Name**	**Description**
Squarrose knapweed	*Centaurea virgata v. squarrosa*	Perennial. Seed heads are deciduous and fall off the stems soon after seeds mature. Readily colonizes disturbed soils. Reported along I-5 in northern California.
Skeletonweed Rush skeletonweed	*Lygodesmia juncea* *Chondrilla juncea*	These two genera closely resemble each other in appearance and habitat. They generally inhabit well-drained, light textured soils along roadsides, in rangelands, grain fields, and pastures. "Skeletonweeds" are reported along I-5 from Ashland to Gold Hill.
Purple Loosestrife	*Lythrum salicaria*	6 to 8 foot tall perennial found growing in moist or marshy areas such as stream banks, pond shores, and wet meadows where standing water lingers. Reduces wildlife habitat due to its competitive nature and effectively crowds out other plants. Reported moving along Bear Creek.
Dodder	*Cuscuta sp.*	Parasitic plant identified using *Ceanothus cuneatus* as a host. The small root system disappears once the plant becomes established on a host. Seeds are long lived and infestations may occur in areas where host plants have not grown for several years. Reports of dodder near Pilot Rock and Agate Flat.
Meadow knapweed	*Centaurea pratensis*	Perennial, considered to be a hybrid between Brown knapweed (*C. Jacea L.*) and Black knapweed (*C. nigra L.*). Meadow knapweed infests roadsides, waste areas, fields, and pastures.
Diffuse knapweed	*Centaurea diffusa*	Biennial, single stemmed plant with numerous lateral branches. Forms dense stands on any open ground and will readily exclude other plants.

APPENDIX E
Channel Morphology Classification

Broad-Level Stream Classification Delineation (Rosgen 1996)



General Stream Type Descriptions for Broad-Level Classification (Rosgen 1996)

Stream Type	General Description	Entrenchment Ratio	W/D Ratio	Sinuosity	Slope	Landform/ Soils/Features
Aa+	Very steep, deeply entrenched, debris transport, torrent streams.	<1.4	<12	1.0 to 1.1	>.10	Very high relief. Erosional, bedrock or depositional features; debris flow potential. Deeply entrenched streams. Vertical steps with deep scour pools; waterfalls.
A	Steep, entrenched, cascading, step/pool streams. High energy/debris transport associated with depositional soils. Very stable if bedrock or boulder dominated channel.	<1.4	<12	1.0 to 1.2	.04 to .10	High relief. Erosional or depositional and bedrock forms. Entrenched and confined streams with cascading reaches. Frequently spaced, deep pools in associated step/pool bed morphology.
B	Moderately entrenched, moderate gradient, riffle dominated channel, with infrequently spaced pools. Very stable plan and profile. Stable banks.	1.4 to 2.2	>12	>1.2	.02 to .039	Moderate relief, colluvial deposition, and/or structural. Moderate entrenchment and W/D ratio. Narrow, gently sloping valleys. Rapids predominate w/scour pools.
C	Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well defined floodplains.	>2.2	>12	>1.4	<.02	Broad valleys w/terraces, in association with floodplains, alluvial soils. Slightly entrenched with well-defined meandering channels. Riffle/pool bed morphology.
D	Braided channel with longitudinal and transverse bars. Very wide channel with eroding banks.	n/a	>40	n/a	<.04	Broad valleys with alluvium, steeper fans. Glacial debris and depositional features. Active lateral adjustment, w/abundance of sediment supply. Convergence/divergence bed features, aggradational processes, high bedload and bank erosion.
DA	Anastomosing (multiple channels) narrow and deep with extensive, well vegetated floodplains and associated wetlands. Very gentle relief with highly variable sinuosities and width/depth ratios. Very stable streambanks.	>2.2	Highly variable	Highly variable	<.005	Broad, low-gradient valleys with fine alluvium and/or lacustrine soils. Anastomosed (multiple channel) geologic control creating fine deposition w/well-vegetated bars that are laterally stable with broad wetland floodplains. Very low bedload, high wash load sediment.
E	Low gradient, meandering riffle/pool stream with low width/depth ratio and little deposition. Very efficient and stable. High meander width ratio.	>2.2	<12	>1.5	<.02	Broad valley/meadows. Alluvial materials with floodplains. Highly sinuous with stable, well-vegetated banks. Riffle/pool morphology with very low width/depth ratios.
F	Entrenched meandering riffle/pool channel on low gradients with high width/depth ratio.	<1.4	>12	>1.4	<.02	Entrenched in highly weathered material. Gentle gradients, with a high width/depth ratio. Meandering, laterally unstable with high bank erosion rates. Riffle/pool morphology.
G	Entrenched "gully" step/pool and low width/depth ratio on moderate gradients.	<1.4	<12	>1.2	.02 to .039	Gullies, step/pool morphology w/moderate slopes and low width/depth ratio. Narrow valleys, or deeply incised in alluvial or colluvial materials, i.e., fans or deltas. Unstable, with grade control problems and high bank erosion rates.

APPENDIX F
Recent BLM Timber Sales

Sale Name	Date	Location (Township, Range, Section)	Unit	Harvest Type[1]	Harvest Method	Acres	Volume Removed MBF[2]
Baldy Green	9/25/86	40S, 3E, Sec. 7,17,19,29	1	SC	Cable	18	125
Baldy Green	9/25/86	40S, 3E, Sec. 7,17,19,29	2,4,5,7,8	CC	Cable	80	1835
Baldy Green	9/25/86	40S, 3E, Sec. 7,17,19,29	6	CC	Tractor	33	329
Baldy Green	9/25/86	40S, 3E, Sec. 7,17,19,29	3	OR	Tractor	14	183
Baldy Green	9/25/86	40S, 3E, Sec. 7,17,19,29	R/W	CC	Tractor	1	27
Grizzly Shale	7/24/86	38S, 2E, Sec. 8,9,17	1,3,5,6	CC	Cable	46	1580
Grizzly Shale	7/24/86	38S, 2E, Sec. 8,9,17	2	CC	Tractor	6	98
Grizzly Shale	7/24/86	38S, 2E, Sec. 8,9,17	4	TH	Cable	16	155
Grizzly Shale	7/24/86	38S, 2E, Sec. 8,9,17	4a	TH	Tractor	2	17
Grizzly Shale	7/24/86	38S, 2E, Sec. 8,9,17	7,8	OR	Tractor	14	234
Grizzly Shale	7/24/86	38S, 2E, Sec. 8,9,17	R/W	CC	Tractor	4	200
Cove Creek	5/29/86	39S, 2E, Sec. 1,3,9-11,13,15	1,2,6-9, 11	CC	Cable	177	4529
Cove Creek	5/29/86	39S, 2E, Sec. 1,3,9-11,13,15	3,4,10	CC	Tractor	47	858
Cove Creek	5/29/86	39S, 2E, Sec. 1,3,9-11,13,15	5	OR/TH	Tractor	32	568
Cove Creek	5/29/86	39S, 2E, Sec. 1,3,9-11,13,15	R/W	CC	Tractor	34	295
Shale Sweeper Salv.	6/30/88	38S, 2E Sec. 3,9	1	SC	Tractor	60	65
Grizzly Knob	8/29/91	38S, 2E, Sec. 3,9,19	1,6	MS/SS	Tractor	291	2061
Grizzly Knob	8/29/91	38S, 2E, Sec. 3,9,19	2,4	MS/SS	Cable	29	295
Grizzly Knob	8/29/91	38S, 2E, Sec. 3,9,19	3A,5	OR	Tractor	32	403
Grizzly Knob	8/29/91	38S, 2E, Sec. 3,9,19	3B	OR	Cable	26	231
Grizzly Knob	8/29/91	38S, 2E, Sec. 3,9,19	R/W	CC	Tractor	10	242
Samson Cove Salvage	9/27/90	39S, 2E, Sec. 1-3,11-13, 15,17-19,30	1,2	SC	Tractor	152	312
Road Kill Salvage	8/30/90	38S, 3E, Sec. 30	1,2,3,4,5	SC	Tractor	277	415
Round Sampson	10/26/95	39S, 3E, Sec. 6,7,18,19,30	2A	TH	Cable	20	103

Sale Name	Date	Location (Township, Range, Section)	Unit	Harvest Type[1]	Harvest Method	Acres	Volume Removed MBF[2]
Round Sampson	10/26/95	39S, 3E, Sec. 6,7,18,19,30	2B	TH	Tractor	15	208
Round Sampson	10/26/95	39S, 3E, Sec. 6,7,18,19,30	3,8	SC	Tractor	37	114
Round Sampson	10/26/95	39S, 3E, Sec. 6,7,18,19,30	6	MSW	Cable	15	50
Round Sampson	10/26/95	39S, 3E, Sec. 6,7,18,19,30	7	SS	Cable	14	72

1/ Harvest Type Codes:
MS= Mortality Salvage SS= Sanitation Salvage MSW= Modified Shelterwood SC= Select Cut
CC= Clear Cut OR= Overstory Removal TH= Thinning
2/ MBF = thousand board feet

APPENDIX G
Grazing Use on BLM-Administered Lands

1999 Upper Bear Creek Watershed Analysis Area Allotment Summaries for BLM-Administered Lands

Allotment (Name and Number)	Percentage of Allotment in Analysis Area	Portion of Allotment in Analysis Area (BLM Acres)	Total Permitted Use (AUMs[1])	Season of Use
Soda Mountain 10110	18	6,400*	1,794	5/1 to 10/15
Emigrant Creek 10111	100	40	7	Vacant
Cove Creek 10112	100	1,408	75	5/1 to 6/15
Courtney Individual 10113	100	160	6	3/1 to 2/28
Buck Point 10114	100	3,835	150	5/1 to 6/15
Keene Creek 10115	10	2,330	1,612	6/5 to 9/30
Grizzly 10119	23	1,200	378	6/1 to 10/15
Cove Ranch 10143	100	40	20	7/1 to 11/30
North Cove Creek 10148	100	281	20	7/16 to 9/15
Conde Creek 20117	2	120	592	6/16 to 9/30

1/ AUMs = animal unit months
*Estimated

APPENDIX H
Road Densities > 4.0 mi/sq. mi. and/or Road/Stream Intersections > 10/sq. mi.

Township	Range	Section	Road Density (mi./sq. mi.)	Stream Crossings (Number)	Near Unstable Area? (Y/N)
Upper Emigrant Creek Subwatershed					
39S	2E	34	6.7	14	N
39S	2E	36	3.4	13	N
39S	3E	32	5.1	12	Y
40S	2E	2	4.1	14	Y
40S	2E	11	4.8	7	Y
40S	2E	12	4.4	5	N
40S	2E	13	4.5	12	N
40S	2E	14	5.7	15	Y
40S	2E	20	6.6	0	N
40S	2E	24	5.5	9	N
40S	2E	25	5.5	15	N
40S	2E	29	8.5	0	N
40S	2E	35	5.3	20	Y
40S	3E	5	3.5	13	Y
40S	3E	19	4.9	14	Y
40S	3E	20	4.4	18	Y
Lower Emigrant Creek Subwatershed					
39S	1E	12	5.4	3	N
39S	2E	13	4.1	9	Y
39S	2E	20	4.5	5	N
39S	2E	31	4.6	2	N
39S	2E	32	4.1	7	N
39S	3E	7	5.6	9	Y

Township	Range	Section	Road Density (mi./sq. mi.)	Stream Crossings (Number)	Near Unstable Area? (Y/N)
Lower Emigrant Creek Subwatershed (cont.)					
39S	3E	18	5.2	10	Y
40S	2E	6	5.3	4	N
40S	2E	7	6.8	5	N
Walker Creek Subwatershed					
38S	2E	9	7.3	16	Y
38S	2E	14	3.1	14	Y
38S	2E	23	2.6	13	Y
38S	2E	24	5.7	23	Y
38S	2E	25	5.5	18	Y
38S	2E	27	5.1	13	Y
38S	2E	34	6.0	23	Y
38S	2E	35	4.2	19	Y
38S	2E	36	4.4	12	Y
38S	3E	30	5.8	20	Y
39S	1E	12	5.4	3	N
39S	2E	2	6.1	20	N
39S	2E	11	6.0	18	N

APPENDIX I
Introduced Plant Species

Introduced Plant Species in the Upper Bear Creek Watershed Analysis Area		
Introduced Plant Species	**Common Name**	**Scientific Name**
Annual Grasses	Ripgut Brome* Medusahead Wildrye* Hedgehog Dogtail* Softchess Cheatgrass	*Bromus rigidus* *Taeneantherum asperum* *Cynosurus echinatus* *Bromus mollis* *Bromus tectorum*
Perennial Grasses	Orchard Grass Bulbous Bluegrass Kentucky Bluegrass Canada Bluegrass Intermediate Wheatgrass Pubescent Wheatgrass	*Dactylis glomerata* *Poa bulbosa* *Poa pratensis* *Poa compressa* *Agropyron intermedium* *Agropyron trichophorum*
Forbs	Filaree Common St. Johnswort* Common Dandelion English Plantain Yellow Starthistle* Spotted knapweed*	*Erodium circutorium* *Hypericum perforatum* *Taraxacum officinale* *Platago lanceolata* *Centaurea solstitialis* *Centaurea maculosa*

*Noxious weeds

APPENDIX J
Stream Habitat Survey Data

Figure J-1. Percent of Pool, Glide, Riffle, and Rapid Areas in Sampson and Upper Emigrant Creeks.

Figure J-2. Residual Pool Depths of Sampson and Upper Emigrant Creeks.

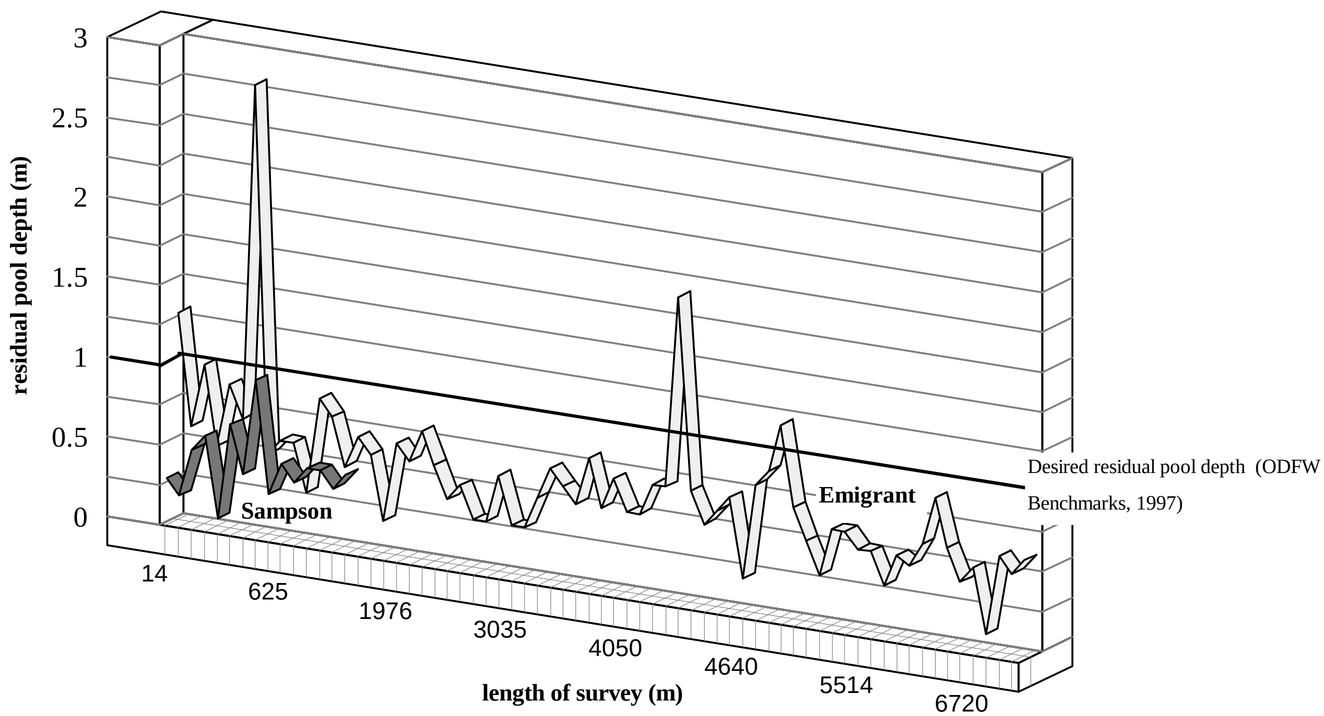


Figure J-3. Wood Volume and Number of Pieces per 100 meters in Upper Emigrant and Sampson Creeks.

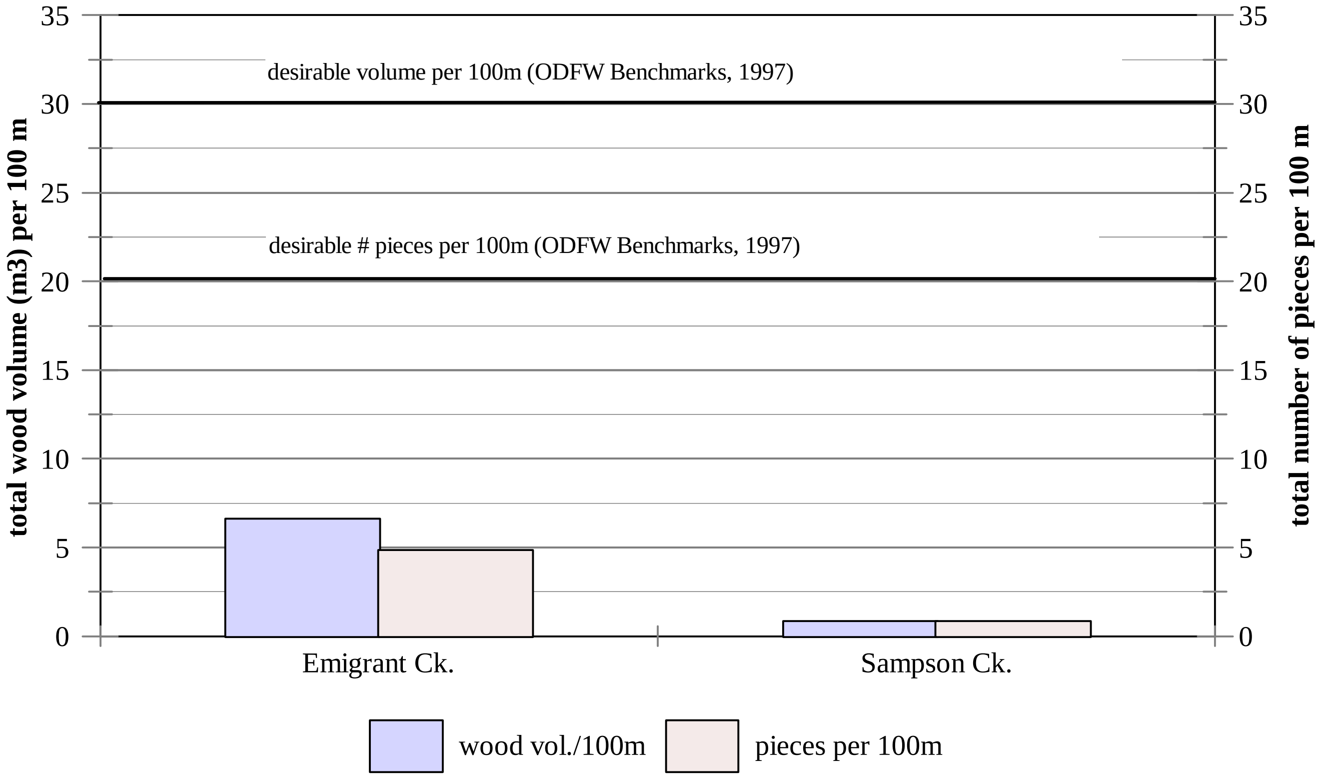


Figure J-4. Wood Diameter in Upper Emigrant and Sampson Creeks.

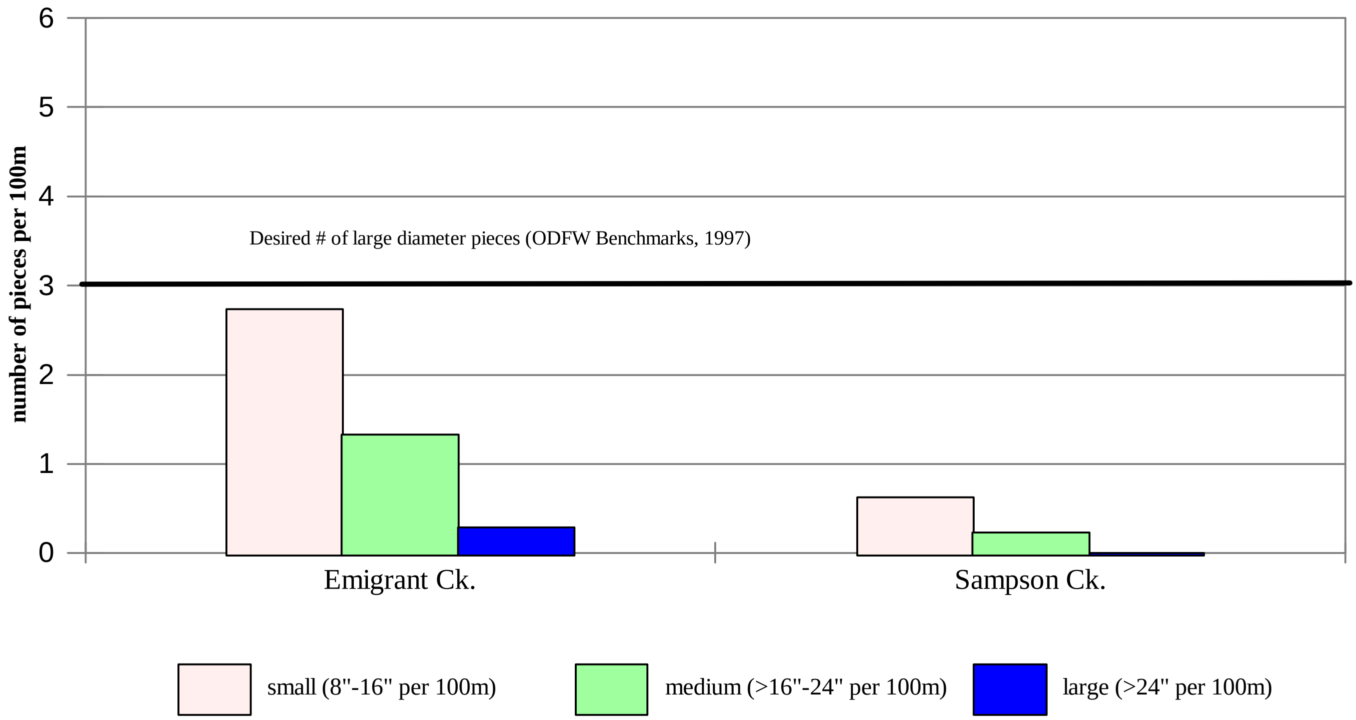
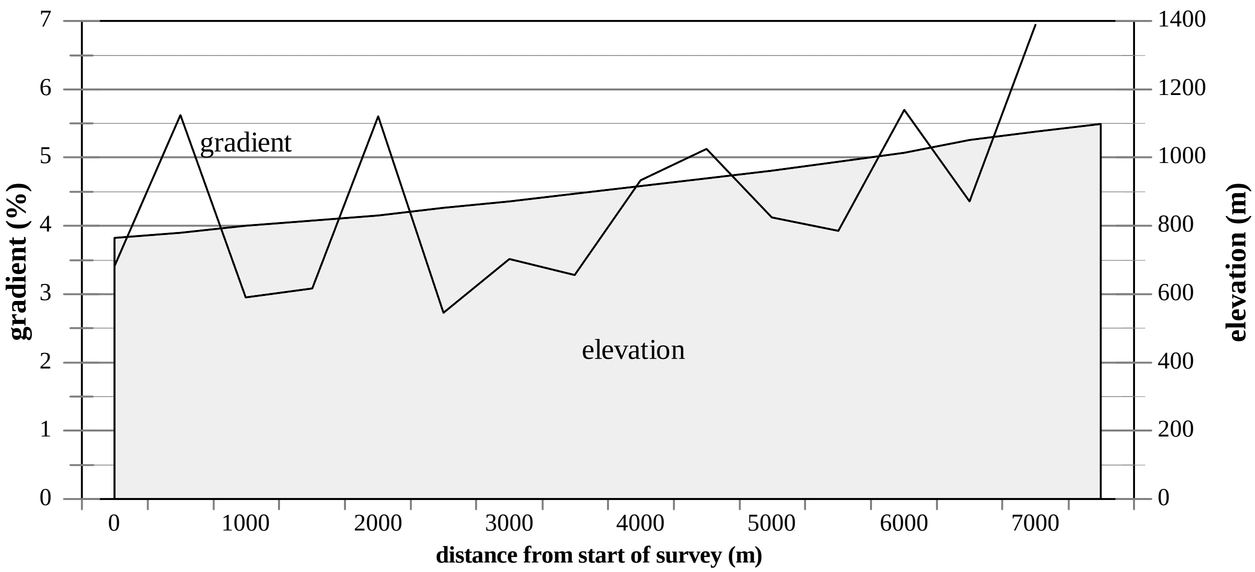
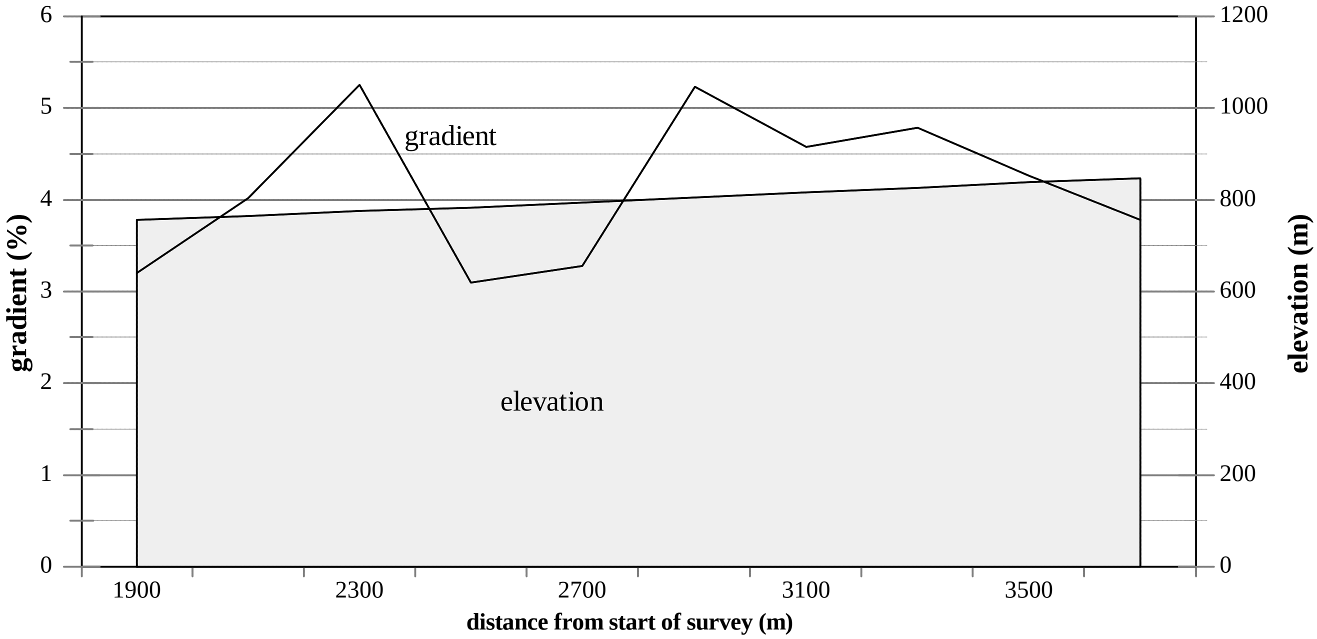


Figure J-5. Gradient for Upper Emigrant Creek.



* gradient was averaged for every 500 meters

Figure J-6. Gradient for Sampson Creek.



* gradient was averaged for every 200 meters

Figure J-7. Percent Substrate in Upper Emigrant Creek.

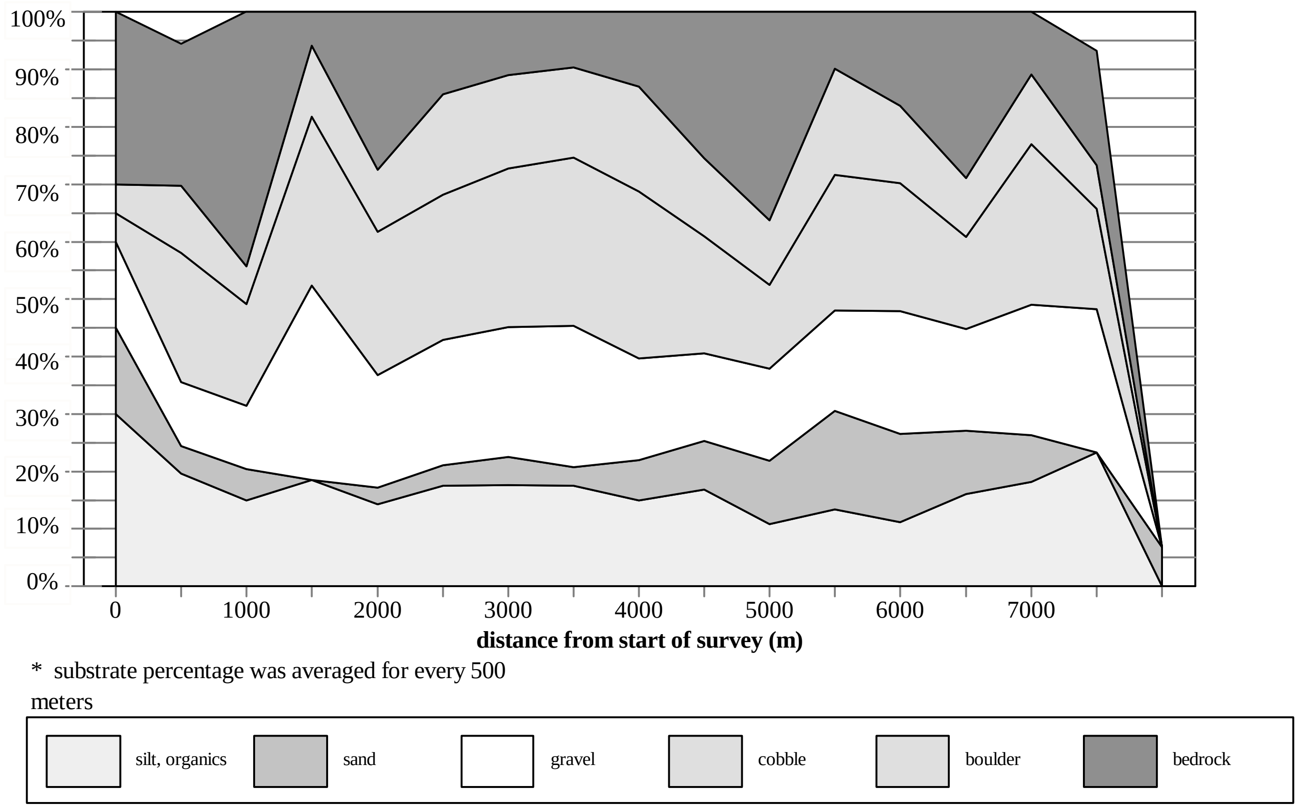


Figure J-8. Percent Substrate in Sampson Creek.

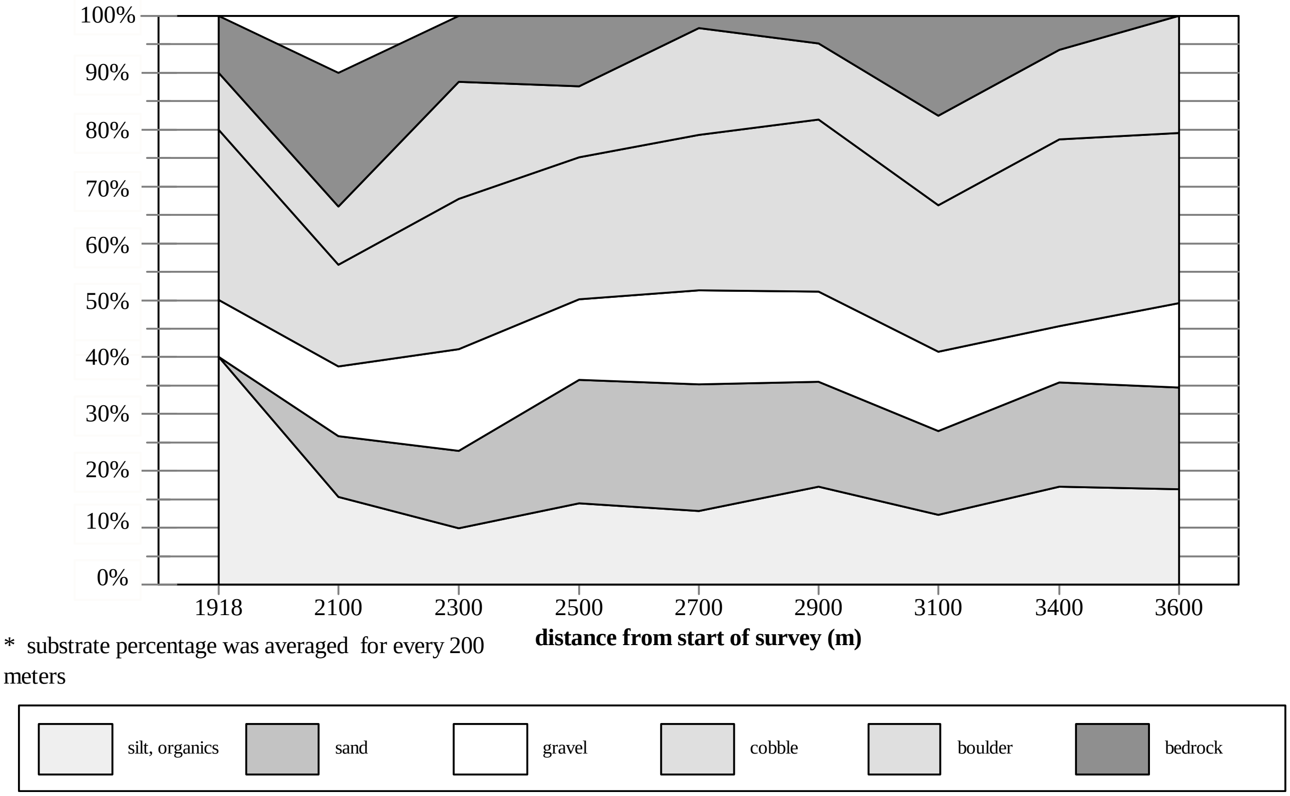
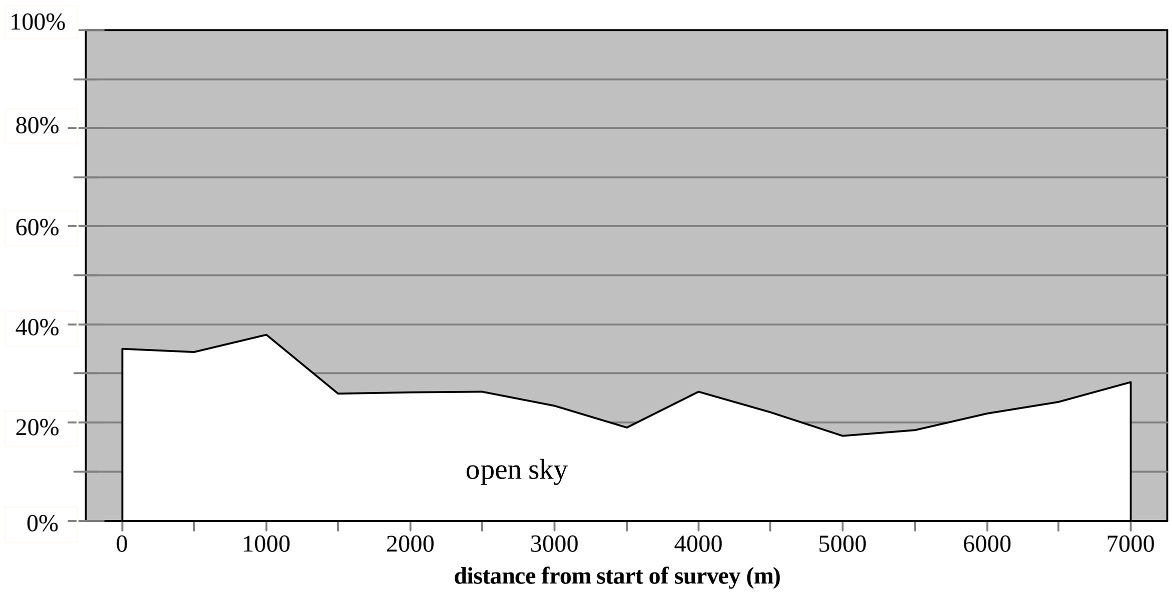
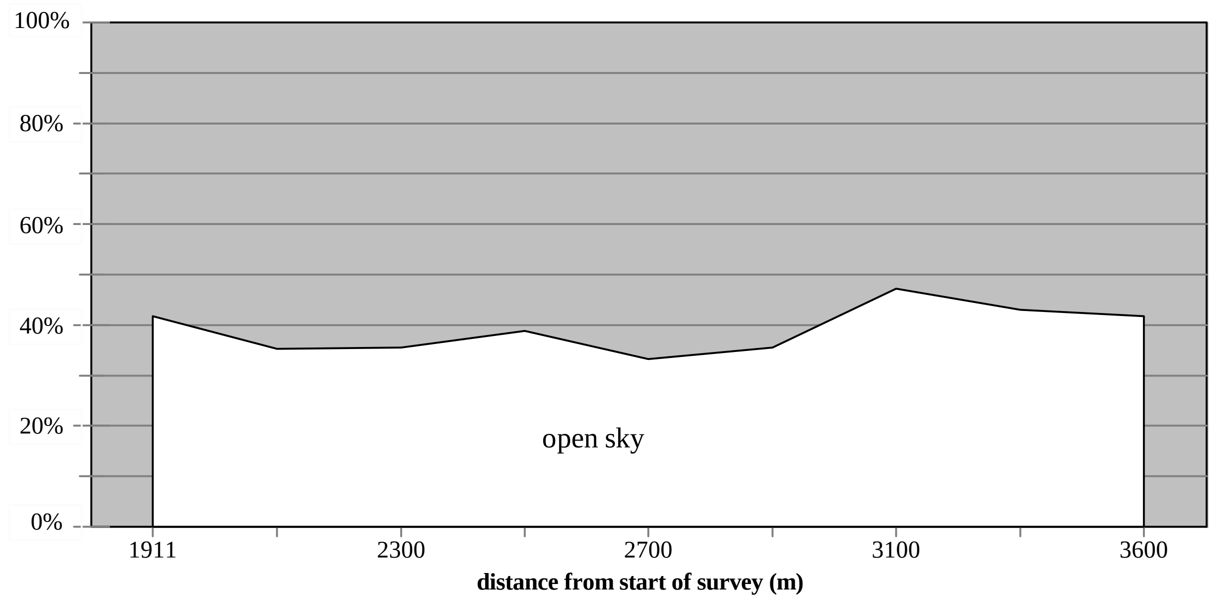


Figure J-9. Percent Open Sky for Upper Emigrant Creek.



* Open Sky percentages were averaged for every 500 meters .

Figure J-10. Percent Open Sky in Sampson Creek.



* Open Sky percentages were averaged for every 200 meters.

APPENDIX K
Fifteen Percent (15%) Late-Successional Retention Areas

The Northwest Forest Plan (NFP) recognizes the value of remnant late-successional (mature/old-growth) forest stands for their biological and structural diversity and for their function as refugia for old-growth related species. The 15 percent Standard and Guide (S&G) in the Record of Decision (ROD) for the NFP addresses the retention of these forest stands on a 5th Field Watershed scale (USDA and USDI 1994a:C-44). The S&G basically states that at least 15 percent of the forested landbase in the watershed should be comprised of late-successional forest. The NFP federal executives, with the assistance of the Regional Ecosystem Office (REO), developed a process to assess what action(s), if any, should be taken to meet the 15 percent S&G.

As part of the Third Year Review of the Medford District Resource Management Plan (RMP), all 5th Field watersheds in the district were assessed using the process developed by the NFP federal executives. For the analysis of the 5th Field Bear Creek Watershed, which includes the Upper Bear Creek Watershed Analysis Area, and other watersheds within the administrative boundary of the Ashland Resource Area, late-successional forest was defined as that which is greater than 80 years old <u>and</u> provides suitable habitat for northern spotted owls. Suitable northern spotted owl habitat provides for nesting, roosting, or foraging by owls, and generally has the following attributes: high degree of canopy closure (approx. 60%+), multilayered canopy, presence of large snags and coarse woody debris.

The results of the late-successional forest analysis for the Bear Creek Watershed (5th Field) follow:

Federal Ownership	Forested Landbase (Acres)	Existing Late-Successional Forest (Acres)	Late-Successional Forest Available for Harvest (Acres)	Late-Successional Forest to be Retained (Acres)	Percent of Forested Landbase Comprised of Late-Successional Forest to be Retained
BLM	18,107	10,438	3,367	7,071	39
USFS	16,590	11,310	. 13	. 11,297	68
Total	34,697	21,748	3,380	18,368	53

As shown in the table above, there are 34,697 acres in the federal forested landbase in the watershed, and of that, 21,748 acres are existing late-successional forest. Of the 21,748 acres of existing late-successional forest, 3,367 acres are available for future timber harvest on BLM managed lands, and approximately 13 acres are available for harvest on U.S. Forest Service (USFS) lands. Fifty-three percent (18,368 acres) of the existing forested landbase is comprised of late-successional forest that will be retained under existing land-use allocations; therefore, in the Bear Creek Watershed the 15 percent S&G is being met.

Although the 15 percent S&G is applicable only at the 5th Field scale, for informational purposes the same analysis used for the 5th Field watersheds was applied to the three 6th Field watersheds (Upper Emigrant Creek, Lower Emigrant Creek, and Walker Creek) comprising the Upper Bear Creek Watershed Analysis Area to evaluate the 15 percent late-successional S&G at that scale.

The results of the late-successional forest analysis for the Upper Bear Creek Watershed Analysis Area follow:

Federal Ownership	Forested Landbase (Acres)	Existing Late-Successional Forest (Acres)	Late-Successional Forest Available for Harvest (Acres)	Late-Successional Forest to be Retained (Acres)	Percent of Forested Landbase Comprised of Late-Successional Forest to be Retained
BLM	13,663	6,846	2,020	4,822	35

As shown in the table, there are 13,663 acres in the federal forested landbase (all managed by BLM) in the watershed, and of that, 6,846 acres are existing late-successional forest. Of the 6,846 acres of existing late-successional forest, 2,020 acres are available for future timber harvest. Thirty-five percent (4,822 acres) of the existing forested landbase is comprised of late-successional forest that will be retained under existing land-use allocations. Late-successional forest to be retained in the Upper Bear Creek Watershed Analysis Area is shown on Map 24.

APPENDIX L
Guidelines for Use of Native/Non-Native Grass for Site Restoration

The retention of native vegetation types within watersheds should be regarded as a long-term management priority. These sites should be carefully managed to retain native species. Management should embrace two guidelines: (1) to reduce ground disturbing activity of native species habitats to prevent invasion by non-native species, and (2) to promote aggressive integrated weed control programs to prevent encroachment into native species habitat.

The Upper Bear Creek Watershed Analysis Area occurs in what is termed a Mediterranean climate. These climates are characterized by cool, wet winters and hot, dry summer months. The lower elevation sites often contain heavy clay soils with high shrink/swell characteristics. Introduced noxious weed species from countries with Mediterranean climates are often “superior competitors” when introduced into native habitats previously not exposed to aggressive competition for moisture and nutrients.

A major portion of the low-elevation habitats in southwestern Oregon are no longer considered native habitats. It is unlikely that these sites will be reclaimed and converted back to native species in the near future, if ever. Higher elevation native habitats should be protected from invasion by limiting ground disturbance and possible exposure to non-natives through aggressive integrated noxious weed control.

Although reclamation using native species is preferred, some sites invaded by non-native species may require intermediate steps in the reclamation process prior to attempting to plant native species. These “site-adopted” non-native grasses would act as an “organic pump” to restore nutrient and soil productivity as well as prevent the “banking” of noxious weed seed in the soil. The long-term goal would be conversion from productive introduced grasses to native species when and wherever feasible.

APPENDIX M
BLM Roads of Concern

Objectives: To reduce road density, compacted area, peak flows, sedimentation, and/or roads adjacent to or in Riparian Reserves.

Recommendation: Decommission the following roads.

Road Numbers
39-3E-30.1
39-3E-32.1
39-3E-32.2
40-2E-Jeep Road in Section 13
40-2E-25.0
40-2E-25.2
40-2E-25.3
40-2E-35.4
40-2E-35.5
40-3E-7.0
40-3E-7.3
40-3E-17.1
40-3E-18.0
40-3E-19.1 (last portion)
40-3E-19.2
40-3E-19.3
40-3E-19.5

Objective: To reduce wildlife disturbance.

Recommendation: Block the following roads.

Road Numbers
39-2E-1.0
39-2E-3.2
39-3E-18.0
40-2E-1.0
40-2E-11.0
40-2E-11.1
40-2E-11.2
40-2E-24.0
40-2E-35.0
40-2E-35.1