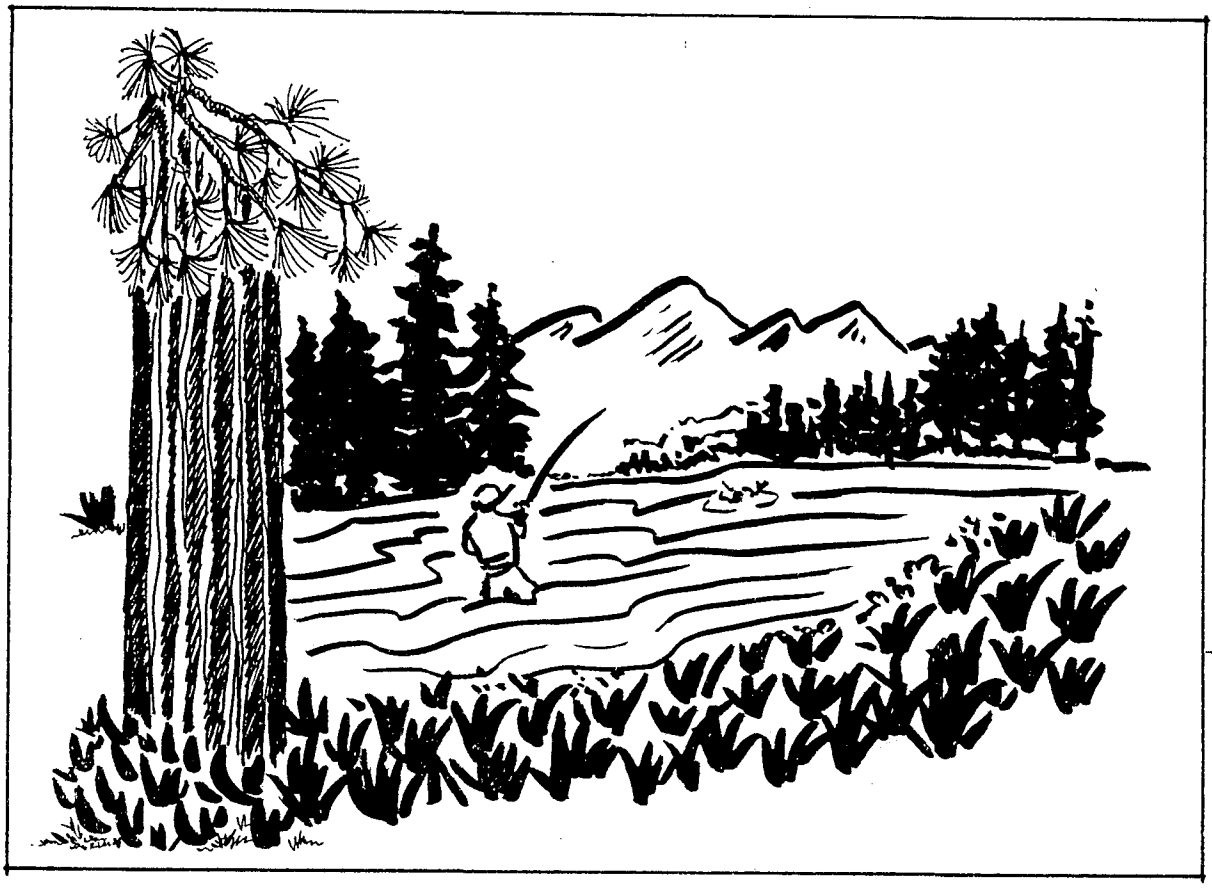

Cascade Lakes Watershed Analysis

Deschutes National Forest

October 5, 1995

CASCADE LAKES WATERSHED TEAM

The Cascade Lakes Watershed Analysis is dedicated with much aloha to our good friend and fellow team member, hydrologist, and great humanitarian, Tom Felando, whose contributions to this project, good humor, vitality, and humanity will long be remembered by all those fortunate to have been associated with him.

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Robin Lee	Landscape Architect/Planner

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Executive Summary

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CASCADE LAKES WATERSHED ANALYSIS
EXECUTIVE SUMMARY

INTRODUCTION

Watershed analysis is intended to develop a scientifically based understanding of the interaction of processes and landscape patterns within the watershed to serve as a guide for the type and priority of future restoration and management activities. It also needs to be used as a tool for subsequent management decisions which rely upon a greater understanding of existing and continuing conditions which may or may not be the result of human interactions with the ecosystem. This planning document will be used to determine strategies for sustaining the watershed for the future. NEPA review or regulatory prescription are not required at this time.

This analysis determines the current state and future trends of the watershed as compared to historic conditions, past uses such as recreation, timber harvest, and range or grazing practices, and past disturbance events such as wildfire, insect and disease epidemics. It presents management goals and future opportunities to prevent ecologically undesirable catastrophic events, maintain physical and biological integrity, and restore ecosystem function to deteriorated areas.

CHARACTERIZATION OF THE WATERSHED

Local and Provincial Context

The Cascade Lakes Watershed is recognized as one of the most scenic areas in central Oregon. Characterized by lakes and streams filled with clear, cool water interspersed with riparian meadows, snowcapped volcanic peaks, and diverse, green forest vegetation, this volcanic landscape provides sharp contrasts and harsh conditions for the alpine plant and animal ecosystems which it supports. Providing habitat for a highly diverse array of terrestrial and aquatic wildlife species, the watershed is prized for deer, elk, osprey, bald eagle, and a trophy fishery.

The Cascade Lakes Watershed is known throughout the Pacific Northwest as a special place to visit where it is possible to leave behind the turmoils and troubles of the urban world. Located twenty miles west of Bend, it is bounded to the north by South Sister and to the south by Highway 42 (See Exhibit 1). It is traversed by Highway 46 (Century Drive or the Cascade Lakes Scenic Byway) which provides easy access to alpine and montane environments and is a gateway to diverse summer and winter recreation opportunities.

Patterns of human use were well established nearly 4,000 years ago, predetermining to a large degree the routes of travel and favorite recreation sites used today. Included in this popular destination area are numerous well-known landmarks and places such as Mt. Bachelor, Broken Top, South Sister, Sparks Lake, Elk Lake, Crane Prairie, Cultus Lake, Lava Lakes, and the Upper Deschutes River (See Exhibit 2).

The flow of people in and out of the watershed is increasing dramatically with the infux of new residents and the growth of tourism in Deschutes and Jefferson Counties. The ease of access through the watershed via Highway 46, proximity to Bend, and a fast growing rural community places even greater demands on the highly valued riparian areas, recreation activities, and scenic resources of the watershed. With tourism ranking as the third largest industry in Oregon, demand for recreational activities is expected to to grow 145% for nature and wildlife observations, 114% for on-road bicycle riding, 94% for hiking trails, 86% for non-motorized boating in lakes and 85% for sailing. Nationally, on public lands the projected trends for the years 2000 to 2040 are for increases of 193% for day hiking, 155% for backpacking, 155% for rafting/tubing, and 122% for bicycling.

The Cascade Lakes Watershed is part of the volcanic Cascade Range of Oregon. All landforms, rocks, and soil are the product of volcanism and 8 periods of glaciation. It includes lands within 4 ecological subsections (Upper Cascades, Mt. Bachelor, La Pine Basin, and Stratovolcanoes) with elevations ranging from 4,400 to 10,358 feet. Soils are made up of glacial tills, Mazama ash, cinders, and ash and pumice from the Devils Hill and Rock Mesa eruptions.

The watershed covers 165,772 acres (67,087 hectares) within 7 sub-watersheds: Charlton, Cultus, Elk, Headwaters, Lava, Snow, and Sparks (See Exhibit 3). The Northwest Forest Plan identifies the Cultus subwatershed as a Tier 2 Key Watershed. Although it does not contain at risk fish stocks, it is an important source of high quality water. The Cascade Lakes Watershed is a critical headwaters area of the Deschutes Province. A great deal of ground water flows eastward and is expressed as springs which are a vital source of water throughout the Deschutes River Basin. Rainfall and snow melt combine to provide a range of 25 to 125 inches of annual rainfall. This is a critical recharge area which provides an important part of the surface and ground water which people from Bend to Madras depend upon. The surface water that flows out of the watershed via the Deschutes River represents only a small portion of the precipitation that falls within the watershed.

The entire watershed lies within the range of the northern spotted owl (See Exhibit 4). The Cultus Mountain LSR and portions of the Sheridan Mountain LSR and Browns Mountain LSR are within the watershed (See Exhibit 5). The Cultus Mountain LSR contains 5 pairs of northern spotted owls, representing one of 3 important centers of activity on the Deschutes National Forest. Late-successional forest structure present in the adjacent Three Sisters Wilderness and Administratively Withdrawn lands of the watershed currently provide effective connective and dispersal habitat to the west (Willamette NF) and to the north (Sisters Ranger District). Connectivity to the northeast (Sheridan LSR) is threatened by the mountain pine beetle epidemic and the existing fragmentation of the dry mixed conifer plant association group (PAG). Connectivity to the south (Odell LSR and ultimately the Umpqua NF) is in part provided by wilderness lands but is restricted by timber harvest fragmentation in the southern portion of the watershed. 24% or 39,840 acres of the watershed currently provide suitable nesting, foraging and roosting habitat for the northern spotted owl.

Exhibit 1
Cascade Lakes Watershed Analysis
DESCHUTES NATIONAL FOREST

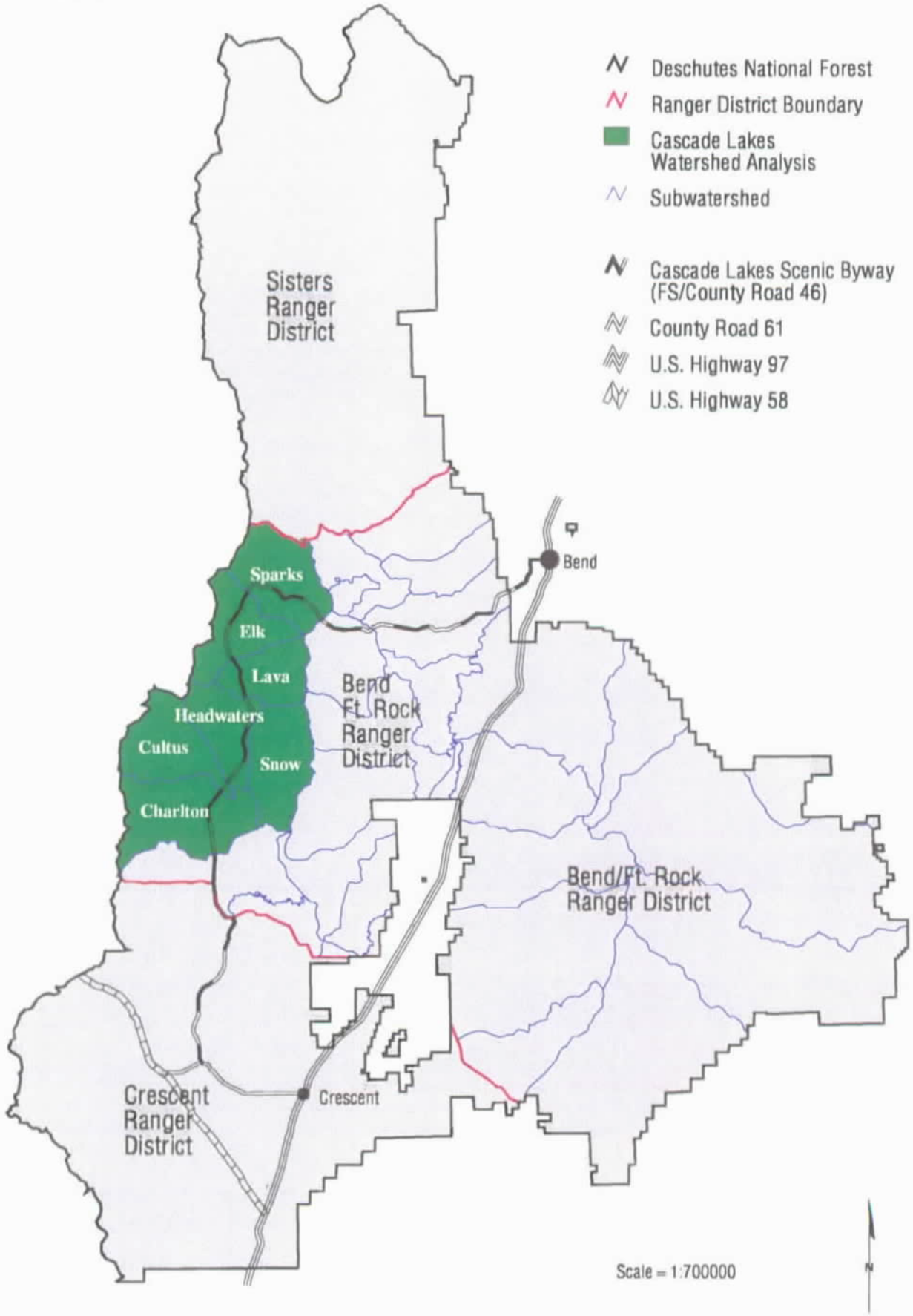
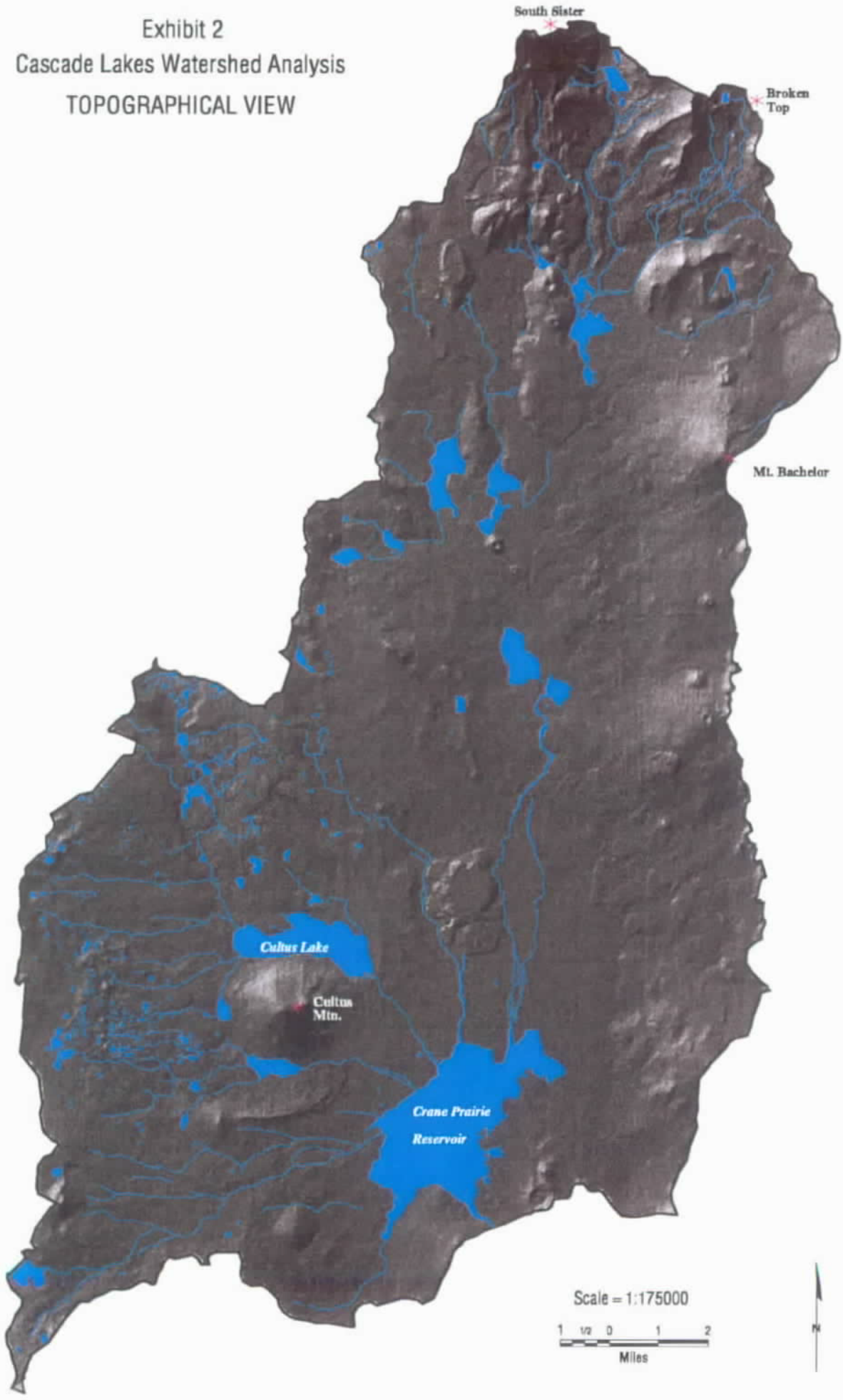


Exhibit 2

Cascade Lakes Watershed Analysis

TOPOGRAPHICAL VIEW



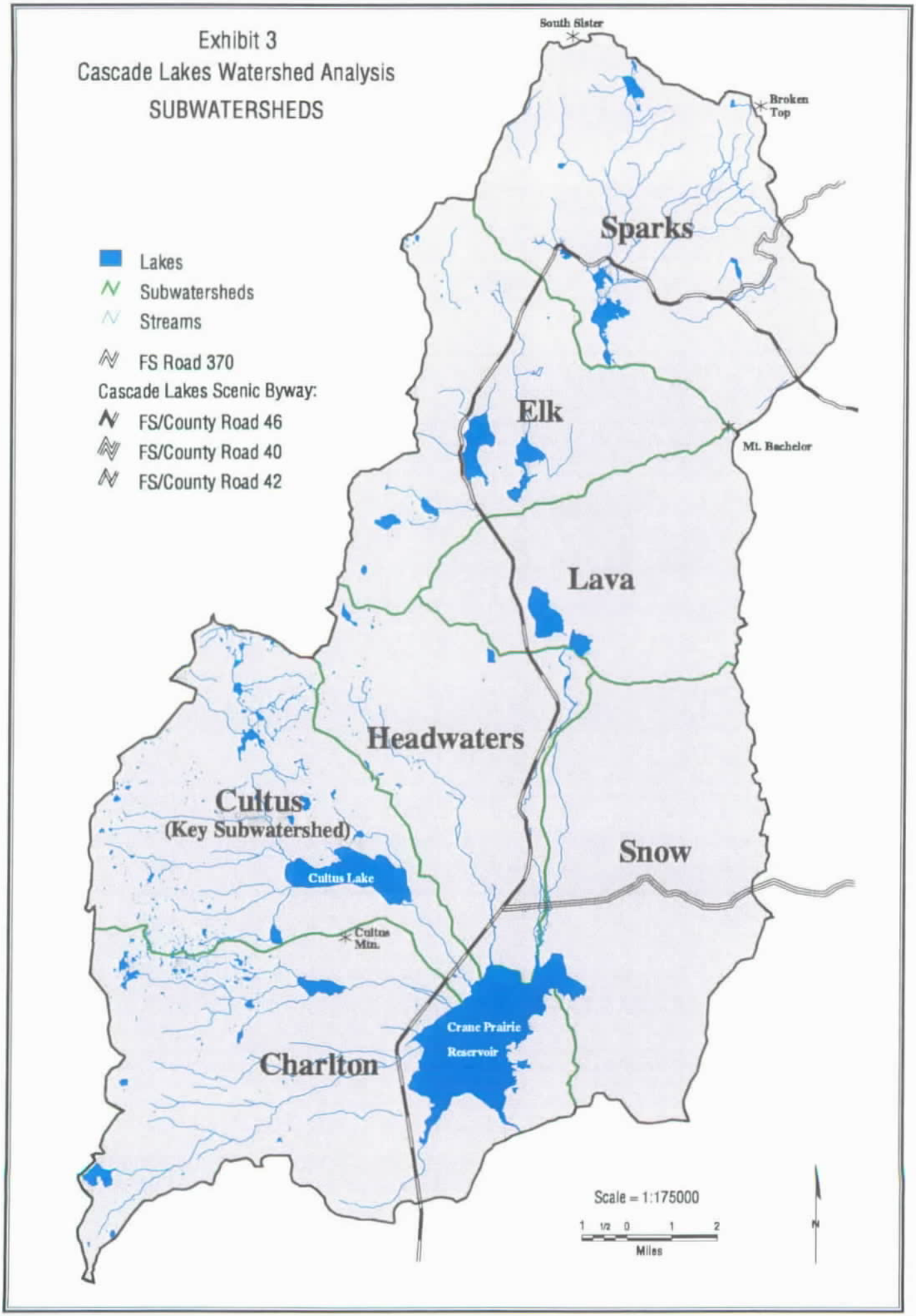
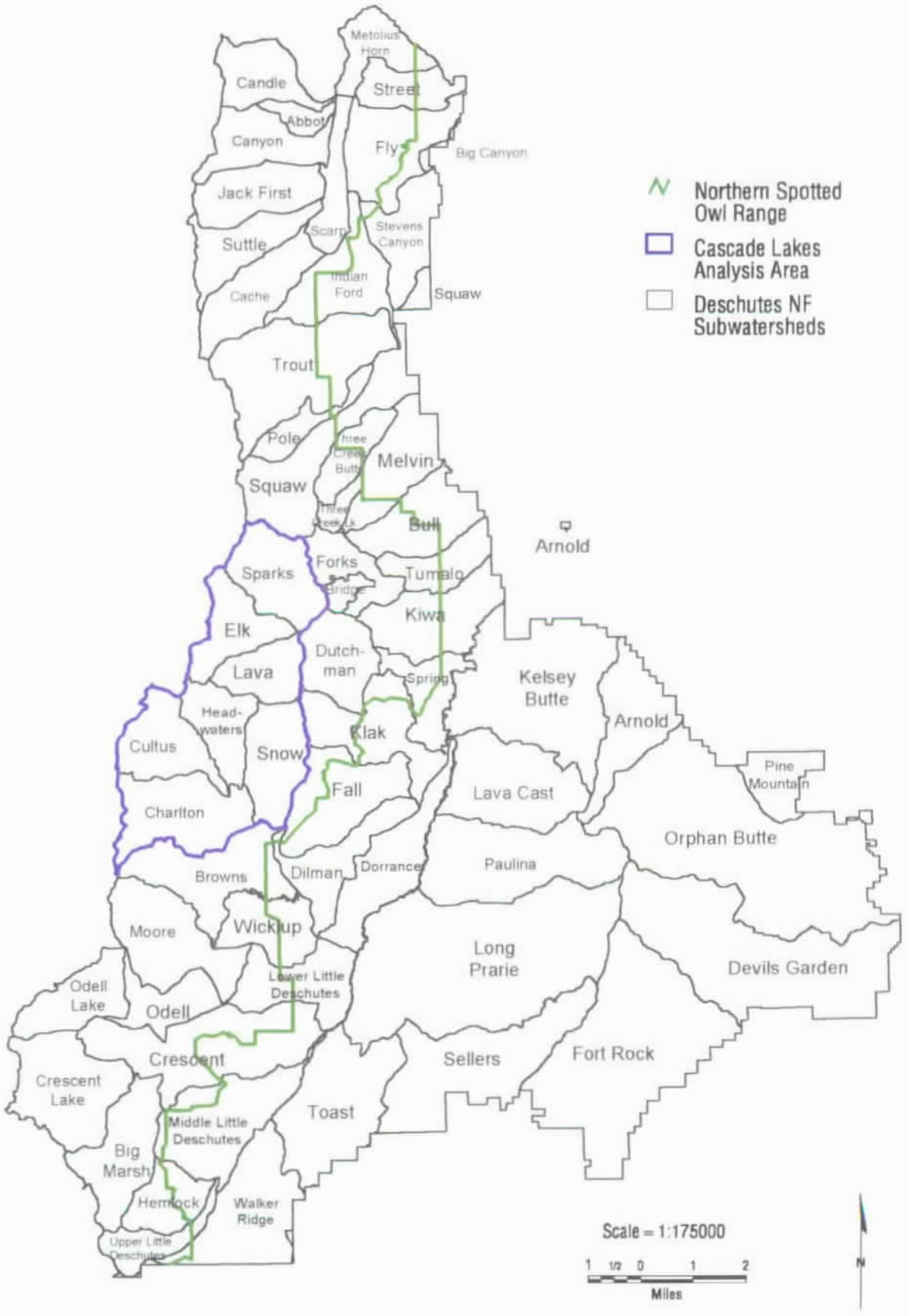


Exhibit 3
Cascade Lakes Watershed Analysis
SUBWATERSHEDS
Lakes
Subwatersheds
Streams
FS Road 370
Cascade Lakes Scenic Byway:
FS/County Road 46
FS/County Road 40
FS/County Road 42
South Sister
Broken Top
Sparks
Elk
Mt. Bachelor
Lava
Headwaters
Cultus
(Key Subwatershed)
Cultus Lake
Cultus Mtn.
Snow
Crane Prairie Reservoir
Charlton
Scale = 1:175000
1 1/2 0 1 2
Miles
N

Exhibit 4

Deschutes National Forest

SUBWATERSHEDS



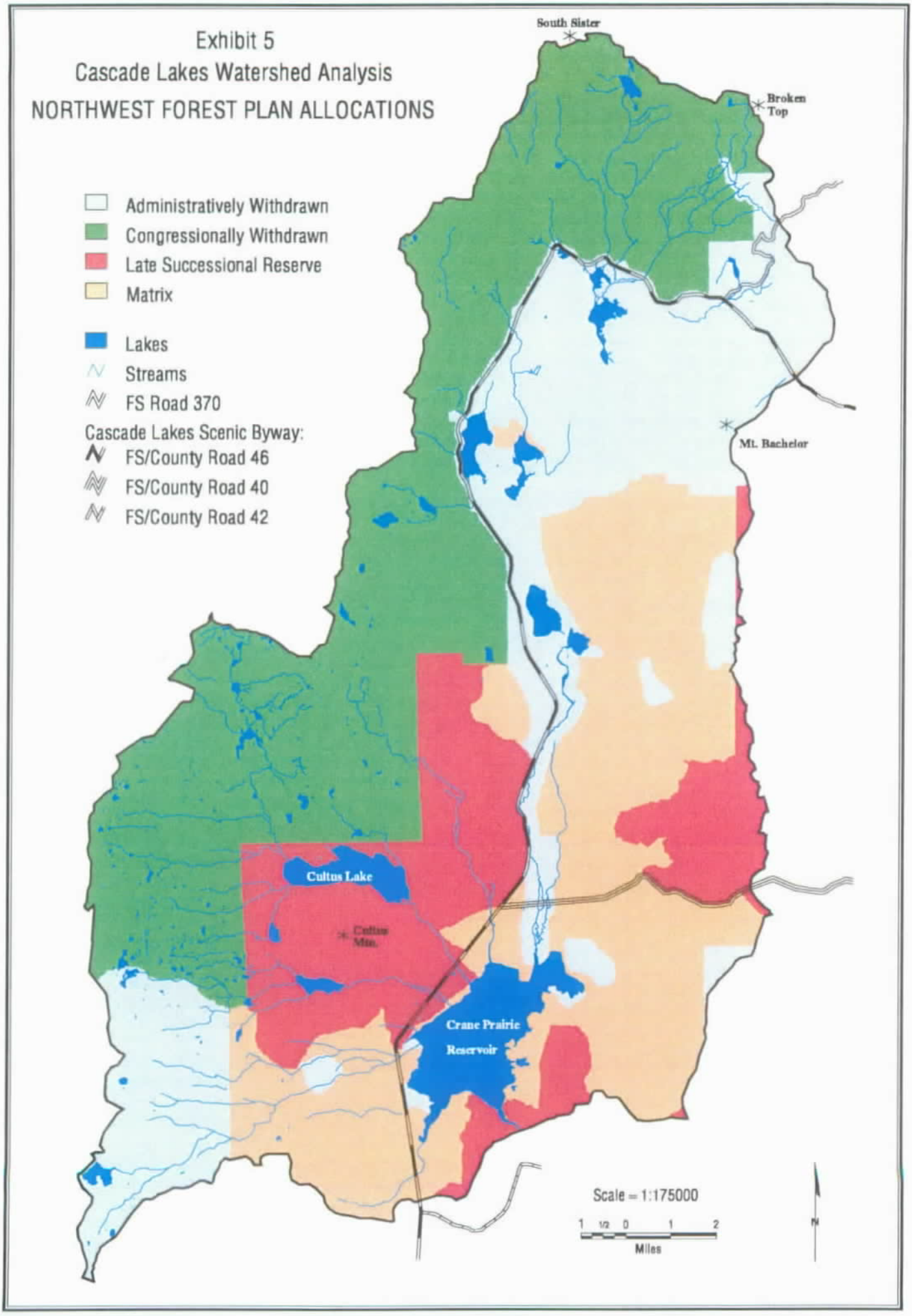


Exhibit 5
Cascade Lakes Watershed Analysis
NORTHWEST FOREST PLAN ALLOCATIONS
Administratively Withdrawn
Congressionally Withdrawn
Late Successional Reserve
Matrix
Lakes
Streams
FS Road 370
Cascade Lakes Scenic Byway:
FS/County Road 46
FS/County Road 40
FS/County Road 42
South Sister
Broken Top
Mt. Bachelor
Cultus Lake
Cultus Mtn.
Crane Prairie Reservoir
Scale = 1:175000
1 1/2 0 1 2
Miles
N

Landscape Flows and Areas

The landscape flows of the Cascade Lakes Watershed are the identification and analysis of the significant elements which make up and influence the dynamics of the watershed ecosystem. These elements are the the migration and movement of deer and elk, waterfowl, amphibians, mountain pine beetle, climate, water, and people's past and present uses of the landscape. Major transportation corridors of affected by these flows are mapped (See Exhibit 6) in order to locate where conflicts could be occuring as a source of problems for current and future trends.

Based upon the landscape flows, the watershed was then stratified into four landscape areas representing an integrated view of the inherent ecological functions and capabilities of the land. The team defined each landscape area through a focused analysis of key issues, key questions, and factors of concern. Predominant physical, biological and social elements were then integrated and expressed at a landscape scale. These resulting areas are described and referred to throughout this analysis as the Recreation/Alpine Tephra, Recreation/Riparian, Timber/Forest Products, and Outback Landscape Areas (See Exhibit 7).

The Recreation/Alpine Tephra Landscape Area (31,127 acres) includes Sparks Lake, Devils Lake, Green Lakes, Moraine Lake, Todd Lake, the section of the Cascade Lakes Scenic Byway which has the most spectacular views, Mt. Bachelor, and the part of the Three Sisters Wilderness which has very high recreation use. It is characterized by a thin soil substrata of 2,000 year old tephra, high elevation lakes, and the mountain hemlock plant association group. Wildlife habitat is provided for wilderness associated species (wolverine and marten). The tephra derived soils are nutrient poor, coarse and slow to self restore, and recreation use is high. In 1994, over 22,000 visitors entered the Three Sisters Wilderness from the Green Lakes trailhead.

The Recreation/Riparian Landscape Area (30,834 acres) contains high elevation lakes and streams centered around the Cascade Lakes Scenic Byway largely within the La Pine Basin ecological subsection. The major lakes are Elk, Hosmer, Lava, Little Lava, Cultus, Little Cultus, Deer, and Crane Prairie. The source of the Deschutes River is found here. The riarian areas provide primary wildlife habitat for 220 species. Connective habitat for upland wildlife and species associated with late-successional forests provides an important function. Heavy use by Forest visitors occurs because of recreation sites located adjacent to prominent water bodies. The high scenic quality created by the mountain hemlock, lodgepole pine, and mixed conifer forests along the Cascade Lakes Scenic Byway is being diminished by an epidemic of mountain pine beetle infestation. This nationally designated scenic travel route is the main access to this major recreation area.

The Timber/Forest Products Landscape Area (40,325 acres) is characterized by a 60 year history of selective timber harvest practices within the wet and dry mixed conifer plant associations groups which dominate this landscape. Wet and dry lodgepole pine plant

associations groups dominate the lower elevations where a 25 year history of selection and shelterwood harvests have created a prominent forest pattern of fragmentation. Site productivity and resilience of the soil resource is limited in some areas (9,358 acres) where shallow soil depths are underlain by recent lava flows. These areas are typically referred to as "forested lavas." Site productivity is moderate to high in other areas of this landscape where soil depths, underlying geology, and precipitation are less limiting factors for survival.

The Outback Landscape Area (63,479 acres) is characterized as an unfragmented, unroaded, and remote area which functions as wildlife refugia for species intolerant to moderate to high disturbances by human activities (wolverine, marten, and furbearers for example). The mountain hemlock plant association group dominates the underlying Upper Cascades and Stratovolcanoes ecological subsections. Use of this portion of the Three Sisters wilderness is moderate compared to the use of the portion located in the Recreation/Alpine Tephra Landscape Area.

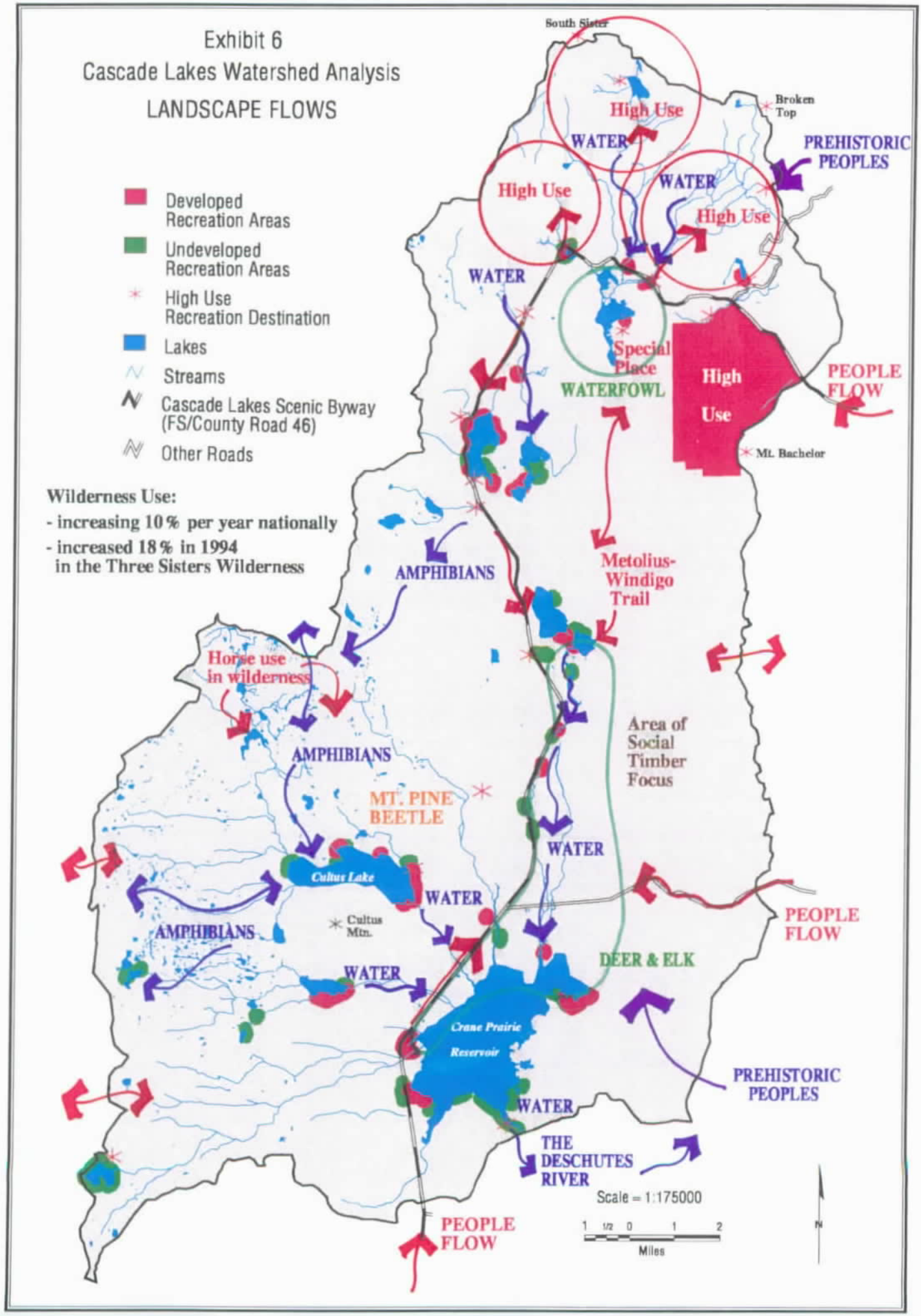


Exhibit 6
Cascade Lakes Watershed Analysis
LANDSCAPE FLOWS
Developed Recreation Areas
Undeveloped Recreation Areas
High Use Recreation Destination
Lakes
Streams
Cascade Lakes Scenic Byway (FS/County Road 46)
Other Roads
Wilderness Use:
- increasing 10% per year nationally
- increased 18% in 1994 in the Three Sisters Wilderness
South Sister
Broken Top
High Use
WATER
PREHISTORIC PEOPLES
High Use
WATER
High Use
WATER
Special Place
WATERFOWL
High Use
PEOPLE FLOW
ML Bachelor
AMPHIBIANS
Metolius-Windigo Trail
Horse use in wilderness
AMPHIBIANS
MT. PINE BEETLE
Area of Social Timber Focus
WATER
Cultus Lake
WATER
PEOPLE FLOW
Cultus Mtn.
AMPHIBIANS
DEER & ELK
WATER
Crane Prairie Reservoir
PREHISTORIC PEOPLES
WATER
THE DESCHUTES RIVER
Scale = 1:175000
1 1/2 0 1 2
Miles
N
PEOPLE FLOW

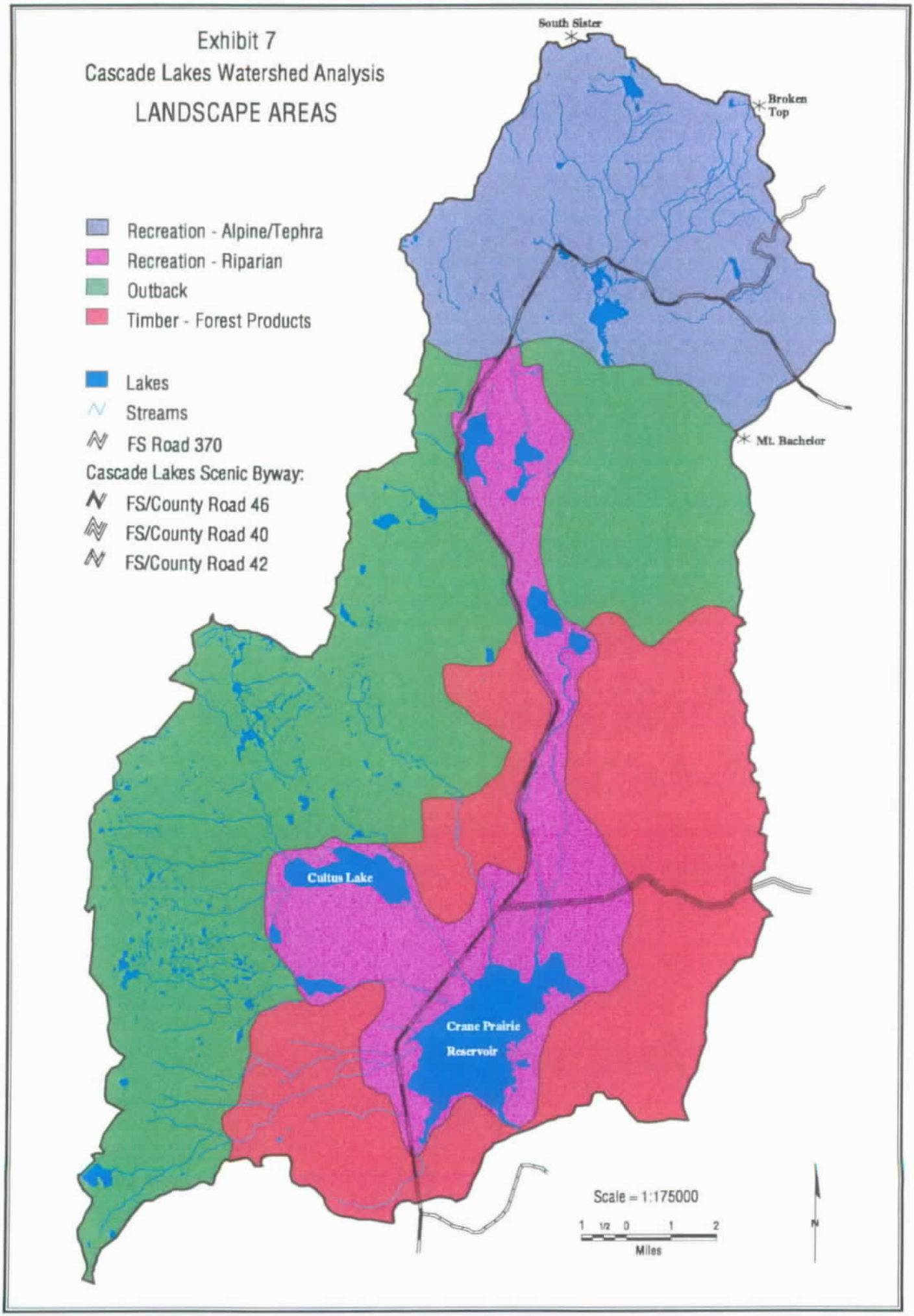


Exhibit 7
Cascade Lakes Watershed Analysis
LANDSCAPE AREAS
Recreation - Alpine/Tephra
Recreation - Riparian
Outback
Timber - Forest Products
Lakes
Streams
FS Road 370
Cascade Lakes Scenic Byway:
FS/County Road 46
FS/County Road 40
FS/County Road 42
South Sister
Broken Top
Mt. Bachelor
Cultus Lake
Crane Prairie Reservoir
Scale = 1:175000
1 1/2 0 1 2
Miles
N

KEY ISSUES AND CURRENT WATERSHED TRENDS

KEY ISSUES

The key issues which address the main concerns within the watershed are: **1)** sustaining recreation quality and riparian health and **2)** sustaining forests that have been altered by past management practices. These issues were further developed to focus the analysis on a watershed scale and to determine the most critical restoration management opportunities.

Issue 1. SUSTAINING RECREATIONAL QUALITY AND RIPARIAN HEALTH.

Background: High recreational demand interfaces with the riparian shorelines and streamsides of the Cascade Lakes Watershed. Patterns of recreational use are well established and demand is expected to increase. Many recreational areas are already denuded of native vegetation. Recreational facilities are deteriorating. Crowding and increasing recreational dispersed use are expanding the geographic extent of undesirable social, biological and physical impacts. Decrease in soil quality, water pollution in high quality lakes, loss of riparian vegetation cover, diversity and structure, decrease in habitat effectiveness for wildlife, loss of aquatic species diversity, and decreasing recreational quality are among the primary undesirable impacts associated with this issue.

Key Question: What level and quality of recreational use can we maintain in riparian areas and continue to sustain biological and physical resources in the long-term?

Issue 2. SUSTAINING FORESTS THAT HAVE BEEN ALTERED BY PAST MANAGEMENT PRACTICES.

Background: High forest stand densities, changing species composition, soil compaction and fragmentation of forests are a result of altered disturbance regimes (lack of fire) and past resource extraction. Current vegetative conditions as a result of these management practices are unstable, less resilient to natural disturbances, and are placing valued wildlife habitats and plant and animal species at risk. Loss of soil quality, high road densities, loss of large tree structure, shift in tree species dominance from ponderosa pine to white fir, loss of forest resilience to natural disturbances (fire, insect and disease), shift from small forest openings to large openings in the dry mixed conifer plant association group, and a decrease in effectiveness of wildlife habitat for species associated with late structured forest are among the undesirable impacts associated with this issue. Loss of long-term site productivity, inability to sustain forest products over time, and wildfire hazards related to public safety are undesirable social impacts associated with this issue.

Key Question: What are the root causes of the current unstable conditions within the forested areas of the watershed and how can we best reduce risk of loss of species biodiversity, habitat functions, and long-term forest productivity?

CURRENT WATERSHED TRENDS

A trend is a result of factors which over time influence change on a given element of the ecosystem. The discussion of trends examines current patterns of change that are seen consistently over broad areas of the watershed that may or may not depart from past patterns. In most cases, the trends are expected to continue into the future unless significant changes occur in social uses, management, or physical and biological processes. The team's analysis includes the discussion and display of future trend development as a method to assess ecosystem risk.

The team identified 18 landscape level trends in the Cascade Lakes Watershed. The trends are closely allied with the key issues and questions. The highest geographic correlation of trends was found to be within the Recreation/Riparian Landscape Area. All trends are highly or moderately correlated to this landscape. The high recreational demand, current forest health deterioration, high fire hazard, Northwest Forest Plan land allocations, riparian health and wildlife habitat needs in this landscape pose challenging management changes in order to implement the recommended goals and opportunities for restoration.

Listed below are the watershed trends which pose high ecosystem risk. The summary of the relative ecosystem resilience, susceptibility, and risk is displayed in Table E-1. Red Flag and Orange Flag trends are highlighted in this summary because they are recognized as critical conditions which would result in the loss of one to several ecosystem elements over a broad geographic area if restoration or management changes do not occur immediately. The priority restoration areas are also identified (See Exhibits 8, 9, and 10).

Physical Domain Trends - Red and Orange Flags

P1. Trend: Throughout the watershed, soil quality is decreasing in riparian areas and adjacent upland areas through loss of surface organics and increase in soil compaction. **Location:** Recreation/Alpine Tephra and Recreation/Riparian Landscape Area - **Red Flag**

Current Condition: The Recreation/Alpine Tephra Landscape Area has several primary areas of impact along the Fall Creek trail, Green Lakes, and Moraine Lake in the Three Sisters Wilderness, and Todd Lake; Forest Road 370 and some associated spurs; camping in undeveloped areas off of the Cascade Lakes Scenic Byway near Sparks, Devils and Todd lakes; and the slopes of the developed ski area on Mt. Bachelor.

The primary area of displacement within the watershed is the Mt. Bachelor ski area development. Management practices have included ground based logging, removal of stumps, rocks and coarse wood from the cleared runs and fine grading of the runs with heavy machinery during the summer. These practices have removed the historic litter and duff layer, creating unstable soil conditions resulting in rill and gully erosion. Annual grading is used to fill and smooth rills and gullies formed by melting snow water and summer rain events.

Revegetation efforts to stabilize these slopes have had mixed results due to the loss of the soil A horizon and high elevation weather.

Current management is addressing impacts from recreational use in the wilderness by designating camp sites at Green Lakes and Moraine Lake and by encouraging an outreach/education program to inform the public about user impacts. Revegetation of impacted areas has been limited and is difficult to accomplish due to the limited growing season, coarse textured soils, and continuing recreational use.

Of the 4 landscape areas, the Recreation/Riparian Landscape Area has received the highest amount of recreational impact. Soils in these areas are compacted from trampling and camping use. Overall, approximately 20% is currently in detrimental soil classes C and D, with the impacts spread between riparian and upland soils. Approximately 52% of the area was found to be in condition class A, 4% in class B, and the remaining 24% in surface water.

P2. Trend: Decline in soil productivity in timber harvest areas. **Location:** Timber/Forest Products and Recreation/Riparian Landscape Areas - **Orange Flag**

Current Condition: The Timber/Forest Products Landscape Area has had the heaviest impacts to the soil resource, primarily from harvest and fuel management activities. Approximately 76% of the Timber/Forest Products Landscape Area has been entered at least once with machine traffic, with much of it entered at least twice. Approximately 62% of this area currently has soils in detrimental condition classes C or D, with 14% currently in class B, and 23% in class A. The majority of harvest activity has occurred in the last 20 years utilizing harvest prescriptions ranging from clearcuts to selective thinning. Impacts to the soil resource are primarily expressed in higher levels of compaction, as well as displacement and mixing of the surface organics and soil A horizon.

Road densities, which are the highest of all the landscape areas at approximately 4.99 miles per square mile, reflect the intensive harvest activity that has occurred here over the last 40 years. The road density includes 0.12, 0.77 and 4.1 miles of paved, cindered, and natural surface roads per square mile.

The forested lava soil areas have incurred a variety of harvest activities on 92% of the 9,358 acres present in this landscape area. Impacts from these activities are concentrated in areas where enough soil had accumulated to grow trees. Planting and/or subsoiling operations are severely limited or impossible in these areas due to the extremely shallow soil depths.

The Recreation/Riparian Landscape Area contains lands that have been and are currently proposed for harvest activities. The majority of these activity areas are located on upland soils within this landscape area. Surface organic litter and duff has been displaced and mixed in the profile. Forest monitoring has shown that compaction has occurred on upwards of 30 to 40% of individual units harvested with ground based equipment.

Biological Domain Trends - Red Flags

B1. Trend: The dry mixed conifer plant association group is outside the historic range of variability for large diameter, ponderosa pine and douglas fir structure, increasing densities of white fir, canopy cover for white fir, and patch size and patch area (fragmentation). **Location:** Timber/Forest Products and Recreation/Riparian Landscape Areas - **Red Flag**

Current Condition: The dry mixed conifer plant association groups are those in which treatment is most urgently needed to protect existing and future resources. There has been a pronounced shift in forest structure, density, and species composition from the relatively open, contiguous, and large tree dominated forest which existed historically. This relatively stable and fire-resistant forest continues to be replaced by dense, multi-storied forest structures of smaller trees. Species composition has shifted from fire climax species like ponderosa pine, to predominantly shade tolerant species such as true firs. These trends are a result of a combination of fire suppression and selective harvest spanning the past 80 years.

This shift has led to an overall lowering of forest health and increased activity of, and overall susceptibility to, various insect and disease agents which affect trees of all size classes, including large diameter trees.

Temporarily, habitat for the northern spotted owl (both Matrix and LSR designations are contained in this plant association group) and other late-successional species has been enhanced. In the near future however, it is inevitable that habitat suitability will decline dramatically. It is expected that canopy closure will be considerably less; the combined result of root disease, defoliaters, and bark beetles. There will be a steady decline in the fire resistant, shade intolerant tree species and large diameter trees. Catastrophic fires will, if they occur, cause a dramatic and immediate reduction in overall forested areas.

B2. Trend: Increase in insect activity and insect induced mortality in lodgepole pine of the lodgepole pine and portions of the dry mixed conifer plant association groups. **Location:** Recreation/Riparian and Timber/Forest Products Landscape Areas - **Red Flag**

Current Condition: Mountain pine beetle attack of the lodgepole pine forests, as well as the lodgepole component of the mixed conifer forests has intensified over the past 5 years. Mortality is high (expected to reach 80%) along scenic corridors and around developed recreation sites such as Cultus Lake and the Cascade Lakes Scenic Byway. Although the dry lodgepole pine plant association group is not outside its range of historic variability, it is in a seral stage and forest health condition that predispose the area to large stand replacement fires and epidemic levels of insect outbreaks. The high fire hazard and the hazard trees are a potential danger to recreationists within the watershed.

B8. Trend: Loss of habitat connectivity between Late-Successional Reserves and associated available late-successional habitat in Adminstratively Withdrawn and Matrix areas.

Current Condition: The decrease in forest health of the dry mixed conifer plant association group and the death of trees due to mountain pine beetle epidemic is also creating a loss of connective habitat. Loss of lodgepole pine forest cover will diminish connectivity between the mixed conifer and mountain hemlock forests associated with LSR designations within the watershed. The lodgepole pine forests in the area bounded by Little Lava Lake, the Upper Deschutes River, and Snow Creek currently serve as connective and security cover for many species of wildlife. Other forested areas between the LSR designations are fragmented by past harvest activities and wildfire events.

Social Domain Trends - Red and Orange Flags

S1. Trend: Increased demand for diversified recreation experiences in developed, non-developed, and wilderness settings within and adjacent to riparian zones and increasing conflicts between recreation, wildlife, fisheries, and irrigation needs. **Location:** Recreation/Riparian and Alpine Tephra Landscape Areas - **Red Flag**

Current Condition: The quality of the recreation experience is declining in high use developed and undeveloped recreation areas. The experience has been affected by the appearance and condition of the natural resources, the appearance and condition of the facilities, accessibility and ease of access flow, personal safety, sanitation and the high number of human encounters. There are increasing conflicts between the diverse types of recreation visitors who are drawn to the area primarily to use trails and bodies of water. There is a growing desire to camp in undeveloped areas in a location of individual choice, close to water and wildlife. The lack of Forest Service presence, direction, and regulation allow existing damage to occur and to spread to larger areas.

Conflicts with other natural resources such as soil quality (See Trend P1), riparian vegetation and widlife habitat are also of high concern. Waterfowl, sandhill cranes, amphibians, neotropical birds, bald eagle and osprey are at highest risk for population decreases due to increasing riparian habitat loss and/or increased recreational use.

S2. Trend: Deterioration of recreation facilities and natural resource amenities. **Location:** Recreation/Riparian and Recreation/Alpine Tephra Landscape Areas - **Orange Flag**

Current Condition: In general, many types of facilities at developed campgrounds are in need of repair (toilet leak and need to be redesigned to provide barrier-free access, appropriate site designation is lacking, sites have erosion and dust problems due to lack of existing vegetation, inadequate barrier posts, poor signing and absence of effective interpretive aids, damage to riparian zones due to uncontrolled vehicular traffic). Developed facilities having the most critical needs for restoration are Todd Lake Campground, Elk Lake Resort, Point Campground, Beach Day Use Area, Sunset Beach, Little Lava Campground, Mile

Camp, Deschutes Bridge Campground, Rock Creek Campground, and Little Cultus Campground.

Disrepair of facilities and crowding is correlated with trends in increased camping in undeveloped areas or undesignated sites. Camping in undeveloped sites conflicts with many natural resource amenities of the watershed and it also affects the quality of the recreation experience. Undeveloped camping areas identified as having the highest needs for restoration are: Green and Moraine Lakes, Soda Creek, Satan Creek, Todd Lake, Road 370, Hosmer Lake, Little Lava Lake, Cow Meadow, Rock Creek, Browns Mountain, the southeast arm and northeast meadows of Crane Prairie Reservoir, Upper Deschutes River, Cultus Lake, Charlton Lake, and Irish and Taylor Lakes.

Increased crime is a related trend which deserves to be mentioned. Increased crime in recreation sites of the watershed appears to be due to population growth and an increasing diversity of user groups. Increasing conflicts, higher use, and the lack of agency presence make it difficult to enforce regulations. More violent crimes, primarily domestic violence and vandalism are occurring. The public continues to express anger over additional fee campgrounds, overcrowded conditions, and deteriorating facilities.

Social, biological and physical causal relationships are highly integrated. The team has rated the relative ecological risk to water bodies associated with these trends by considering all of the related resources (See Table E-1). The water bodies in critical need of restoration are also listed and ranked as Red, Orange, and Yellow Flags with Red being the most critical.

Exhibit 8

Cascade Lakes Watershed Analysis

PRIORITY RESTORATION FOR SOILS

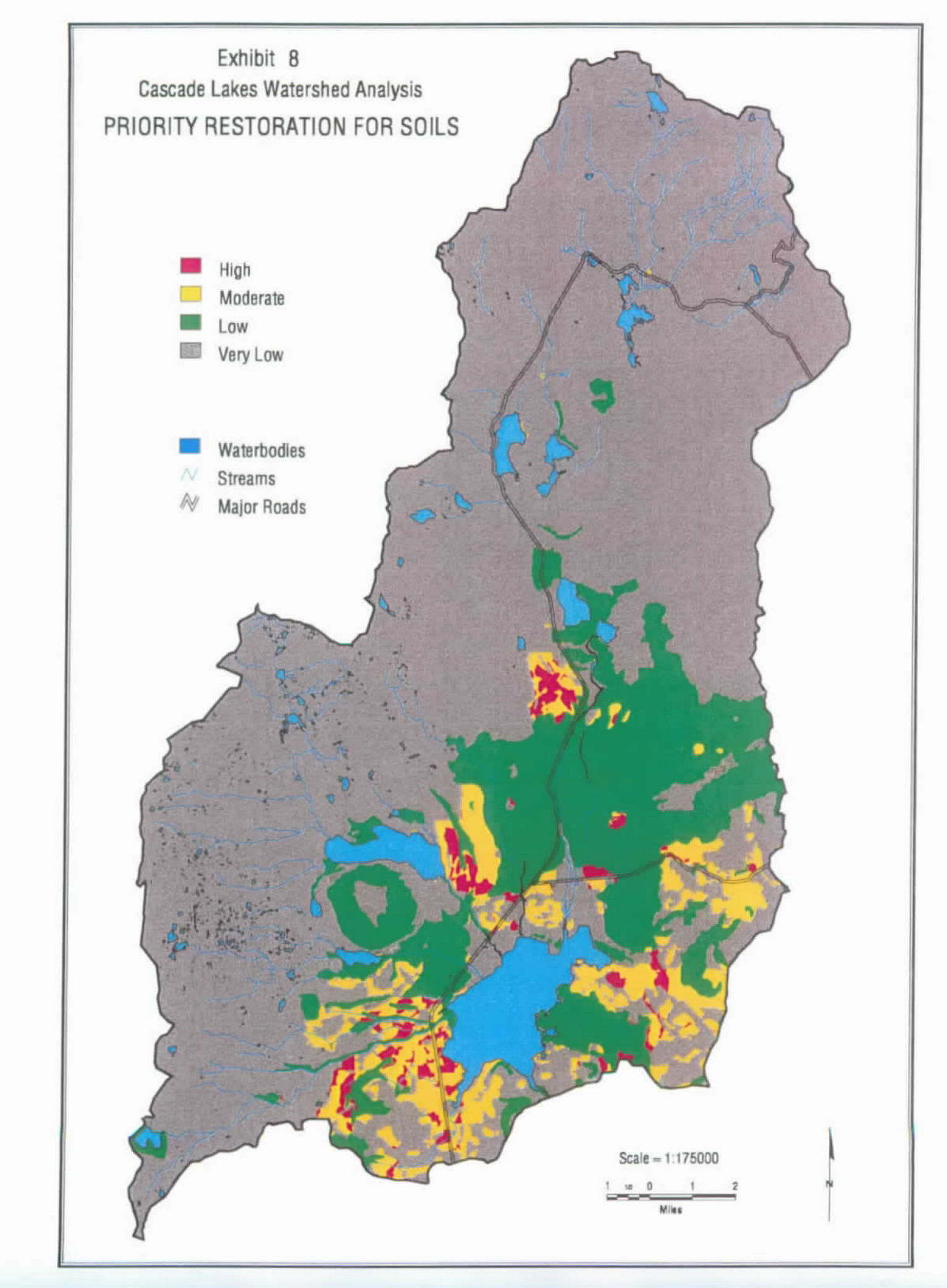


Exhibit 9

Cascade Lakes Watershed Analysis

PRIORITY RESTORATION FOR VEGETATION

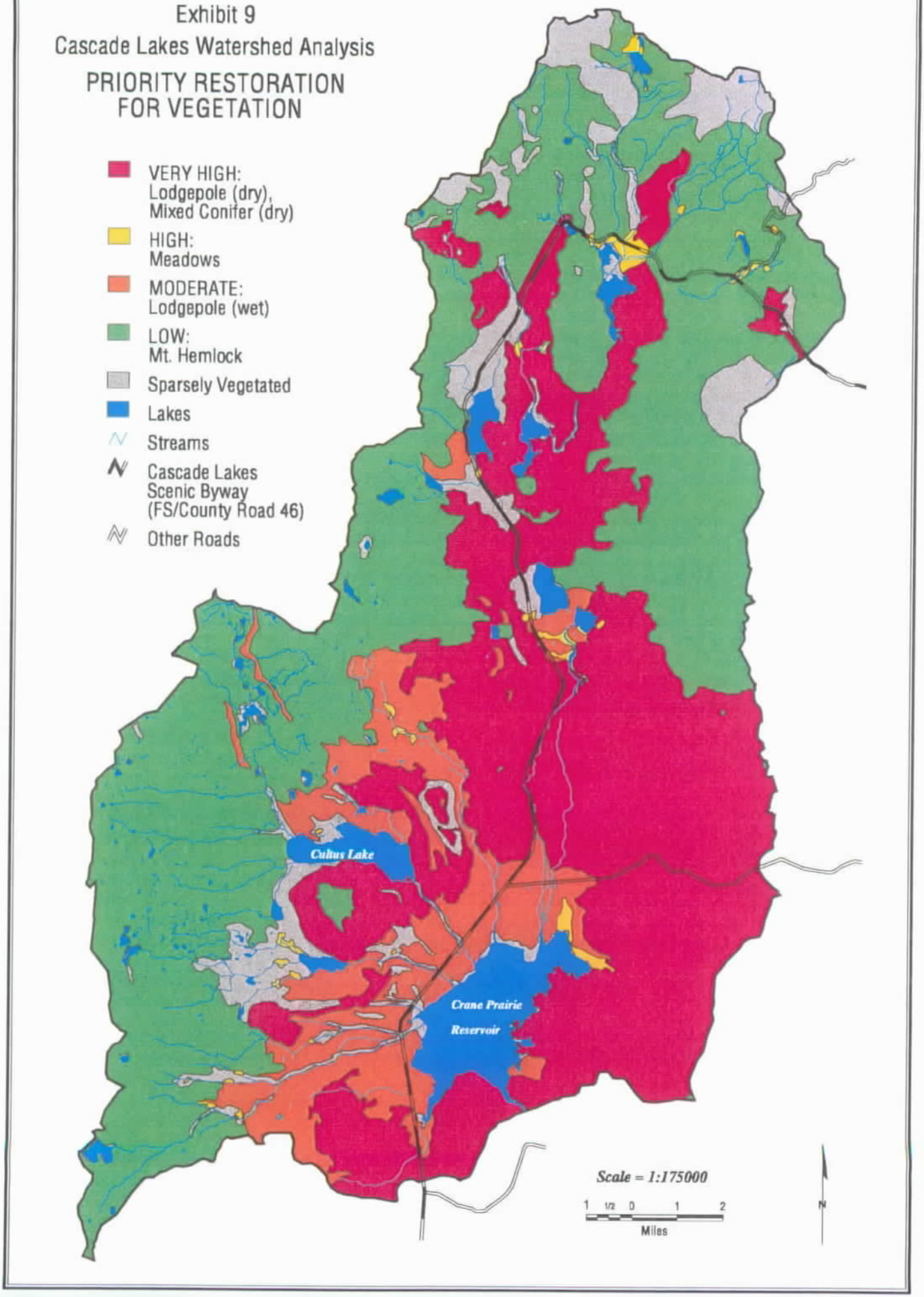


Exhibit 10

Cascade Lakes Watershed Analysis

PRIORITY RESTORATION FOR WATER BODIES

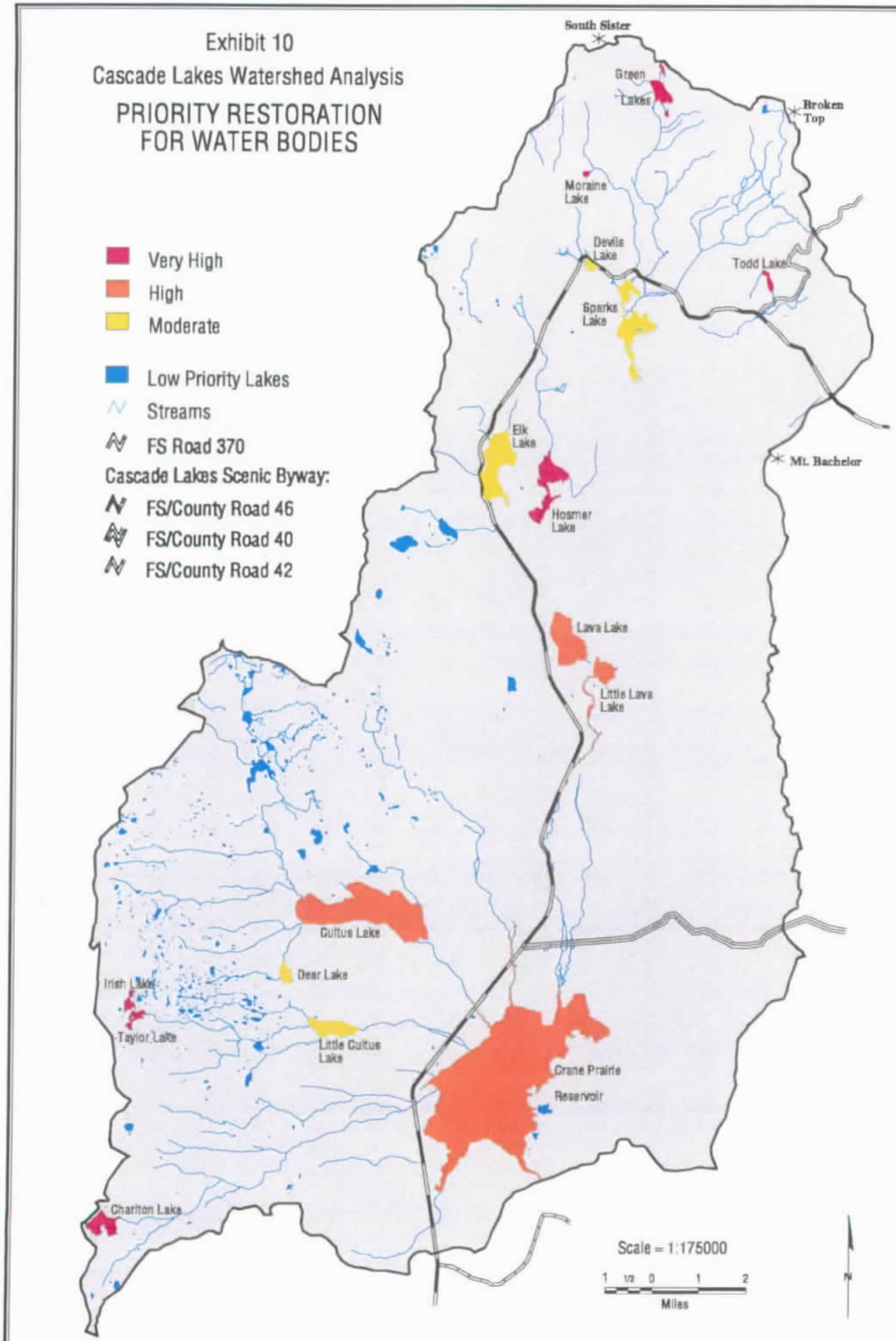


Table E-1 - Cascade Lakes Watershed - High Risk Trends
P-Physical, B-Biological, S-Social

Trends	Landscape Areas	Susceptibility	Resiliency	Risk to Ecosystem	Trend Rating
P1 - Decreasing soil quality in riparian and adjacent upland areas.	Common to All	High/Moderate	Low/Moderate	High	Red Flag
B1 - Loss of large diameter PP and DF components of dry mixed conifer PAG.	Rec/Riparian	High	Low	High	Red Flag
B2 - Insect/Disease induced mortality in LP PAG	Timber/Forest Products and Rec/Riparian	High	Moderate	High	Red Flag
B8 - Loss of habitat connectivity between LSR's.	Rec/Riparian Timber/Forest Products	High	Low	High	Red Flag
P2 - Decreasing soil productivity in timber harvest areas.	Timber/Forest Products and Rec/Riparian	Moderate	Low/Moderate	Moderate/High	Orange Flag
S1 - Increased demand in developed, undeveloped, and wilderness settings.	Alpine Tephra Rec/Riparian Outback				
Green, Moraine Todd, Hosmer, Irish/Taylor and Charlton Lakes.	Alpine Tephra Rec/Riparian Outback	High	Low/Moderate	Moderate/High	Red Flag
Lava and Little Lava, Cultus Lake, Upper Deschutes River, Crane Prairie	Rec/Riparian	Moderate/High	Moderate/High	Moderate	Orange Flag
Sparks, Devils, Elk, Little Cultus, Deer, and several wilderness lakes.	Rec/Riparian Alpine Tephra Outback	Moderate/High	Low/Moderate	Moderate	Yellow Flag
S2 - Deterioration of recreation facilities and natural resource amenities.	Rec/Riparian Alpine Tephra	High	Moderate	Moderate	Orange Flag

MANAGEMENT GOALS AND OPPORTUNITIES

Management goals and opportunities were developed to meet needs identified in the trends analysis to protect soils, restore riparian function and forest health, return resilience to ponderosa pine stands, maintain scenic and recreation qualitites, and promote environmental and interpretive programs that feature the watershed's outstanding geological, hydrological, scenic, riparian, and wildlife values. These goals and opportunities were developed by landscape area and are recommended by the team as a way to restore natural processes and to enhance human interactions within the watershed.

MANAGEMENT GOALS

The Recreation/Riparian Landscape Area

1. Promote and direct diverse recreational uses to lessen visitor impacts on the landscape to maintain or enhance water quality, aquatic resources, scenic quality, critical wildlife habitat and corridors, riparian integrity, heritage resources, and special uses (resorts, summer homes, utilities, concessionaires, travel routes).

2. Manage vegetative component in order to provide for sustainable forest and meadow ecosystems with an emphasis on connectivity among later seral stages and to enhance and improve the area's scenic quality.

The Recreation/Alpine Tephra Landscape Area

1. Maintain the outstanding scenic quality of the area.

2. Promote the recreational day use opportunities that pose no threats or disturbances to wildlife refugia and human solitude.

3. Promote environmental education and interpretive programs that feature the outstanding geologic, hydrologic, scenic, riparian, and wildlife values.

4. Restore riparian function to areas impacted by human use.

The Timber/Forest Products Landscape Area

In order to provide sustainable commercial forest products:

1. Restore forest resiliency to insect, disease, and fire disturbances to enhance a mosaic of forest structural diversity, species composition and wildlife habitat.

2. Respond aggressively to the effects of high forest density and species composition changes, soil compaction and fragmentation to promote long-term site productivity and forest health.

3. Perpetuate the large ponderosa pine and douglas fir tree component for scenic and wildlife values.

The Outback Landscape Area

1. Emphasize environmental awareness to maintain the pristine character of the area in relation to wildlife habitat, scenic quality, and a primitive recreational experience.

2. Emphasize and enhance habitat for native species.

3. Allow natural processes, including fire, to shape the landscape.

4. Maintain the unroaded character of the area.

CRITICAL RESTORATION OPPORTUNITIES

The Cascade Lakes Watershed is one of the crown jewels of the Deschutes National Forest. Scenery, water quality, recreation, forest beauty and health, and wildlife values are very high. The community of Bend and the surrounding counties depend upon the watershed for water supply, recreation, and economic stability. In view of the high risk trends and current conditions present in the watershed, the team recommends swift management changes and restoration in the following categories:

* **Forest Health and Scenic Quality:** Vegetation treatment to reduce stand densities and wildfire risk, and retain the remaining large trees and forest cover highly valued by the public and of major importance to wildlife.

* **A Sense of Forest Service Stewardship:** An aggressive shift in recreation promotion of the watershed from overnight use to day use. Heavy emphasis on providing interpretive and outdoor educational programs, utilizing Human Resource programs, and a greater Forest Service presence.

* **Recreation and Wildlife Habitat Quality:** Relocation and restoration of camping sites in undeveloped areas critical to wildlife, riparian health, and high water quality.

* **Facility Maintenance:** Riparian campground facility restoration to prevent further degradation of fragile lake chemistry (clear water), provide a quality recreation experience, and improve site damage caused by camping sites in undeveloped areas.

* **Soil Quality:** Restoration of riparian and upland soils to promote long-term productivity, vegetation diversity, and forest health.

Listed below are the high priority restoration and management oppportunities for each landscape area. Other opportunities are listed in Chapter IV and these are specific to certain areas, plant association groups, or water bodies.

Recreation/Alpine Tephra and Recreation/Riparian Landscape Areas

1. Promote day use activities throughout these landscape areas using a recreational opportunity guide which gives visitors information on what to see, where to visit, and a description of the special features to be viewed. Close overnight use in all areas along the Upper Deschutes River with the exception of Mile Camp and Deschutes Bridge.

2. Promote camping in developed sites by restoring vegetation groundcover, providing screening, improving pedestrian and vehicular circulation, and installing sanitary toilets designed for barrier-free access.

3. Develop barrier-free facilities for parking, trail access, and access to the water where feasible and appropriate.

4. Classify campgrounds by describing the allowed use in terms of appropriate vehicle type and size (motorhomes), walk-in tent camping, or car camping. An excellent example is Quinn Meadow Horse Camp.

5. Designate undeveloped camping sites in appropriate areas where conflicts with other resource values is absent and increasing use can be sustained over time. Use the Green Team program and other volunteer groups to restore and maintain undeveloped camping areas.

6. Close and restore undeveloped camping sites in areas that currently pose a significant threat to physical, biological, and social values and cannot sustain increasing use over time.

7. Close roads which provide unnecessary access to Riparian Reserves and to undesignated camping sites which have been restored.

8. Provide environmental education and interpretive programs at recreation sites which describe the roles played by the riparian ecosystem.

9. Provide an information guide for off-highway vehicles describing opportunities and closures so that unnecessary roads and closed roads do not become reopened.

10. Restore the natural flow of water to areas where surface or groundwater flow has been disrupted from channelization, ditching, or improperly functioning culverts.

11. Monitor water quality adhering to USFS Region 6 lake survey protocol every 3 to 5 years on the following water bodies: Elk, Cultus, Todd, Charlton, Irish, Taylor and Green Lakes. If water quality decreases, diagnose and remedy the water pollution source.

12. Improve forest health conditions which would enhance and support the optimal forage, long-term cover, and calving habitat required in Key Elk Areas, and support the large tree component within one mile of lakes for bald eagle and osprey.

13. Design vegetation management treatments that restore resilience to the dry lodgepole pine plant association group and the dry mixed conifer plant association group and maintains or promotes connectivity for late successional species between the Cultus LSR and the Sheridan LSR.

14. Design and implement vegetation management treatments which enhance scenic views and improve the recreation experience. Integrate treatments with roadside pullouts and interpretive information featuring riparian ecology, late-successional species and habitats, wildflower identification, noxious weeds identification, forest management practices, and natural ecosystem processes such as the role of fire and insect and disease outbreaks.

The Timber/Forest Products Landscape Area

1. In the dry mixed conifer plant association group, implement broadscale treatments (commercial thin, selective harvest) to maintain large tree structure, reduce stocking densities to promote forest health, and provide future large tree replacements. Integrate treatments to create small (1/4 to 2 acre) openings and enhance species diversity. Integrate understory treatments to maintain wildlife habitat, snags, and down woody debris. Treat stumps with borax to prevent spread of annosus root disease. Plant ponderosa pine, white pine, and douglas fir to improve species composition, increase resistance to disease, and reduce fragmentation. Introduce prescribed fire, where feasible, to promote ponderosa pine and douglas fir, and to reduce brush and competition to seedlings.

2. Design long-term logging systems dedicating areas for landings and skid trails. Use helicopter, horse and winter logging in sensitive areas.

3. Reduce road densities by installing barriers, obliteration, and rehabilitation of compacted areas. Consider a green dot road system for use during hunting season.

4. Enhance and create scenic views from the Cascade Lakes Scenic Byway and water bodies, and to and from the visible landmarks such as buttes and mountains.

5. Implement a mistletoe removal project between roads 40, 4270, 4242, and 42. Conduct intensive survey of old seed tree, shelterwood and plantations due to overstory of mistletoe. Reduce mistletoe overstory and adjacent stands on edge of plantations. Design timber sale with objective of pruning and/or removing mistletoe infected trees and except those needed for wildlife habitat, snags, and future down woody material.

The Outback Landscape Area

1. Identify riparian corridors for amphibian movements north/south and east/west along the Cascade Range. Identify lakes critical for amphibians and their movements. Decide if these areas should continue to be stocked with non-native fish species by the Oregon Department of Fish and Wildlife.

2. Develop a prescribed natural fire plan for the wilderness.

3. Establish a maximum capacity for camping in undeveloped areas at Irish, Taylor, and Charlton Lakes (and other hike-in lakes as necessary) by designating camping sites. Restore damaged shoreline areas and undesignated sites. Install toilet facilities at Charlton Lake that can be administered and maintained by the Willamette National Forest.

AQUATIC CONSERVATION STRATEGY

INTRODUCTION

The Northwest Forest Plan developed a strategy for the protection and restoration of aquatic/riparian ecosystems for Forest Service administered lands within the range of the Northern Spotted Owl. It also identified several objectives for the Aquatic Conservation Strategy. These objectives can be summarized as follows: ensure protection of aquatic systems, maintain connectivity, maintain water quality, maintain water and sediment storage and transport regimes, maintain and restore fish, wildlife, and plant populations and diversity. There are 4 components of the strategy: Riparian Reserves, Key Watersheds, Watershed Analysis, and Watershed Restoration. Of importance to note is that within the Cascade Lakes Watershed Analysis area, the Cultus subwatershed was identified as a Tier 2 Key Watershed.

Watershed Analysis is a planning tool which ensures the above objectives are considered and incorporated into all management decisions. Implementation would occur through watershed restoration and the following special standards, guidelines, and recommended Riparian Reserves. The interim Riparian Reserves as defined in the Northwest Forest Plan are shown in Exhibit 11.

RIPARIAN RESERVES

RESOURCE CONSIDERATIONS FOR SETTING RIPARIAN RESERVES

Processes which drive the dynamics of the floodplain and channel are paramount considerations for setting Riparian Reserve widths and conditions. The width of the channel and floodplain and flow regime characteristics dictate the minimum size of the trees needed to provide effective, instream wood. The presence of large woody material (LWM) within a stream channel is critical to maintaining the integrity of the system. In fact, there cannot be an overabundance of LWM. This wood plays an active role in the storage of sediment in the channel. The general rule is, the larger the tree, the more stable it will be in the floodplain, and the more stream shade it will provide while it is alive. Natural sediment storage in the uplands results from woody material that accumulates on the forest floor and impedes its movement downslope.

The floodplain vegetation is important in resisting the erosive forces of flood events. These zones are very important filters of sediment and nutrients; the thick vegetation creates an extreme roughness which inhibits water movement through and over it.

Under the Aquatic Conservation Strategy, Riparian Reserves are also used to provide habitat benefits to riparian-dependent and associated species other than fish, enhance habitat conservation for species dependent on the riparian transition zone, improve travel and dispersal

corridors for terrestrial animals and plants, and serve as connectivity corridors between Late-Successional Reserves. Riparian areas provide a moist zone within which amphibians and other wildlife species travel and reside. Ungulates use the riparian areas disproportionately more than terrestrial areas for fawning and calving. Lactating females take advantage of the improved cover and succulent vegetation. Nearly 80% of the terrestrial wildlife species are either directly or indirectly dependent upon riparian areas for meeting their habitat needs.

In the Riparian Reserves (particularly in the lodgepole pine and the mixed conifer wet plant association groups), it is desirable to maintain healthy forest stands over the long-term, while maintaining high snag densities and green tree replacements. Wildlife habitat requirements, water quality, and long-term stand health should dictate vegetation treatment needs within the Riparian Reserves. These Reserves constitute an area where higher risks are taken (including reduced fire suppression efforts) in order to allow natural processes to occur and continue without excessive human intervention.

RIPARIAN RESERVE WIDTHS AND MANAGEMENT REQUIREMENTS

The Riparian Reserves, as described in the Northwest Forest Plan and Record of Decision (ROD) have been adapted (USDA, USDI, 1994) for the Cascade Lakes Watershed. These Riparian Reserves will be managed as special management areas, utilizing the sideboards listed below in addition to the Standards and Guidelines in the ROD. Site specific conditions and mitigation will be developed in the project Environmental Assessments (EA).

Vegetation

East of the Cascades, fire plays an important role in shaping vegetation patterns across the landscape. A combination of salvage, thinnings, and fire can be used as tools to create small openings in the riparian zone. No large trees with the potential of providing shade (within the distance equal to the height of 2 site-potential trees) or LWM to the creek will be disturbed. Wildlife habitat needs will dictate the remaining condition of the patches to be created. Fuel loading in the Reserves will be greater than that in the surrounding uplands except within established facilities (campgrounds, summer home tracts, etc).

Roads, Grazing and Minerals Management

As per the ROD, site specific conditions and mitigation will be developed in project EA's. No net increase in roads will occur.

Lands, General Riparian Area Management, Watershed and Habitat Restoration, Fish and Wildlife Management and Research

As per the ROD, site specific conditions and mitigation will be developed in project EA's.

Recreation Management

New campgrounds will not be developed within the distance equal to the height of 2 site-potential trees of any water body. At existing campgrounds with sites closer than 50 feet to the water (fire ring or picnic bench), redesignation of sites falling within this setback zone will be necessary. Dispersed campgrounds will also need to conform to the setback through site designation with a limit to the numbers of camp sites allowed. Vegetative buffers will be used to contain any sediment in the wash into the water body. Avoid development or traffic in any areas lacking coarse soils.

Day use picnic sites will need to be designated with picnic table locations especially away from areas where the riparian vegetation is damaged or removed. Circulation patterns and access will need to be redirected through trail realignment or trailhead relocation, the use of different surface materials such as wood boardwalks, wood viewing platforms or hard surfaces, trail borders or boundaries using natural elements such as the surrounding fallen woody material, semi-buried stones, or native shrubs or groundcovers. Native plant species are to be 12 to 18 inches minimum height where appropriate to prevent foot traffic. Mixed tree sizes and spacing will be planted to ensure future generations of tree growth in areas of predominantly large trees. Native plant species are to be approved per site by the District Ecologist/Botanist or the Forest Botanist.

Scenic views will be strongly considered when relocating camping sites, day use picnic sites, trails, and viewpoints. Opening views, providing more sun exposure and light, and replanting damaged riparian vegetation areas will improve not only the overall scenic quality but also the recreation experience.

Fire/Fuels Management

Develop a fire management strategy for the Riparian Reserves within 5 years that will allow for fire by prescription (both natural and human caused ignitions). The intent is for heavy loading of down fuels in the Reserves to result however, some openings can be created in order to provide a diversity of habitats and to reduce encroachment of conifers in the wetlands.

The fire management strategy should allow fire to burn to and through the water influence zone. No firelines constructed with mechanized equipment should be allowed within or across riparian areas. It should also be commensurate with the surrounding vegetation zone, providing for structural diversity and where appropriate, include the three C's--confine, contain, and control.

RIPARIAN RESERVES WITHIN THE LANDSCAPE AREAS

The designated riparian widths are designed to be wide enough to maintain floodplain integrity and water quality. These widths ensure that when floods occur, there is enough room for the anticipated water to pass and to allow for sediment deposition to occur, and that there is adequate vegetation to provide long-term large woody material recruitment. Corridors for wildlife are needed which extend beyond the readily recognizable riparian/wetland vegetation.

The Recreation/Alpine Tephra Landscape Area

Mountain hemlock and lodgepole pine are the dominant species within this landscape area. Mountain hemlock occupies north slopes and higher elevations while lodgepole pine tends to occur at lower elevations. In spite of the porous volcanic soils, many spring and lake fed perennial streams occur in this area in addition to many intermittent channels fed by snow melt. This landscape area is about 60% wilderness with the rest being only lightly roaded (the main road through area is the Cascade Lakes Scenic Byway). Natural processes have prevailed across much of this landscape and vegetative manipulations have been minimal in the rest of the area.

The lands within this landscape area are identified in the Northwest Forest Plan as Congressionally Withdrawn (wilderness) and Administratively Withdrawn. Late structural stages of vegetation are emphasized however, a diversity of vegetative structure is desired. Few vegetative treatments will occur since the emphasis is to allow for natural processes and for fire and hydrologic events to continue to design the vegetative patterns on the landscape. When vegetative manipulation does take place in riparian areas, management flexibility is needed in order to maintain or achieve healthy stands.

Along many of the streams in the Recreation/Alpine Tephra Landscape Area, there is a narrow floodplain/water influence zone and the outer terrace defining the vegetation break is very close to the edge of the active channel. Channels are perennial to ephemeral in nature. Some of the channels in the wilderness area contain flowing water for only a few days each year, while others are spring fed and flow year round. There are wide zones of riparian vegetation around portions of some of the lakes (such as Sparks and Todd).

Recommended Riparian Reserve Widths

With the exception of the Todd Lake area, the recommended Riparian Reserve widths to be used in this portion of the watershed are equivalent to the greatest distance reported in the Northwest Forest Plan (minimum slope distances being: 300 feet from lakes and fish-bearing streams; 150 feet from permanently flowing nonfish-bearing streams or edge of riparian vegetation on wetlands greater than 1 acre; 100 feet from intermittent streams or wetlands less than 1 acre). Water quality, wildlife corridors, and vegetative integrity are key components controlling the management needs for these Riparian Reserves. All management activities are

commensurate with riparian goals for existing facilities and complimentary to riparian goals in the undeveloped areas.

At the west end of Todd Lake, the Todd Riparian Reserve (Figure 1) has been established to protect the steep slopes above the many springs which define the upper limits of the extensive wetlands around the western end of the lake. This Riparian Reserve extends upslope to the drainage divide surrounding the west end of the lake. Around the remainder of the lake and along Todd Creek, the standard reserve widths of the Northwest Forest Plan apply with one exception. The exception is along the section of Todd Creek between crossings of the Cascade Lakes Scenic Byway and Forest Service Road 4600-370 where the western boundary of the Riparian Reserve extends to the base of the steep slope west of Forest Service Road 4600-370.

The Recreation/Riparian Landscape Area

Lodgepole pine is the dominant species within this landscape area along with areas of mixed conifer. This landscape contains a series of large lakes with high recreational use. The Cascade Lakes Scenic Byway crosses the length of area and the relatively high road density allows access to many riparian areas.

The lands within this landscape area are identified in the Northwest Forest Plan as Late-Successional Reserve, Administratively Withdrawn, and Matrix. Late structural stages of vegetation are emphasized however, a diversity of vegetative structure is desired. Vegetative treatments will occur due to the high mortality in the lodgepole stands and the risk of catastrophic fire. When vegetative manipulation does take place in riparian areas, management flexibility is needed in order to maintain or achieve healthy stands.

Along many of the streams in the Recreation/Riparian Landscape Area, there is a narrow floodplain/water influence zone and the outer terrace defining the vegetation break is very close to the edge of the active channel. Due to the many springs and large lakes in this landscape area there are a large number of perennial channels. Some intermittent channels contain flowing water for only a few days each year, while others may flow well into the summer months. There are wide zones of riparian vegetation around portions of some of the lakes (such as Hosmer, Lava, and Crane Prairie Reservoir).

Recommended Riparian Reserve Widths

With the exception of the Crane Prairie area, the recommended Riparian Reserve widths to be used in this portion of the watershed are equivalent to the greatest distance reported in the Northwest Forest Plan (minimum slope distances being: 300 feet from lakes and fish-bearing streams; 150 feet from permanently flowing nonfish-bearing streams or edge of riparian vegetation on wetlands greater than 1 acre; 100 feet from intermittent streams or wetlands less than 1 acre). Water quality, wildlife corridors, and vegetative integrity are key components controlling the management needs for these Riparian Reserves. All management activities are

commensurate with riparian goals for existing facilities and complimentary to riparian goals in the undeveloped areas.

In the Crane Prairie area, the Riparian Reserve has been expanded around the reservoir to provide dispersal and travel corridors for terrestrial animals and plants adjacent to riparian areas and areas with relatively shallow ground water levels and to serve as a connectivity corridor between the Cultus LSR and the Sheridan LSR. Around the reservoir, the Riparian Reserve boundary has been extended to 300 feet beyond the maximum pool elevation. North of the reservoir, the Crane Riparian Reserve (Figure 2) has been established beginning with the meadows along the northeast arm of the reservoir. The expanded Riparian Reserve boundary is located 300 feet (east) beyond the edge of riparian vegetation and/or Snow Creek until Forest Service Road 4270 is reached. The boundary then goes west along Forest Service Road 4270 to the Cascade Lakes Scenic Byway at Deschutes Bridge on the Deschutes River. The boundary then follows the Cascade Lakes Scenic Byway south (or is 300 feet west of the Deschutes River, which ever is greater) until the highway and river separate in Section 16. It then goes south 300 feet west of the Deschutes River to Forest Service Road 4000-990 and again south along Forest Service Roads 4000-990 and 4000-970 and then west along Forest Service Roads 4600-620, 4600-622, 4600-626, 4635, and 4630 to Deer Creek. The boundary then returns to Crane Prairie along a line 300 feet south of Deer Creek.

The Outback Landscape Area

Mountain hemlock and lodgepole pine are the dominant species within most of this landscape area. Mountain hemlock tends to occur at higher elevations with lodgepole pine at lower elevations and within old burns in the mountain hemlock. Due to the porous volcanic soils, there is only one perennial stream. In addition, there are many small lakes and intermittent channels fed by snow melt. This landscape area is about 55% wilderness with less than 10 miles of low standard roads in the remainder of the area. Natural processes have prevailed across this landscape.

The lands within this landscape area are identified in the Northwest Forest Plan as Congressionally Withdrawn (wilderness) and Administratively Withdrawn. Late structural stages of vegetation are emphasized however, a diversity of vegetative structure is desired. Few vegetative treatments will occur since the emphasis is to allow for natural processes and for fire and hydrologic events to continue to design the vegetative patterns on the landscape. When vegetative manipulation does take place in riparian areas, management flexibility is needed in order to maintain or achieve healthy stands.

Along most of the streams in the Outback Landscape Area, there is a narrow floodplain/water influence zone and the outer terrace defining the vegetation break is very close to the edge of the active channel. With one exception, all stream channels are intermittent in nature. Some of the channels in the area contain flowing water for only a few days each year, while others may flow well into the summer months.

Recommended Riparian Reserve Widths

With the exception of the Many Lakes area, the recommended Riparian Reserve widths to be used in this portion of the watershed are equivalent to the greatest distance reported in the Northwest Forest Plan (minimum slope distances being: 300 feet from lakes and fish-bearing streams; 150 feet from permanently flowing nonfish-bearing streams or edge of riparian vegetation on wetlands greater than 1 acre; 100 feet from intermittent streams or wetlands less than 1 acre). Water quality, wildlife corridors, and vegetative integrity are key components controlling the management needs for these Riparian Reserves. All management activities are commensurate with riparian goals for existing facilities and complimentary to riparian goals in the undeveloped areas.

The Many Lakes area is a region of numerous lakes, meadows, and intermittent stream channels with a unique geologic history of volcanic and glacial interaction. Much of the area is wilderness and a part of it has been proposed as a Research Natural Area. Because of the abundance of riparian features within this area, the Many Lakes Riparian Reserve (Figure 3) was established. In general, the area lies west of Little Cultus and Deer Lakes, north of the intermittent drainage between Taylor and Little Cultus Lakes, east of the Pacific Crest Trail and south of a line between Brahma and Deer Lakes.

The Timber/Forest Products Landscape Area

Mixed conifer stands dominate much of this landscape area but areas of mountain hemlock occur at higher elevations with lodgepole pine at lower elevations. Due to the porous volcanic soils and lavas, there are no perennial streams and limited numbers of intermittent and ephemeral channels.

The lands within this landscape area are identified in the Northwest Forest Plan as mainly Matrix and Late-Successional Reserve with smaller areas of Administratively Withdrawn. Late structural stages of vegetation are emphasized however, a diversity of vegetative structure is desired. When vegetative manipulation does take place in riparian areas management flexibility is needed in order to maintain or achieve healthy stands.

Along the few stream channels in the Timber/Forest Products Landscape Area, there are narrow floodplain/water influence zone and the outer terrace defining the vegetation break is very close to the edge of the active channel, which are all intermittent and ephemeral in nature. Most channels are intermittent or ephemeral in nature, with running water rarely occurring on the surface. A few of these channels have been abused during past vegetative manipulation activities which resulted in compaction of the ground and removal of the LWM. Fortunately, sediment movement and accelerated erosion have not detrimentally affected the integrity of the channel.

Recommended Riparian Reserve Widths

The recommended Riparian Reserve widths to be used in this portion of the watershed are all equivalent to the greatest distance reported in the Northwest Forest Plan (minimum slope distances being: 300 feet from fish-bearing streams; 150 feet from the edge of riparian vegetation on wetlands greater than 1 acre; 100 feet from intermittent streams or wetlands less than 1 acre). Water quality, wildlife corridors, and vegetative integrity are key components controlling the management needs for these Riparian Reserves. Management activities occurring in this landscape area will be complimentary to riparian goals.

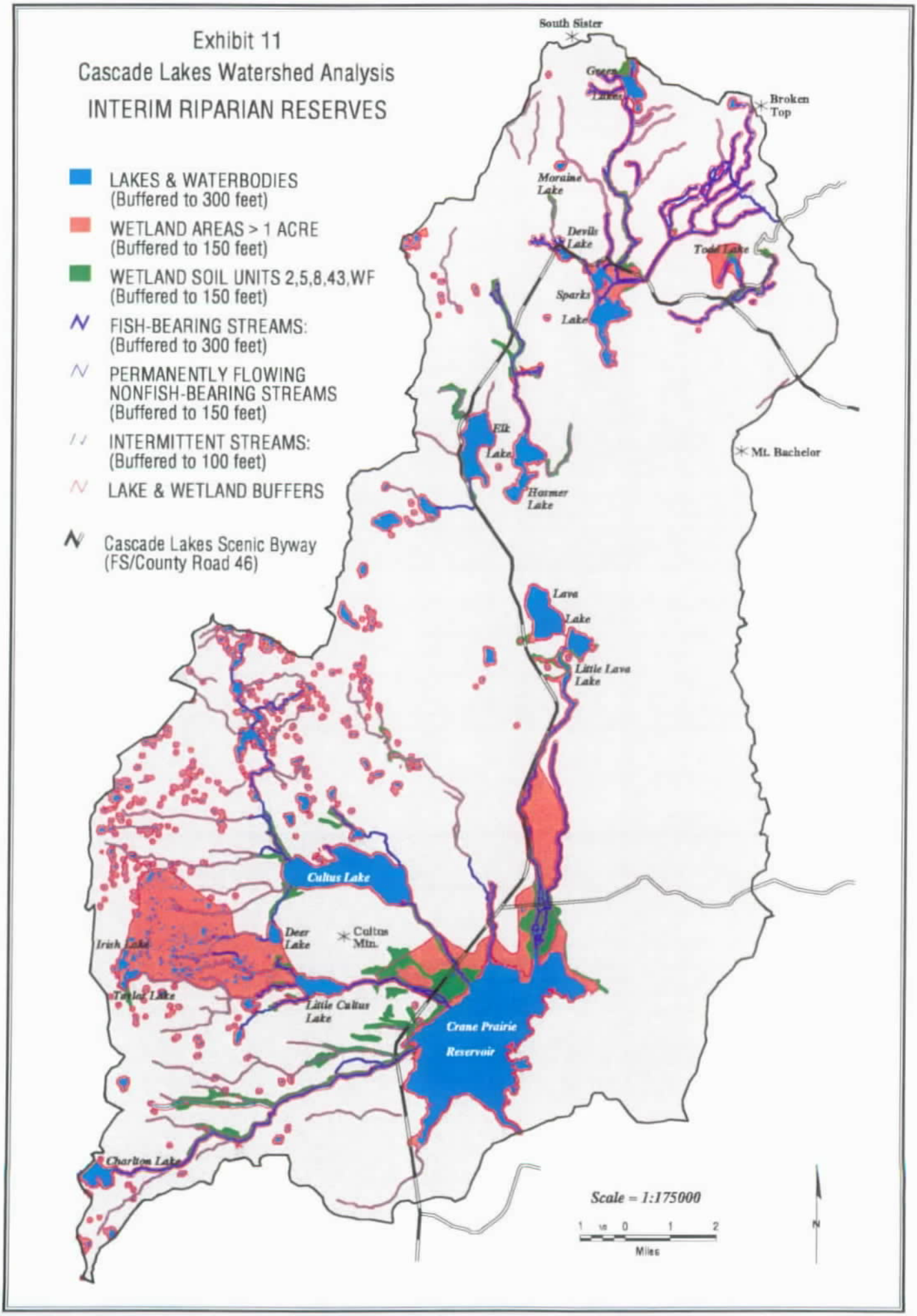


Exhibit 11
Cascade Lakes Watershed Analysis
INTERIM RIPARIAN RESERVES
LAKES & WATERBODIES
(Buffered to 300 feet)
WETLAND AREAS > 1 ACRE
(Buffered to 150 feet)
WETLAND SOIL UNITS 2,5,8,43,WF
(Buffered to 150 feet)
FISH-BEARING STREAMS:
(Buffered to 300 feet)
PERMANENTLY FLOWING
NONFISH-BEARING STREAMS
(Buffered to 150 feet)
INTERMITTENT STREAMS:
(Buffered to 100 feet)
LAKE & WETLAND BUFFERS
Cascade Lakes Scenic Byway
(FS/County Road 46)
South Sister
Broken Top
Moraine Lake
Devils Lake
Todd Lake
Sparks Lake
Elk Lake
Hosmer Lake
Mt. Bachelor
Lava Lake
Little Lava Lake
Cultus Lake
Deer Lake
Cultus Mtn.
Irish Lake
Little Cultus Lake
Crane Prairie Reservoir
Charlton Lake
Scale = 1:175000
0
1
2
Miles
N

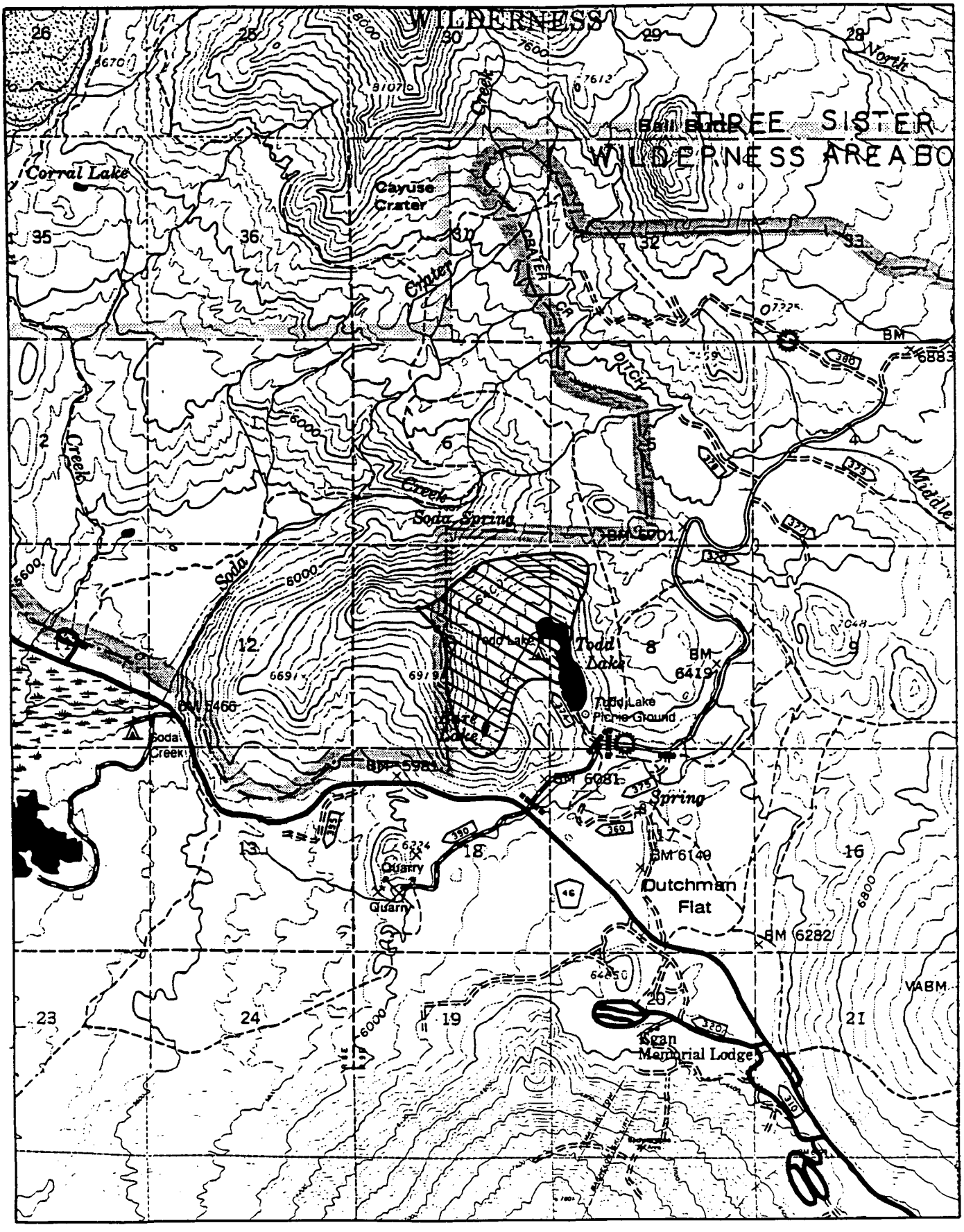


Figure 1 - Cascade Lakes Watershed Analysis - Todd Riparian Reserve

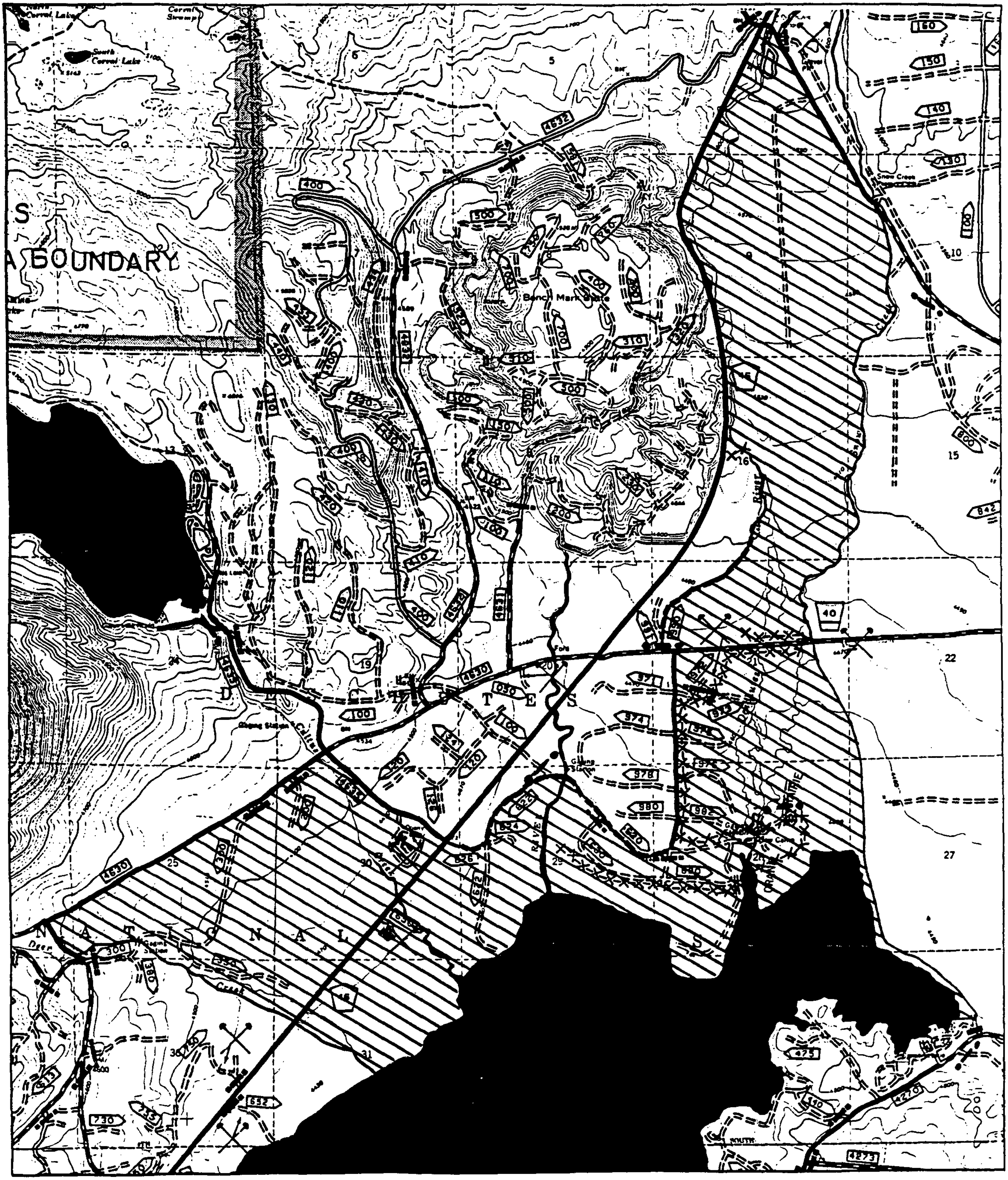


Figure 2 - Cascade Lakes Watershed Analysis - Crane Riparian Reserve

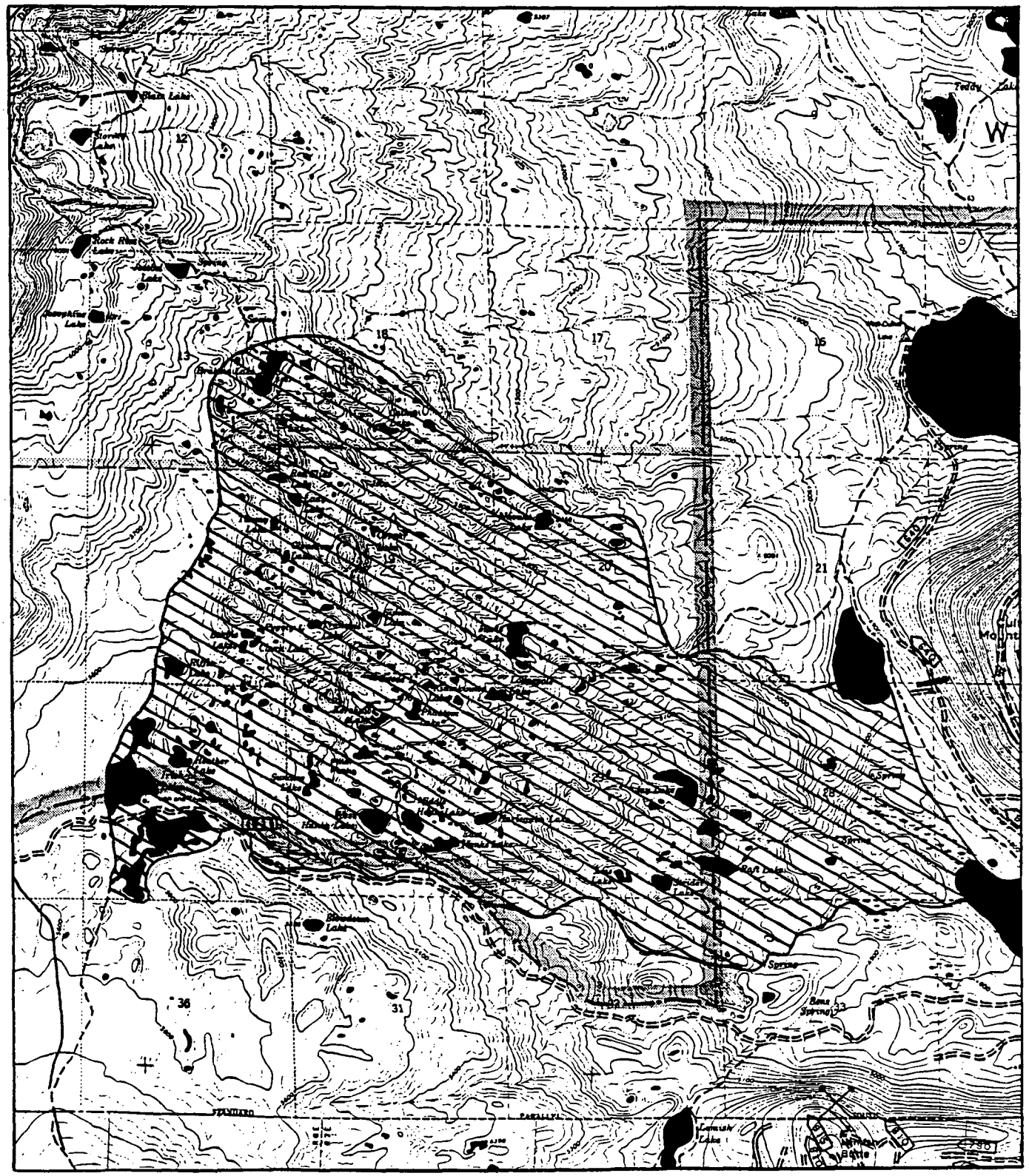


Figure 3 - Cascade Lakes Watershed Analysis - Many Lakes Riparian Reserve

DATA GAPS AND MONITORING

DATA GAPS

1. Direct measures of silvicultural stand densities (stand exams) in the Cascade Watershed Analysis area were not available. Integrated Satellite Imagery (ISAT), field reconnaissance, and aerial photo interpretation were used to estimate stand density. This method was suitable for broad scale analysis but for project level analysis, more site specific information is needed.

2. Data identifying forested areas of insect and disease activities in the Cascade Lakes Watershed Analysis area was very limited. Field reconnaissance, FPM aerial survey, and aerial photo interpretation were used to estimate insect and disease activities. For project level analysis, more site specific information is needed.

3. Patch pattern analysis was accomplished using aerial photo interpretation at a coarse, gross scale. "Fragstats" or other comprehensive analysis methods were not used. General trends were summarized for wildlife habitat analysis. More comprehensive modeling for wildlife habitat requirements are needed for project level vegetation management treatments.

4. We assumed that Historic Range of Variability (HRV) was an indicator of healthy and viable vegetation patterns. Patterns that fall outside of this HRV do not meet this definition. This may not be a completely valid assumption. There may be other patterns outside HRV that are healthy and will sustain a viable ecosystem.

5. Analysis of fragmentation in the forested areas in the Cascade Lakes Watershed Analysis area was not completed.

6. Data to estimate quantities of snags/down wood in forested areas was not available.

7. The genetic status of the redband trout is currently unknown. The Deschutes National Forest and the Oregon Department of Fish and Wildlife (ODFW) are in a Challenge Cost Share partnership program investigating the genetic identity of the redband trout in the watershed.

8. Not all lakes within the Cascade Lakes Watershed Analysis area have been recently surveyed (within the last 10 years). Lake surveys are intended to be repeated on each lake on the Forest at least once every 10 years. More recent lake survey data would provide more current data to facilitate a more thorough analysis.

9. Data identifying bacterial contamination on water bodies in the Cascade Lakes Watershed is incomplete. Testing for fecal coliform in water bodies near high recreational use areas is a way to further identify failing or insufficient septic systems or vaulted toilets.

10. Population data on amphibians and aquatic invertebrates is incomplete in the analysis area. The effects that introduced fish has on these populations in lakes lacking a natural historical presence of fish populations is not fully understood.

MONITORING

1. Monitor success of forest health treatments to restore resilience to insect, disease, and wildfire.

2. Monitor water quality in all other water bodies every 10 years at a minimum adhering to USFS Region 6 lake survey protocol.

3. Monitor the black-backed woodpecker in the dry and wet lodgepole pine plant association groups as an indication of vegetation treatment effectiveness for the maintenance and enhancement of late-successional habitat.

4. Continue northern spotted owl monitoring once every 3 years to maintain records of nesting pairs and resident singles.

5. Consult existing monitoring data for neo-tropical birds collected annually at Elk Lake (BBS breeding bird survey route). Monitor trends.

6. Consult Oregon Eagle Foundation Report for annual monitoring of bald eagles in the Central Oregon Recovery Zone. Monitor trends.

7. Monitor osprey nest sites associated with the watershed in calendar year 1996 and then annually once every 3 years for fledgling success.

8. Monitor effectiveness of road closures in bald eagle, osprey, and sandhill crane habitats of the Crane Prairie Reservoir annually.

9. Conduct initial surveys to determine the presence/absence and extent of non-native wildlife species within the watershed. Conduct 3 to 5 years of survey to obtain baseline data, then every 10 years conduct 2 years of surveys to determine the trend or invasion potential.

Chapter I
Overview and Key Issues

CHAPTER I
OVERVIEW AND KEY ISSUES

OVERVIEW

Through the Cascade Lakes Watershed Analysis, an interdisciplinary team of social, physical, and biological resource specialists have undertaken the task of gaining an understanding of the root causes of existing conditions and the interactions of human use with the ecosystems in order to determine strategies for sustaining the watershed for the future. The results of their shared perspectives are recommendations for restoration and protection efforts and proposed changes needed in behavior and management activities.

This analysis determines the current state and future trends of the watershed as compared to historic conditions, past uses such as recreation, timber harvest, and range or grazing practices, and past disturbances such as wildfire, insect and disease epidemics. The management goals and recommended opportunities are designed to prevent ecologically undesirable catastrophic events, site deterioration, and to change the course of trends which are detrimental to the sustainability of the watershed ecosystems and the quality of the social interactions with the landscape.

The Cascade Lakes Watershed is known throughout the Pacific Northwest as a special place to visit where it is possible to leave behind the turmoil and troubles of the urban world. It is one of the most scenic areas in central Oregon characterized by lakes and streams filled with clear, cool water interspersed with riparian meadows, snowcapped volcanic peaks, and diverse forest vegetation. This volcanic landscape provides sharp contrasts and harsh conditions for the alpine plant and animal ecosystems which it supports. Providing habitat for a highly diverse array of terrestrial and aquatic wildlife species, the watershed is prized for deer, elk, osprey, bald eagle, and a trophy fishery.

The watershed provides access to alpine and montane environments and is a gateway to winter and summer recreation opportunities. Although evidence of man's use of the area dates back to nearly 4,000 year ago, today's use patterns have been established during the past 150 years. Within this popular destination area are well known landmarks and places such as Mt. Bachelor, Broken Top, South Sister, Sparks Lake, Elk Lake, Crane Prairie, Cultus Lake, Lava Lakes, and the Upper Deschutes River.

CHARACTERISTICS

The geology for the watershed is less than 300,000 years old. The Mt. Bachelor chain is 20,000 years old with Mt. Bachelor being the youngest peak. The area has seen extensive volcanic activity including the eruption of Mt. Mazama 7,600 years ago which deposited

approximately one to two feet of ash over the entire watershed. Eruptions have occurred consistently every 500 to 1,000 years within the Cascade Range.

The watershed has seen periods of glacier activity including the Little Ice Age (1700's and 1800's) which formed high glacial moraines including one on Mt. Bachelor. The high lakes were formed when the glaciers retreated. Glaciated lakes such as Cultus are very clear. Springs feed many of the lakes within the watershed and also contribute to the flow of the Deschutes River. In the crest zone, many streams are intermittent due to porous soils creating underground streamflows.

An active game fish stocking program is maintained by ODFW. Fish stocking initiated over 80 years ago has increased the diversity and distribution of fish populations above that of historic conditions. The native bull trout has been eliminated from the watershed and the native redband trout may no longer be present as well.

Vegetation in the watershed consists of 7 plant association groups: dry mixed conifer, wet mixed conifer, dry lodgepole pine, wet lodgepole pine, mountain hemlock, sparsely vegetated, and meadow. All of these areas have been exposed to wildfire, insects, and disease. Fire occurrence in the watershed has been light. In the past 24 years, 17 out of 22 fires were caused by lightning. The 1994 Four Corners Fire was the largest in the history of the watershed. Due to high recreation use and increased insect and disease activity creating large concentrations of fuels, the ability to suppress and control wildfire is being lost in the wet and dry lodgepole pine areas.

The area receives heavy recreation use in both winter and summer. There are resorts at Elk Lake, Cultus Lake, Lava Lake, and Crane Prairie. There are horse camps at Quinn Meadow and Cultus Corral. There are also several developed campgrounds as well as undeveloped areas known as "dispersed recreation" areas. All the lakes and streams are used for recreational fishing and many other activities. Hiking and camping are popular in the wilderness area as well as anywhere close to riparian areas and water. Biking and sightseeing are especially popular on the Cascade Lakes Scenic Byway.

Soils in the Three Sisters Wilderness area are fragile, nutrient-poor, and subject to erosion, compaction, and low productivity. Soils in the high use riparian area are experiencing a high rate of compaction and the restorative potential for these areas is low. This compaction and trampling of vegetation in the high use areas is reducing plant diversity, structure and cover. High use also disturbs and causes loss of wildlife species.

A variety of wildlife utilizes the habitats available in the watershed. Species include deer, elk, black bear, wolverine, coyote, marten, fisher, bald eagle, osprey, goshawk, black-backed woodpeckers, other avian species, small mammals and amphibians. Historically, several species of wildlife inhabiting the watershed were hunted and trapped extensively (beaver, wolverine, marten, coyote, and deer).

KEY ISSUES

The key issues which address the main concerns within the watershed are: **1)** sustaining recreation quality and riparian health and **2)** sustaining forests that have been altered by past management practices. These issues were further developed to focus the analysis on a watershed scale in order to determine the most critical restoration management opportunities.

Issue 1. Sustaining Recreational Quality and Riparian Health

Background: High recreational demand interfaces with the riparian shorelines and streamsides of the Cascade Lakes Watershed. Patterns of recreational use are well established and demand is expected to increase. Many recreational areas are already denuded of native vegetation. Recreational facilities are deteriorating. Crowding and increasing recreational dispersed use are expanding the geographic extent of undesirable social, biological, and physical impacts. Decrease in soil quality, water pollution in high quality lakes, loss of riparian vegetation cover, diversity and structure, decrease in habitat effectiveness for wildlife, loss of aquatic species diversity, and decreasing recreational quality are among the primary undesirable impacts associated with this issue.

Key Question: What level and quality of recreational use can we maintain in riparian areas and continue to sustain biological and physical resources in the long-term?

Factors of Concern: Physical

Soils: Fragile, nutrient poor soils of the Three Sisters Wilderness Area are subject to erosion, compaction, and low productivity. Soil compaction in the high use riparian areas throughout the watershed is occurring. **Slow restorative potential in high use areas.**

Water Quality: Human waste disposal and porous soils have potential to pollute lakes and streams. **Oligotrophic, pristine lakes and streams are sensitive to water chemistry changes.**

Factors of Concern: Biological

Riparian Vegetation: Trampling of vegetation and soil compaction in high use areas reduces plant diversity, structure and cover. **Riparian function reduced.**

Riparian Wildlife Habitat: Loss and disturbance of riparian wildlife species. **Riparian function reduced.**

Aquatic Species: Stocking of non-native fish species in lakes and streams has displaced native fish and may be displacing native amphibians. **Riparian function reduced.**

Factors of Concern: Social

Recreation Experience: Crowding in the Three Sisters alpine area and in developed campgrounds of the Cascades Lakes area is changing the quality of the recreation experience. Opportunities for isolated recreational experiences are decreasing in popular areas. Overcrowding is increasing dispersed use patterns in the watershed, exacerbating riparian effects. **Recreational and riparian function reduced.**

Recreation Access: Increasing use on poorly maintained roads in fragile, erosive soils, providing access to remote areas (road from Todd Lake to Three Creeks Lakes and the road from Little Cultus Lake to Irish and Taylor Lakes) is creating resource damage and changing the quality of the dispersed recreation experience in these areas. **Demand for use exceeding carrying capacity of roads and dispersed sites.**

Issue 2. Sustaining Forests That Have Been Altered by Past Management Practices.

Background: High forest stand densities, changing species composition, soil compaction, and fragmentation of forests are a result of altered disturbance regimes (lack of fire) and resource extraction. Current vegetative conditions as a result of these management practices are unstable, less resilient to natural disturbances, and are placing valued wildlife habitats and plant and animal species at risk. Loss of soil quality, high road densities, loss of large tree structure, shift in tree species dominance from ponderosa pine to white fir, loss of forest resilience to natural disturbances (fire, insects, and disease), shift from small forest openings to large openings in the dry mixed conifer PAG, and a decrease in effectiveness of wildlife habitat for species associated with late structured forest are among the undesirable impacts associated with this issue. Loss of long-term site productivity, inability to sustain forest products over time, and wildfire hazards related to public safety are undesirable social impacts associated with this issue.

Key Question: What are the root causes of the current unstable conditions within the forested areas of the watershed and how can we best reduce risk of loss of species biodiversity, habitat functions, and long-term forest productivity?

Factors of Concern: Physical

Soils: High density roading and mechanical resource extraction has compacted soils. **Reduced long-term productivity forest vegetation.**

Resource Extraction: Resource extraction over soils perched on lava flows has created long-term soil productivity loss. **Reduced long-term productivity forest vegetation.**

Factors of Concern: Biological

Forest Structure: Past timber harvests have shifted forest structure from a large tree dominated landscape to a small tree dominated landscape. **Changed forest function.**

Forest Tree Composition: Past timber harvest and fire suppression has shifted tree species from ponderosa pine and douglas fir in the dry mixed conifer zone to true fir species. This shift has caused a decreased resistance to insect and disease outbreaks and a decrease in resistance to stand replacement fire events. **Reduced resilience to forest disturbance events.**

Forest Tree Composition: Fire suppression has changed the pattern and size of forest openings important to the establishment of early seral tree species such as: whitebark pine, ponderosa pine, western white pine. **Reduced biodiversity.**

Forest Pattern: Past timber harvest and fire suppression has changed the size and arrangement of forest openings, resulting in a higher degree of wildlife habitat fragmentation. Wildlife species dominance is shifting from specialist species to generalist species. **Changed forest habitat function.**

Fire: Past fire suppression and resource extraction patterns have changed fire regimes in the dry mixed conifer and lodgepole pine plant association groups. We are losing the capability to suppress and control wildfires in these areas. **Public safety and resource protection are diminished. Changed forest disturbance regime.**

Factors of Concern: Social

Scenic Quality: Social expectations for scenic quality may not be achievable in the mountain pine beetle infected lodgepole pine and mixed conifer stands within the watershed.

Resource Extraction: Social expectations for resource extraction may conflict with recreation social expectations and current biological conditions.

Public Safety: High recreational use interfacing with insect and disease problems pose a hazard tree risk and high fire risk. See "Fire" above.

Chapter II
Landscape Analysis and Trends

CHAPTER II
LANDSCAPE ANALYSIS AND TRENDS

PHYSICAL DOMAIN

GEOLOGY AND CLIMATE

OVERVIEW

The geology and climate of the Cascade Lakes Watershed is characterized by:

A landscape created by volcanism and glaciation.
A grouping of large lakes and many smaller lakes.
A rugged landscape of tall peaks and steep to gentle slopes.
Elevations ranging from 4,400 to 10,358 feet.
Soils derived from volcanic ash, lava, glacial till, and glacial outwash.
Precipitation ranging from about 25 to over 125 inches annually.
Annual precipitation dominated by winter snow.
Warm, dry summers.
Spring-fed streams.

ECOLOGIC SUBSECTIONS

The Cascade Lakes Watershed is part of four ecological subsections: Upper Cascades, Mt. Bachelor, La Pine Basin, and Stratovolcanoes. The Upper Cascades subsection includes the volcanic upper slopes of the Cascade Range where glaciers have left a major imprint on the shape of the land and its soils. Ground moraines and deeply eroded volcanic peaks dominate the upper regions, and glacial valleys with associated end and lateral moraines dominate the lower regions.

The Mt. Bachelor subsection includes the post-glacial volcanic cones and lava flows from the Mt. Bachelor volcanic chain which extends from Mt. Bachelor to small cinder cones on the east flank of Lookout Mountain. The land is dominated by lava flows with thin, wind deposited soils.

The La Pine Basin subsection is characterized by thick basin fills of lake and stream deposits. The La Pine Basin subsection within this watershed has been isolated from the rest of the subsection by post-glacial volcanism southeast of Crane Prairie. Typical La Pine Basin deposits north of Crane Prairie have been covered by gently sloping plains of glacial outwash.

The Stratovolcanoes subsection includes a large group of unglaciated shield and stratovolcanoes east of the Cascade crest. These volcanoes typically have relief of 1,000 to 2,500 feet and range in age from about 15,000 years to more than 800,000 years old.

Lookout Mountain, Round Mountain, and the post-glacial volcanism southeast of Crane Prairie are part of this subsection.

GEOLOGY

The Cascade Lakes Watershed is part of the volcanic Cascade Range of Oregon. This mountain range has endured a number of Ice Ages during the past 800,000 years. In the watershed, virtually all landforms, rocks, and soil are the product of volcanism and glaciation.

Most of the Cascade Lakes Watershed is probably less than 200,000 years old and consists of many overlapping shield volcanoes like Charlton Butte and Sheridan Mountain. Hundreds of these basaltic shield volcanoes have constructed the present Cascade crest and slopes. The center of each is usually a cinder cone, their slopes are lava flows, and sheets of cindery ash cover their downwind slopes and land beyond. Near the Cascade crest itself are the glacially eroded remnants of large basaltic cones (Broken Top, Sixbit Point, Elk Mountain, Irish Mountain, etc.) that once looked similar to Mt. Bachelor. The South Sister has been a major volcanic center for about 150,000 years. It has erupted a wide range of rocks including lavas, domes, and ash of basaltic to rhyolitic composition.

The Cascades have endured eight Ice Ages over the last 800,000 years. However, in central Oregon there is direct evidence for only three (450,000 years, 150,000 years, and 25,000 years ago). Within the Cascade Lakes Watershed, evidence for only the 25,000 year old glaciation exists. Each glaciation produced a major, continuous ice sheet in the Cascades from Mt. Jefferson to south of Crater Lake. The ice caps have greatly eroded the upper elevations of the Cascades and left ground moraines. By far, the greatest erosion has been done by glaciers on volcanic peaks and in the valleys below the ice cap. In the Sparks Lake area, the ice was over 1,000 feet thick and was at least 600 feet thick at Cultus Lake. Extensive ridges of moraines mark the location of the ends of glaciers during the Ice Ages. Below this elevation, lands have been buried under large fans of sand and gravel from glacial outwash.

Since the last Ice Age, volcanoes have continued to erupt on or near the Cascade crest. The eruption of the Mt. Bachelor volcanic chain began about 20,000 years ago and ended about 10,000 years ago. Eruption of the Wuksi/Shukash volcanic field southeast of Crane Prairie probably occurred during this same time span. About 7,600 years ago, the eruption of Mt. Mazama (Crater Lake) 55 to 70 miles to the south covered the entire watershed with up to 2 feet of ash and pumice. Much later, as the result of two eruptive episodes about 2,000 years ago, the northern end of the watershed was covered by more than a foot of pumice and ash. These two eruptive episodes also formed a group of 100 foot thick lava flows and domes on the south flank of the South Sister.

The generally porous and permeable volcanic and glacial rocks strongly affect how the land handles water. Large amounts of melting snow and rainfall infiltrate the ground and percolate downward to perched aquifers and to the regional aquifer. This ground water emerges from a

host of springs to feed many streams and some lakes. A great deal of ground water continues to flow eastward to feed springs and to supply water for water wells in other parts of the Deschutes River Basin. The surface flow of water via the Deschutes River represents only a small portion of the precipitation that falls within the watershed (See Appendix A-1, Geology and Climate).

CLIMATE

The climate is in general characterized by a precipitation gradient from west to east. Along the Cascade crest, annual precipitation ranges from about 75 inches in the southern part of the watershed to over 125 inches near South Sister. The lowest precipitation occurs in the southeastern part where about 25 inches falls annually. This gradient is due to masses of moist marine air from the Pacific Ocean that flow eastward over Oregon. The air masses rise, cool, and lose most of their moisture as they pass over the Cascades. Immediately east, annual precipitation decreases to less than 20 inches.

About two-thirds of the annual precipitation falls between October and March. Winter storms bring heavy snowfalls to much of the watershed. A secondary peak of precipitation generally occurs in May and June due to thunderstorms and upper level low pressure systems. Winter low temperatures are typically in the teens and low twenties while summer high temperatures rise into the eighties and nineties. Daytime humidity is generally low in the summer and fall.

The climate includes abundant sunshine and extremes of temperature and precipitation. Winters are long and relatively cold with considerable cloudiness. Occasionally, Arctic air from Canada flows through the area and causes temperatures to drop well below zero degrees. Summer days are usually warm with cool nights and low rainfall. Moist subtropical air often brings thunderstorms and localized heavy rains.

The Cascade Lakes Watershed has recently emerged from the Little Ice Age, a climate somewhat cooler and wetter than today. Between 1600 A.D. and 1900 A.D., glaciers extended down the slopes of mountain peaks considerably farther in the central Oregon Cascades. Between 1920 and 1980, all glaciers retreated greatly. Whether or not this retreat will continue is unknown. The climate-driven ecologic zones in the Cascades have likely all moved upslope somewhat since about 1920 to accommodate a warmer and drier climate.

THE SOIL RESOURCE

OVERVIEW

Soil development in the Cascade Lakes Watershed has been influenced by five primary parent materials located on a variety of volcanic or glacial landforms. The parent materials include, individually or in combination, glacial outwash, glacial till, igneous basaltic lava, gravel sized pumice tephra, and fine ash and sand sized pumice tephra. Pumice and ash tephras were expelled from Mt. Mazama approximately 7,600 years ago and the Devils Hill and Rock Mesa complex approximately 2,100 years ago.

Landscape position and surrounding landforms within the Cascade Lakes Watershed have also influenced soil development and vegetative growth. The watershed is an upper end extension of the La Pine Basin, a large drainage basin that functions as a cold air sink throughout the year. The eastern edge is bounded by the volcanic formations of the Mt. Bachelor chain that have created a barrier to the eastward flow of lower level air. The high peaks of South Sister and Broken Top border the northern end and a moderate elevation Cascade crest creates the western boundary. These features combine to trap air flowing in from the west and force it to drain south toward the heart of the La Pine Basin. As a result, morning surface temperatures are often below freezing, even during the summer months.

Cold mornings, cryic soil temperature regimes (mean annual temperture between 32 and 46 degrees Fahrenheit), shallow and undeveloped profiles and extreme daily fluctuations in temperature combine to create a shortened growing season and marginally productive soils. This is offset only slightly by a moderately high annual precipitation level of 35 to 75 inches in the majority of the watershed and up to 125 inches annually in the northern portion. Precipitation falls primarily as snow, with occasional spring, summer, and late fall rains. The importance of canopy cover, surface organic matter, and coarse wood is heightened to maintain the productivity and offset the limited resiliency of the soils present.

Five broad soil type groups are classified within the watershed. These groupings reflect differences in soil characteristics and response to management and vegetation types. The following lists contain, in parenthesis, the primary Soil Resource Inventory mapping units found for each type group.

Soil Type Groups:

1) Wet/Riparian (2, 5, 8, WF and XH)

   a) High seasonal or year round water table.

b) Primarily drainage bottoms and wet meadows.

c) Support diverse types of vegetation (forbs/grasses, trees, shrubs).

d) Variable textures and rock fragment amounts.

2) Upland moderate elevation (67, 70, GK)

a) Moderate depths of coarse textured Mazama tephra and/or residual soils over glacial till, glacial outwash and/or basaltic lavas.

b) Elevation below 6,000 ft/cryic soil temperatures.

c) Moderate productivity (site class 4 and 5).

3) Forested Lava (11, 14, 65, 74, 76 and LM)

a) Thin layers of Mazama tephra and/or thin residual soils on lava.

b) Matrix of soil accumulations supporting vegetative growth and rock outcrops.

c) Moderate productivity with limitations on reforestation.

4) Alpine Upland (16, 85, MC, HG)

a) Moderate depths of Mazama pumice and ash.

b) Elevation above 6,000 ft/cryic soil temperatures.

c) Marginal site productivity.

d) Deep seasonal snowpack.

5) Coarse Pumice Tephra (13, 17 and HF)

a) Marginally weathered (2,100 years old) with fewer mineralized nutrients.

b) Low available water holding capacity.

c) Marginally low productivity.

d) Generally above 5,000 ft./cryic soil temperatures

e) Deep seasonal snowpack.

These five major soil type groups correlate roughly with the four landscape areas within the watershed identified by the team.

HISTORIC CONDITION

The Recreation/Alpine Tephra Landscape Area

The Recreation/Alpine Tephra Landscape Area contains extensive areas of gravel sized pumice tephra from the Devils Hill and Rock Mesa events. There are also areas of exposed volcanic rock, moderate accumulations of Mazama tephra, and riparian meadow soils. Soils were historically low in organic matter content and available water holding capacity. Surface accumulations of litter and duff were common under the mountain hemlock plant association groups with lesser amounts in the lodgepole and higher elevation meadow areas. The meadows at Sparks Lake and along Todd Creek accumulated and incorporated higher amounts of organic matter into the soil profile. Overall soil quality outside the meadow areas was very low to low as a result of the gravel sized pumice substrates and a sub-alpine growing season limited by cold temperatures and deep snowpacks. Approximately 96% of the landscape area was found to have inherently low soil quality with 2% in the high category and 2% in surface water.

The Outback Landscape Area

The Outback Landscape Area contains primarily alpine upland soils interspersed with small amounts of riparian, forested lava and upland soils. The soils historically had very occasional disturbance from lightning started fires which combined with low decomposition rates to allow for moderate accumulations of litter and duff on the soil surface.

Soils consist of moderate depths of pumice and ash from Mt. Mazama over glacial till or basaltic lavas. The sand sized grains of these soils provided a moderate available water holding capacity due to the many vessicles within the grains themselves. Organic matter content within the soil profile was historically low due to the young age of these soils and the relatively low decomposition rates. Overall soil quality was low to moderate with the sand sized pumice and ash from Mt. Mazama providing a slightly higher quality than the coarse pumice soils of the Recreation/Alpine Tephra Landscape Area. Approximately 93% of the landscape area had inherently low soil quality with 3% in the moderate class, 2% in the high class, and 2% in surface water.

The Recreation/Riparian Landscape Area

The Recreation/Riparian Landscape Area contains primarily upland and riparian soil types underlain by glacial outwash and/or glacial till. These subsurface layers are relatively impermeable to water and create lateral subsurface water flows that feed the lakes, streams, and aquifers of this landscape area. Ash and pumice from Mt. Mazama is the primary material source of the upper soil horizons.

The upland soils historically contained slightly higher amounts of organic matter in the profile than the surrounding alpine upland soils due to the higher amounts of vegetative biomass produced. Fire events were also an occasional disturbance factor in these soils that moderated accumulations of litter and duff on the surface. Available water holding capacity and overall soil quality was moderate.

This landscape area contains the greatest extent of riparian meadow soil types of the four landscape areas. These soils have a comparatively high organic matter content due to the high amounts of graminoid and forb biomass produced annually on these sites. Historic fire intervals in these systems is not clear, although the lack of burned material in soil profiles and relatively wet hydrologic regimes support a limited occurrence of these events. Overall soil quality of the soils ranged from low to high with 16% low, 34% moderate, 27% high, and 23% surface water.

The Timber/Forest Products Landscape Area

The Timber/Forest Products Landscape Area contains primarily upland and forested lava soil types. The upland soils historically had regular disturbance from fire that created low to moderate accumulations of surface organics. Litter and duff that did accumulate was stratified at the top of the soil profile with minimal mixing into the mineral soil. Organic matter content in the profile was also low to moderate. The historic levels of surface and profile organic content varied by aspect with northerly and easterly aspects accumulating higher amounts. This is generally reflected in the depths of the A horizons that have developed in these soils with depths up to five inches on northern aspects and as little as one half inch on some southern aspects.

Soils had a moderate level of available water holding capacity as a result of the pumice and ash content from Mt. Mazama and a moderate to high level of productivity due to moderately deep soil depths and moderate precipitation levels. Overall quality of these soils was moderate to high.

The forested lava soil types had a less regular disturbance from fire and accumulated higher amounts of surface organics. Extreme variability in profile depth existed across these areas. Areas of soil accumulation had moderate levels of organic matter content that, along with small pores in the lava rock within reach of plant roots, improved the

available water holding capacity and allowed for vegetative growth. Overall soil quality in areas of accumulation over a foot in depth was moderate, with shallower profiles having a low soil quality. Inherent soil quality was calculated to have been 16% in the low category, 38% in the moderate, and 46% in the high.

CURRENT CONDITION

Managed activities including summer home and resort recreation, camping in developed and undeveloped areas, day use trail activities, timber harvest, and fuels piling have all influenced the current condition of soils.

Recreation patterns have occurred since the early 1900's as residents of the Willamette Valley began to travel to summer homes and resorts adjacent to lakes. The location of these homes and resorts were generally the same as that of previous camping sites established by native use, which has focused human recreational activities and their associated impacts to the soil resource around the primary water bodies.

Concentrated timber harvest and fuel reduction activities began in the 1950's and have been concentrated in the southern and southeastern sections of the watershed. Harvest and piling systems used ground based machinery due to the gentle topography.

The Recreation/Alpine Tephra Landscape Area

The Recreation/Alpine Tephra Landscape Area has been managed for year round recreation in wilderness, developed, and undeveloped settings. Soils have incurred compaction impacts from a variety of recreational uses associated with trails and access to riparian areas. When analysed on a percentage basis, approximately 2% of this landscape area has been detrimentally impacted with 96% of the landscape area currently having soils in condition class A, 2% in surface water, and 2% in condition classes C or D.

The primary areas of impact are along the Fall Creek trail, Green and Moraine Lakes in the Three Sisters Wilderness, and Todd Lake; Forest Road 370 and some associated spurs; camping in undeveloped areas off of the Cascade Lakes Scenic Byway near Sparks, Devils, and Todd lakes; and the slopes of the developed ski area on Mt. Bachelor.

The primary area of displacement within the watershed are the developed ski slopes of Mt. Bachelor. Management practices have included summertime ground based logging, removal of stumps, rocks and coarse wood from the cleared runs, and fine grading of the runs with heavy machinery. These practices have removed the historic litter and duff layer creating unstable soil conditions resulting in rill and gully erosion. Annual grading is used to fill and smooth rills and gullies formed by melting snow water and summer rain events.Revegetative efforts to stabilize these slopes have had mixed results due to redistribution of percolation patterns brought on by nudification of surface drainage

patterns, the loss of the soil A horizon, and high elevation weather. The agency has just approved an expansion project that will build another chairlift and clear 80 acres of additional runs within this landscape area.

The Outback Landscape Area

Current management is addresssing impacts from recreational use in the wilderness by designating camping sites at Moraine and Green Lakes and by promoting an outreach/education program to inform the public about user impacts. Revegetation of impacted areas has not been attempted and would be difficult to accomplish due to the limited growing season and coarse textured soils.

The Outback Landscape Area has also been managed as a recreational area that combines wilderness, roadless, and mixed trail uses. Overall, less than 1% has incurred detrimental impacts to the soil resource. These are concentrated in the riparian/upland interface areas surrounding lakes and streams. Approximately 97% of the landscape area is in condition class A with the remaining 2% of the area in surface water.

Soils have incurred impacts from recreational uses that include camping, hiking, mountain biking, horseback riding, and motorized off-road vehicles. The wilderness portion is less intensively used than that in the Recreation/Alpine Tephra Landscape Area, although use and its associated impacts to the soil resource are present. The non-wilderness areas surrounding Charlton and Irish/Taylor lakes have incurred impacts from camping in undeveloped areas, shoreline recreation, and motorized recreational vehicles. Sanitary disposal of human waste is not occurring in these areas.

The Recreation/Riparian Landscape Area

The Recreation/Riparian Landscape Area has received the highest amount of recreational impact of the four landscape areas. Overall, approximately 20% is currently in detrimental soil classes C and D with the impacts spread between riparian and upland soils. Approximately 52% of the area was found to be in condition class A, 4% in class B, and the remaining 24% in surface water.

Road densities were found to be relatively low, with paved, cindered and natural surface road densities calculated to be 0.60, 0.41, and 2.0 miles of road per square mile respectively.

There are numerous streams and water bodies used by wildlife and recreationists. Summer resorts, developed and undeveloped campgrounds, and designated use trails are located primarily adjacent to lake, reservoir,and river frontage that has been heavily impacted from recreational use over the past 70 years. Soils are compacted from trampling and camping use.

Two grazing allotments have incurred some impacts on the soil resource. Both have been grazed since the early 1900's and have slight increases in compaction levels, channelized streams, and altered hydrologic cycles. Overall soil quality has been reduced slightly from these impacts.

There are also lands currently proposed for harvest activities. The majority of these activity areas are located on upland soils although some management has occurred in the past along Snow Creek, the Deschutes River, and Crane Prairie Reservoir. Soils in areas with managed harvest activities have resulting impacts from machine harvest and piling activities.

Surface organic litter and duff has been displaced and mixed in the profile. Forest monitoring has shown that compaction has occurred on upwards of 30 to 40% of individual units harvested with ground based equipment. The majority of the riparian soil types have not had commercial harvest activity within them.

The 1994 Four Corners Fire primarily burned through a lodgepole dry plant community on upland soils. The soil was impacted to varying degrees over approximately 1,000 acres. Litter and duff was removed across 50% of the burned area, while only 9% of the soils were discolored from the fire. The burned area is currently proposed for salvage activity over snow or frozen ground with a portion to be left to recover on its own.

The Timber/Forest Products Landscape Area

The Timber/Forest Products Landscape Area has had the heaviest impacts to the soil resource, primarily from harvest and fuel management activities. A large percentage has been covered by machine traffic with much of it entered at least twice. Approximately 62% currently has soils in detrimental condition classes C or D with 14% in class B and 23% in class A.

The majority of harvest activity has occurred in the last twenty years utilizing harvest prescriptions ranging from clearcuts to selective thinning. Impacts to the soil resource are primarily expressed in higher levels of compaction as well as displacement and mixing of the surface organics and soil A horizon.

Road densities, which are the highest of the four landscape areas at approximately 4.99 miles per square mile, reflect the intensive harvest activity that has occurred over the last 40 years. The road density includes 0.12, 0.77, and 4.1 miles of paved, cindered, and natural surface roads per square mile.

The forested lava soil areas have incurred a variety of harvest activities on 84% of the 13,364 acres present in this landscape area and/or subsoiling operations are severely limited or impossible due to the extremely shallow soil depths.

RESOURCE TRENDS

The trends for the soil resource are primarily in response to vegetative management and recreational activities.

The Recreation/AlpineTephra Landscape Area

The Recreation/Alpine Tephra Landscape Area has a continuing trend of compacted and displaced soils associated with recreational uses. Increasing numbers of recreationists seeking to camp and use trails in the area continue to compact and displace soils adjacent to riparian, road, and trail corridors. Visible damages to the resources are being perpetuated by continued intensive use.

The developed ski area on Mt. Bachelor has been approved for expansion. This includes building a ski lift and clearing 80 acres of additional ski runs in the forested area on the northwest side of the mountain. Operations will include summertime logging using ground based machinery.

The impacts being incurred on areas containing coarse pumice tephra are primarily expressed in vegetative loss and displacement of the minimal organic litter and A horizons that were historically present. Some compaction is also occurring as a result of trampling. Soil quality is being moved from an inherently low soil quality toward a very low existing soil quality with these losses. The resiliency of these soils to the loss of these organic and mineral components is very low due to the subalpine climate and low organic input and decomposition rate in these systems. Current impact trends in the Three Sisters Wilderness are being addressed by designating camping sites around Green and Moraine Lakes to limit the extent of these impacts.

Similar impacts are continuing to occur on the sandy loam texture soils developing in ash and pumice tephra from Mt. Mazama. Areas around Todd Lake and the Big Meadow ski and snowmobile trail systems are incurring trampling and displacement from summer recreational uses. These soils are slightly more resilient to the loss of organic components but are less resilient to compaction.

The meadow areas around Sparks Lake and Todd Creek appear to be maintaining healthy soil conditions due to vegetative growth and the removal of grazing. Some impacts from recreation traffic and camping are becoming more apparent.

Infrequent fire occurrence and continued suppression has allowed for organic litter and duff accumulation under the mountain hemlock, lodgepole wet and mixed conifer wet plant association groups. Coarse wood is present on the soil surface throughout these plant association groups as a result of these trends. Overall accumulations of these materials in the mountain hemlock plant association group appear to be within natural

levels due to the 60 to 80 year fire intervals and the historically small, patch size character of fires in these stands. The lodgepole wet and mixed conifer wet plant association groups may have elevated levels of organic matter build up due to the slightly higher return frequency of 20 to 30 years (up to 60 to 80 years in some stands) of these plant association groups.

The Outback Landscape Area

The Outback Landscape Area is also experiencing a trend of compacted and displaced soils associated with recreational uses. Wilderness lakes have enlargening areas of devegetated and compacted soils. The Charlton and Irish/Taylor lake areas have increasing impacts from dispersed recreation activities such as camping, hiking, biking and off-highway motorized vehicles. Sanitation problems have been identified due to the increasing use and the lack of proper non-toilet area waste disposal practices.

Fire suppression has also allowed for continued accumulation of litter and duff in the forest types. Coarse wood levels on the ground also continue to increase. These accumulations are currently pushing the upper end of natural levels across this landscape area.

Overall soil quality remains low with concentrated areas of impact reducing this quality near water bodies and along road and trail corridors. The climatic factors influencing the resiliency of these soils are similar to the Recreation/Alpine Tephra Landscape Area although the deeper profiles and older age of the sand sized Mazama parent material allow these soils to be slightly more resilient than the gravel sized pumice tephra found here.

The Recreation/Riparian Landscape Area

The Recreation/Riparian Landscape Area has a trend of continued hardening and erosion of soils from recreational activities along water bodies and travel corridors. Soil quality has been diminished due to physical trampling and subsequent erosion from campers, hikers, bikers and off-highway motorized vehicles. Recreational related traffic continues to increase and will continue to impact the soil resource in areas surrounding campgrounds, day use trails, and water bodies.

There are also areas that have had their soil quality decreased from past harvest activities. The inherent soil quality of 3,392 acres has been reduced to a lower existing quality class, including 2,508 acres reduced from the high category and 934 acres reduced from the moderate category.

Harvest activities are currently proposed to address insect and disease issues primarily in areas adjacent to or within riparian soils, many of which have had little or no activities on them in the past. Logging systems are trending toward winter logging, boom mounted

machinery or hand felling and cable yarding in these types of areas to lower the impacts to the soil resource.

The Timber/Forest Products Landscape Area

The Timber/Forest Products Landscape Area has a trend toward declining soil quality. This landscape area has received the most harvest activity of the entire watershed and the soils have incurred the greatest impact. Harvest activities continue to utilize ground based equipment that physically impact the soil resource over 20 to 30% of an individual harvest unit. Agency efforts have reduced the extent of these impacts over the last five years from levels that impacted in excess of 30 to 40% of a unit area.

Impacts to the soil resource are in the form of compaction of the soil profile, as well as displacement and mixing of surface organic cover and the soil A horizon. Coarse wood levels left behind on many sites are minimal and reduce the sites ability to retain moisture, provide long-term nutrient input and ameliorate temperature fluctuations.

Approximately 76% of the Timber/Forest Products Landscape Area has been entered at least once, with much of it entered multiple times. The inherent soil quality of 9,275 acres has been reduced from management activities, with 9,185 acres reduced from the high category to either moderate or low.

RESTORATION PRIORITIES

Soil restoration priorities were developed in this analysis by identifying changes incurred on inherent soil quality by management activities. The inherent soil quality layer (See Exhibit 12) was developed using soil profile characteristics and site productivity figures for a given soil type. An existing soil quality layer (See Exhibit 13) was generated by overlaying the inherent soil quality layer with a soil condition class layer (See Exhibit 14) compiled from a past activity data base, photo interpretation, and ground truthing. Areas changing from high soil quality to moderate or low were given the highest priority for restoration. Areas changing from moderate to low, or low to very low, follow in succession.

The process described above captured primarily soil areas that were degradated by harvest and/or fuel piling activities. Riparian and adjacent upland areas impacted from recreational traffic were not all captured or given priorities reflective of the impacts currently present on the ground. Many of these areas are associated with lakes given critical restoration priorities and undeveloped camping sites along the Deschutes River and around Crane Prairie. While these areas were not identified graphically in Exhibit 8, they have been identified by the team and are described in Chapter III.

The Recreation/Alpine Tephra Landscape Area

In the Recreation/Alpine Tephra Landscape Area, the areas along the Fall Creek trail and around Moraine, Sparks, Todd, and Green Lakes were identified by the team as needing revegetation and soil restoration work. Forest Road 370 and adjacent meadow areas were also identified as needing drainage maintenance or barrier installation to limit automobile encroachment. Soils on the developed slopes of Mt. Bachelor were field identified as having degraded soil quality due to the removal of tree stumps, rocks, coarse wood, and organic litter and duff. Revegetation efforts have been quite variable across the area.

An 8 acre area surrounding the Green Lakes trailhead was identified as having a #2 restoration priority. While this is associated with a short stretch of Fall Creek identified by the Fisheries Biologist as needing bank stabilization, it is a developed trailhead committed to parking and access purposes.

The remaining 30,419 acres or 98% was identified as restoration priority #4. Impacts to the soils are relatively low due to the recreational management allocations. The remaining areas contain surface water.

The Outback Landscape Area

The majority of this landscape area has had little or no impacts to the soil resource. Impacts incurred by recreational traffic are associated with trails and lake areas in the Three Sisters Wilderness and the southern most roadless area. Charlton, Irish and Taylor Lakes were identified as areas needing designated camping sites and rehabilitation of areas adjacent to or on riparian soils. An area of approximately 3 acres just north of Wire Meadow was identified as restoration priority #2. Approximately 1,953 acres, located in various areas of past activities along the eastern edge were identified as restoration priority #3. The remaining 95% of the landscape area (60,304 acres) was identified as restoration priority #4.

The Recreation/Riparian Landscape Area

Riparian and adjacent upland areas associated with campgrounds were identified as having incurred compaction impacts to soils and loss of vegetation. Areas along the Deschutes River, around Crane Prairie and near Lava and Little Lava Lakes were identified as needing campsite designation, road closure and rehabilitation of impacted areas proposed for closure.

Approximately 2% of this landscape area (647 acres) was identified as restoration priority #1. These acres are located in various harvest units along the southwestern shore of Crane Prairie on soil type GK and north of Crane Prairie on soil type XH.

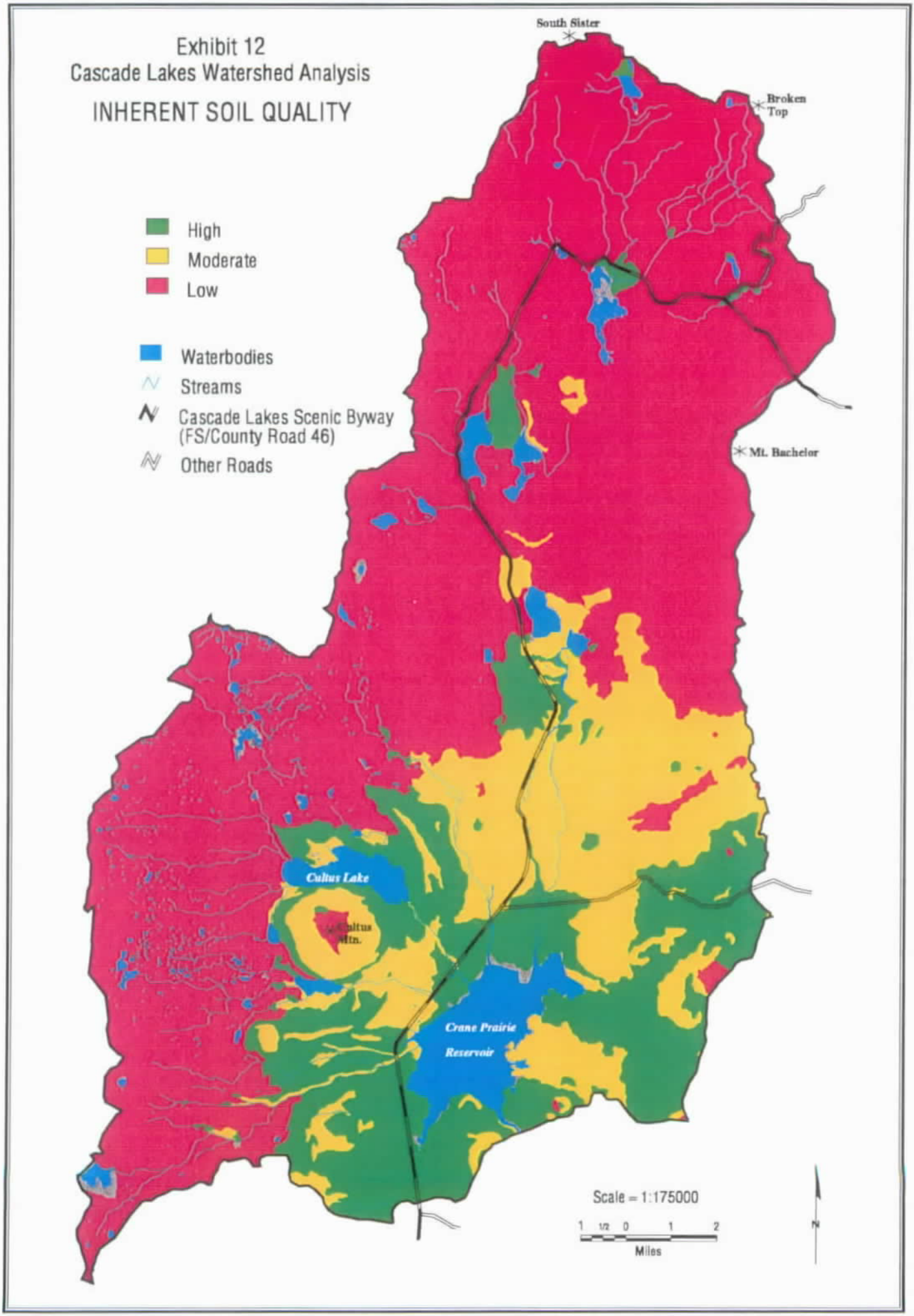


Exhibit 12
Cascade Lakes Watershed Analysis
INHERENT SOIL QUALITY
High
Moderate
Low
Waterbodies
Streams
Cascade Lakes Scenic Byway
(FS/County Road 46)
Other Roads
South Sister
Broken Top
Mt. Bachelor
Cultus Lake
Cultus Mtn.
Crane Prairie Reservoir
Scale = 1:175000
1 1/2 0 1 2
Miles
N

Exhibit 13

Cascade Lakes Watershed Analysis

EXISTING SOIL QUALITY

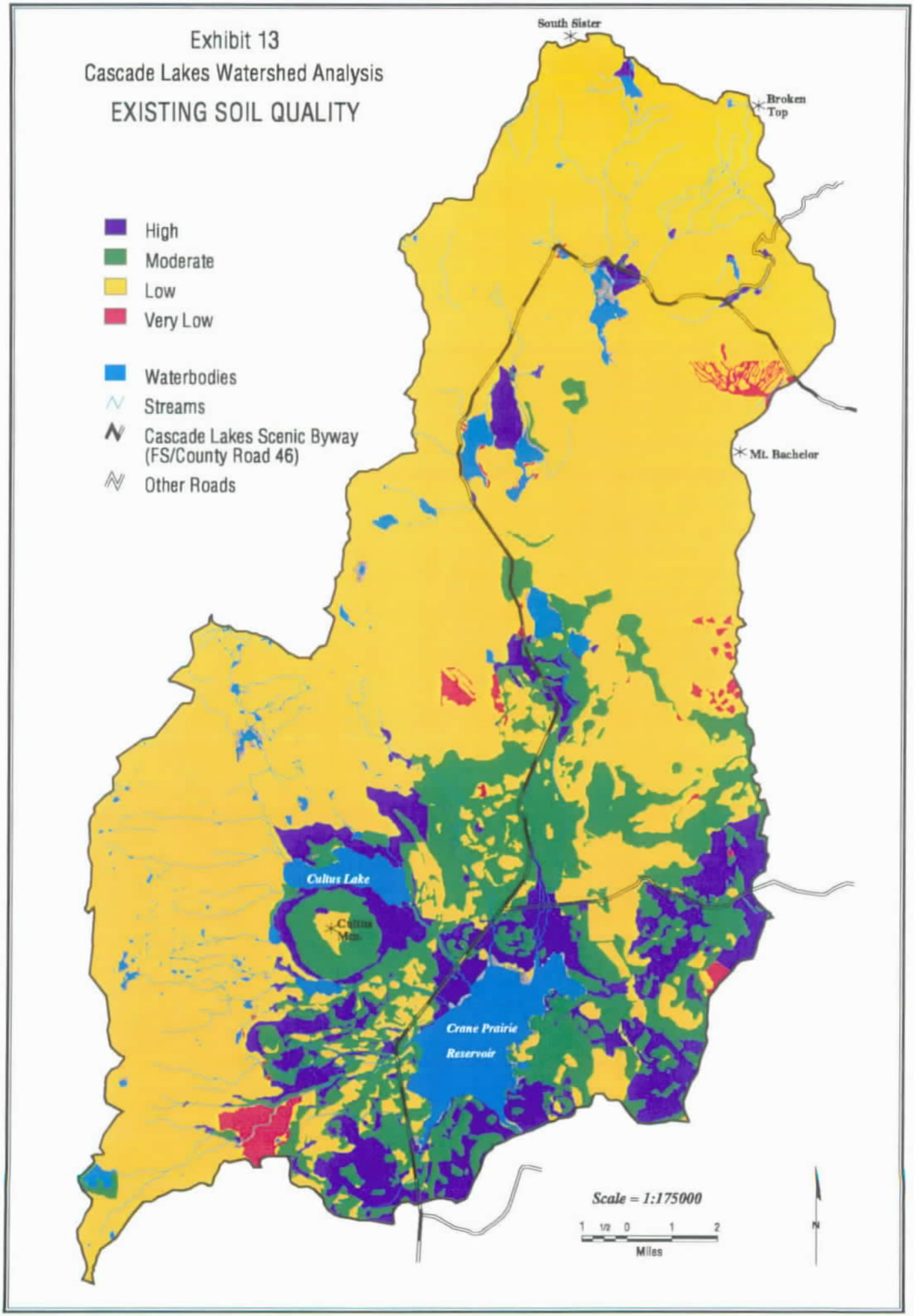
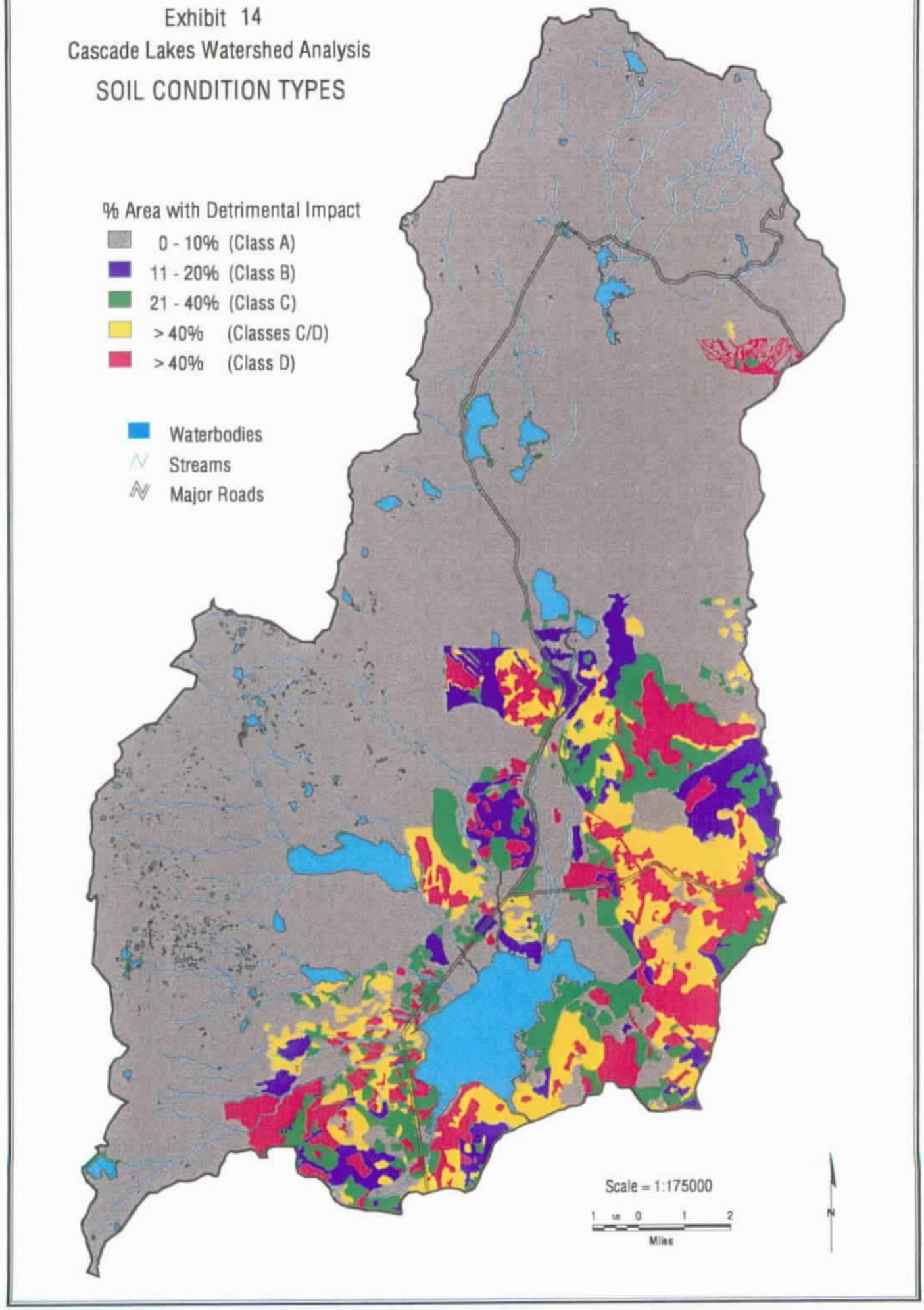


Exhibit 14

Cascade Lakes Watershed Analysis

SOIL CONDITION TYPES



Approximately 6% (1,861 acres) was identified as restoration priority #2. The majority of these acres are also in harvest units southwest and north of Crane Prairie.

Approximately 34% (10,549 acres) was identified as restoration priority #3 and 35% (10,797 acres) was identified as restoration priority #4. The remaining 23% of the landscape area contains surface water.

The Timber/Forest Products Landscape Area

Approximately 5% (1,873 acres) of this landscape area was identified as restoration priority #1. These areas are located in harvest units that are primarily on soil types 25, 70, 82 and GK.

Approximately 18% (7,516 acres) was identified as restoration priority #2, again located in harvest units throughout the area. Soils in these areas have incurred slightly less damage than the priority #1 areas due to greater resiliency to machine impacts or fewer impacts incurred from past machine harvests.

Of the remaining acreage, 38% (15,421 acres) was identified as restoration priority #3 and 39% (15,770 acres) was identified as restoration priority #4. The majority of the forested lava acres fall into these two categories and cannot be rehabilitated with a subsoiler due to the shallow depths to bedrock. Though this is the case, it should be noted that many of these acres fall within the dry mixed conifer plant association group that has been identified as needing vegetative management. While the soil rehabilitation limitations should not prevent entry into these areas, the methods used for thinning should take this into account.

WATER RESOURCES

OVERVIEW

The Cascade Lakes Watershed includes over 100 lakes and ponds, one reservoir, 19 named streams, and many other unnamed springs, seeps, and intermittent channels. The watershed contains a significant portion of the surface water resources found on the Bend Ranger District (See Exhibit 15). There is an abundance of spring complexes that form cool, clear streams. The porous soils, composed of glacial till or of volcanic origins, absorbs and transfers precipitation subsurface (snow melt and rainwater) providing for extensive ground water exchange. The surface flow out of the watershed at Crane Prairie Dam represents only a portion of the precipitation that falls within the basin. Due to the spring-fed nature, most of the streams exhibit very stable flow regimes throughout the year.

Precipitation from the high country in the Cascades (over 10,000 feet elevation) forms streams or becomes groundwater that descends south or east within the watershed with the decline in elevation toward Crane Prairie Reservoir (elevation 4,445 feet).

The natural lakes were formed predominantly by glacial scouring or lava flows blocking streams. The trophic status of the lakes are predominantly oligotrophic, with several in the mesotrophic range, while few are eutrophic. Oligotrophic lakes, being low in nutrients, ionic concentrations, and high in transparency, are susceptible to changes in water chemistry and biological productivity from recreational pressure. Although several lakes receive heavy recreational pressure, water testing has not detected a degradation to lake water quality from recreational activity, with the exception of Elk Lake, where there is evidence of bacterial contamination attributed to failing septic systems. The factors that protect the water quality of the lakes is the high elevation that retards biological growth, the flushing effect of inlet and outlet streams, and the porous lake bottoms that allow for rapid exchange of the water volume.

Most of the lakes have a low buffering capacity to acid deposition, the potential source being acid rain. The Deschutes National Forest is in the initial stages of lake water quality monitoring, in part to track changes that may be attributable to acid deposition.

Many stream reaches are largely unaltered from historic conditions. Some reaches have been affected in the last 100 years by natural causes, grazing, mechanical channelization, timber harvest, irrigation withdrawals, recreational activity, road and trail construction, and the Crane Prairie Reservoir impoundment.

A common threat to the water quality appears to be sewage input from intense dispersed camping, failing vaulted toilets, and inadequate or failing septic systems. Riparian areas trampled by recreational users contributes towards introducing additional fine sediments

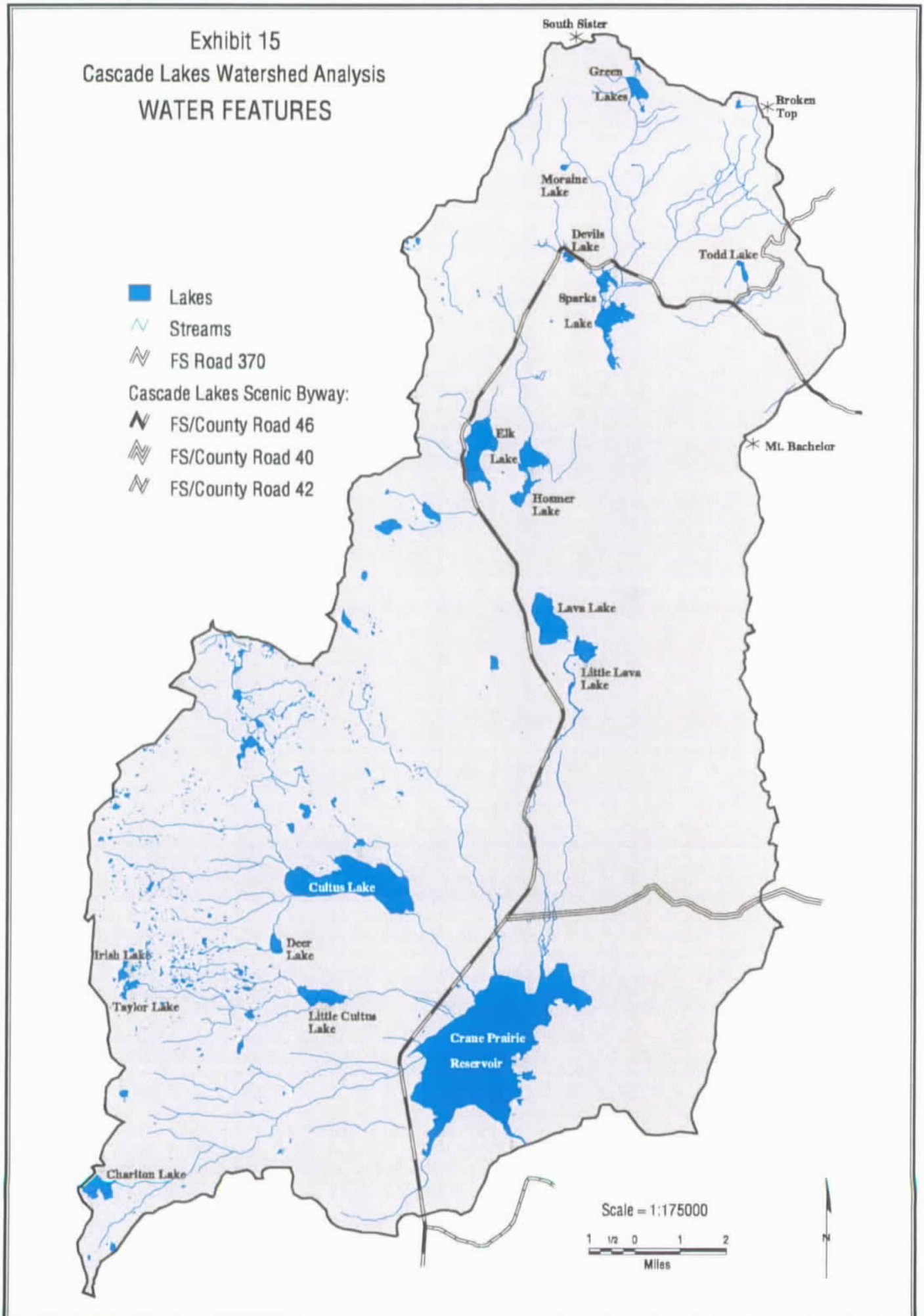


Exhibit 15
Cascade Lakes Watershed Analysis
WATER FEATURES
Lakes
Streams
FS Road 370
Cascade Lakes Scenic Byway:
FS/County Road 46
FS/County Road 40
FS/County Road 42
South Sister
Green Lakes
Broken Top
Moraine Lake
Devils Lake
Todd Lake
Sparks Lake
Elk Lake
Mt. Bachelor
Hosmer Lake
Lava Lake
Little Lava Lake
Cultus Lake
Deer Lake
Irish Lake
Taylor Lake
Little Cultus Lake
Crane Prairie Reservoir
Charlton Lake
Scale = 1:175000
1 1/2 0 1 2
Miles
N

into streams. Protection of riparian vegetation is important to the health of aquatic systems, acting as a filter to sediments and pollutants, providing shade, streambank stability, large wood recruitment, and nutrient input.

HISTORIC AND CURRENT CONDITIONS BY LANDSCAPE AREA

The Recreation/Alpine Tephra Landscape Area

The Recreation/Alpine Tephra Landscape Area includes the Sparks subwatershed and the northern section of the Elk subwatershed. Despite the heavy precipitation (up to 125 inches annually), there is limited surface runoff due to the porous soils. The streams have their origins high up on the flanks of the Cascade mountains or from springs, and descend southeasterly until reaching the Bachelor lavas, at which lakes were formed. There is no surface water connection to the Deschutes River, but there is evidence of groundwater movement from the Sparks-Devils complex downslope toward the Lava Lakes (refer to Appendix A-1, Geology and Climate).

The streams located within the Recreation/Alpine Tephra Landscape Area include: Crater Creek, Fall Creek, Goose Creek, Hell Creek, Satan Creek, headwaters of Sink Creek, Soda Creek, Todd Creek, and Tyee Creek. In addition, there are several other unnamed perennial and intermittent streams. Crater Creek is a constructed irrigation diversion ditch that routes water from Soda Creek out of the Cascade Lakes Watershed. Excluding the ditch and Sink Creek, which flows out of the area into Quinn Creek, there are no other surface water outlets in the Recreation/Alpha Tephra Landscape Area. The streams either flow into a lake or submerge into the lava (Todd Creek). The streams are generally low in turbidity and conductivity and discharge is a combination of springs and snow melt. Because of the elevation of the subwatersheds, Crater, Soda, Fall, and Goose Creeks are somewhat susceptible to rain-on-snow events. The porous tephra soils absorb much of the moisture and limit the increase in flow associated with these events. Thunderstorm events that occasionally occur in the area do not typically result in sudden large increases in stream flow.

The lakes within the area are: Bare, Camelot, Corral, Devils, Junco, North, Middle, and South Green Lakes, Moraine, Sisters Mirror, Sparks, Todd, and a small unnamed lake high on Broken Top. The lakes were formed either by glaciation or lava flows. The elevation ranges from 5,428 feet at Sparks Lake to 8,000 feet at the lake on Broken Top.

The riparian conditions, floodplain functions, streamflow, water quality, and channel morphology have been affected by natural processes and from recent past and current human activities. Past or present human activities include recreation, grazing of livestock, range improvements, road and trail construction, and water diversions. Vegetative treatments in the Recreation/Alpha Tephra Landscape Area has historically been limited to highway corridors, Mt. Bachelor Ski Resort, trailheads, and in the campgrounds.

Stream water quality is generally high, and except for Soda Creek, all streams are probably within the historic range of variability. There are no known pollution sources observed through past or current stream surveys nor any anecdotal information to suggest that the streams are degraded. Soda Creek flows slightly turbid during high spring runoff periods, but this occurs for a short period of time and is caused primarily by snowmelt in its headwaters (wilderness).

There are several trails adjacent to streams and lakes that may contribute small amounts of fine sediment to the water bodies. Fine sediment are particles less than 1/4 inch in diameter. Research has shown that there is decreased survival of salmonid eggs and newly hatched fry when the fine sediment volume exceeds 20% (Meehan, 1991). There is also decreased habitat for aquatic invertebrates as the interstitial spaces within the gravel substrate fill in with fine sediment. Stream sediment monitoring on Fall Creek, Soda Creek, and Goose Creek has revealed fine sediments exceeding 20% in nearly all samples. The high percentages of fine sediment is probably due to the pumice and ash dominated surface soils, and probably not a reflection of land management activities. The damaged banks of Soda Creek contribute fine sediments, but as the banks revegetate over time with the cessation of grazing in Sparks Meadows, the trend is for decreased sediment input.

The lakes in general have high quality water and are either oligotrophic or mesotrophic. Surface water temperatures in most of the lakes are generally cool however, Sparks Lake can occasionally exceed 70 degrees Fahrenheit. Pollutants in the lakes from motor boat use is probably insignificant. Although motor boat use is allowable on Devils, Sparks, and Todd Lake, most watercraft use is non-motorized. The water quality of the lakes are within the historic range of variability except for perhaps Sparks Lake. The diversion of water from Soda Creek, and grazing and water diversions within Sparks Meadow has probably resulted in elevated water temperatures of the lake however, no pre-diversion water temperature data is available.

A familiar pattern exists between increased human activity around a lake and an increase in the production of phytoplankton, zooplankton and on up the food chain. This is referred to as "cultural eutrophication", and can lead to excessive aquatic plant growth and degraded water transparency and water quality. Within a lake, phosphorus and nitrogen are the two most important nutrients that effect aquatic plant growth (especially phytoplankton). An increase in nitrogen and phosphorous in a lake, typically results in an increase in the growth of phytoplankton and on up the food chain. Nutrient enrichment from human activity, especially sewage, is of particular concern to lakes with very porous soils in their drainage basins and the tephra dominated soils within this area are very porous (Johnson, et al 1985).

The wilderness lakes within this area that are most vulnerable to "cultural eutrophication" are Camelot, the Green Lakes, Moraine Lake, and Sisters Mirror Lake. They are all popular camping spots for backpackers and attracts day use hikers as well. The Green

Lakes and Moraine Lake area receives the greatest number of visitations in the entire Three Sisters Wilderness.

Water chemistry data was collected in 1992 on Moraine and the Green Lakes. Relative to other high Cascade lakes, the phosphorus concentration was high in North and South Green, moderately high in Moraine, and moderate in Middle Green (Gibbons 1993). Nitrate nitrogen was non-detectable in all except for South Green which had 0.05 mg/l. Middle Green Lake was sampled also in 1982. The phosphorus concentration from that sample (0.017 mg/l) was slightly higher than the 1992 sample (0.012 mg/l).

Nitrate nitrogen was not tested for. The other elements tested for were reasonably comparable, although sulfate concentration was elevated in 1992 from what was measured in 1982, 7.5 mg/l to 0.3 mg/l. The transparency measured with a Secchi disc was greater in 1992, 26.5 feet, compared to 23.5 feet in 1982. A change in the trophic status cannot be determined when comparing the data between the years 1982 and 1992. It is important to note that the variability of water quality measurements could be the result of the time of year the data was collected, lake water levels and cyclic weather patterns. Also, the high elevation of the lakes in the wilderness and the corresponding short growing season limits biological growth. There is no earlier data available. The filamentous blue-green algae, Anabaen flos-aquae is present, and is of concern because of its potential for creating blooms and forming toxic conditions for other aquatic life (Gibbons 1993).

Sparks Meadow Area

Sparks Lake is considered oligotrophic (Johnson, et al 1985). The lake has a popular primitive non-fee campground and is also widely used for camping in undeveloped areas. The latest water analysis was done in 1982, and the phosphorus concentration was moderately high at 0.022 mg/l. Although the ski slopes of nearby Mt. Bachelor are salted, there is no evidence of increased salt content in Sparks Lake. The Na content was sampled in 1982 and found to be 1.3 mg/l, being within the mid range of all the lakes analyzed.

Two flood events in 1966 and 1968 significantly altered the channel morphology of Soda Creek and its tributary Crater Creek. Tons of sediment were deposited in Soda Creek, Sparks Lake, and the Sparks Lake Meadow. An estimated 10,000 to 20,000 tons ended up in the meadow from the 1966 flood (Johnson, et al 1985). In years thereafter, peak flows during the spring left the channel and flowed into the campground access road and the meadow. To alleviate the flooding, approximately 250 meters of Soda Creek below the Cascade Lakes Scenic Byway crossing was channelized in the early 1970's. Sediment from the channelization effort was piled in berms along the stream edge and deposited into a large pile proximal to the stream. These "structures" are still present. The effect of the flood and subsequent channelization is reduced channel meander, riparian vegetation, and available fish habitat. The channel is wider and shallower in this reach than historic

conditions. Water temperature monitoring indicates that late summer water temperatures exceed 70° Fahrenheit in Soda Creek in the meadow. This increase in temperature is probably a result of damage to the riparian vegetation from channelization and grazing and from upstream diversions. Increased temperatures adversely affects salmonids that use the creek for rearing.

Grazing of domestic livestock has been another factor influencing the riparian conditions and channel morphology within the Sparks Lake Meadow. This area has been grazed by sheep and cattle since the late 1800's, but a regulated allotment was not established until 1931. The current allotment has been rested since the completion of the 1990 grazing season. A streambank damage survey within the meadow was conducted by Deschutes National Forest personnel during the 1992 field season. Streambank damage attributed to grazing (trampling, hoof slide) was 47% on Soda Creek and 6% on Fall Creek. Because of grazing, undercut banks that provide fish hiding cover have been decreased, and the channel has become wider and shallower. Grazing is presumed to have reduced the abundance of willows along the streams. Fecal deposition from cattle is a detriment to water quality.

Beginning in 1916, efforts were made to divert the flow of Soda Creek to distribute water throughout the meadow in an attempt to increase forage for cattle. In the late 1950's and early 1960's, intensive efforts were made at spreading water with the construction of 93 headgates, several check dams, and over 7 miles of ditches. The system is now defunct, but during high flows some water leaves the main channel and enters these diversion channels, reducing the flow within the main channel of Soda Creek.

Range "improvements" during the history of the allotment have included the seeding of exotic grasses and herbicide treatments that has changed the composition of the meadow vegetation from historic conditions.

A non-fee campground is adjacent to the channelized section of Soda Creek. Because the campground is near the stream, there are increased opportunities for recreational activity in the sensitive riparian zone in this area. The vegetation has been slow to recover because of trampling and the lack of soil in the berms. Recovery of the riparian vegetation would allow for narrowing and deepening of the channel, increased shade, overhead cover for fish, increased food source for aquatic invertebrates, and increased habitat for wildlife.

Aquatic macroinvertebrate sampling was completed recently on Soda Creek and Fall Creek. The invertebrate community was slightly impaired in Fall Creek, and it was hypothesized that the lack of natural cobbles, high embeddedness (high volume of fine sediment in the substrate), and winter scour were the limiting factors (Wisseman 1991). Invertebrate samples on Soda Creek were taken within the channelized section. Analysis of the samples indicated that the aquatic community was impaired and the channelization of the stream was thought to be a contributing factor (Wisseman 1991).

The Crater Creek ditch diverts flow from Crater Creek, a tributary to Soda Creek on the flanks of Broken Top, and delivers it to the Middle Fork of Tumalo Creek. The water rights are owned by the Tumalo Irrigation District which withdraws irrigation water from Tumalo Creek west of Bend. The ditch has been in operation since 1914, and withdraws approximately 3,000 to 4,000 acre-feet annually (Cartwright, personal communication 1994). The period of operation is from July to October, and the peak withdrawal flow is near 20 cfs. There are occasional breaches of the ditch, resulting in soil erosion. The withdrawal can amount to 50% or more of the flow that would be destined for Soda Creek, reducing available habitat for aquatic species and elevating water temperatures. Water temperature monitoring on Soda Creek within the meadow has shown that the maximum diurnal temperatures often exceed 58° Fahrenheit, with a maximum high above 70° Fahrenheit several times during July and August 1994, a water year in which some of the lowest stream flows in the Deschutes Basin were recorded.

The diversion of flow from Crater Creek (tributary to Soda Creek) also reduces the volume of Sparks Lake, reducing fish and wildlife habitat and increasing water temperatures. The amount of water diverted annually is 3 to 4 times greater than the volume of the lake.

Beginning in 1963, efforts were made to reduce some of the loss of water through the porous lava substrate at Sparks Lake by constructing a dam that blocked off a major sink hole, and pouring cement into other leaks and fissures. There is still tremendous water loss, and during recent drought years, the lake has become quite shallow by late summer, with a substantial area less than 2 feet deep.

Green Lakes Area

The three Green Lakes are at about 6,500 feet elevation, and Moraine Lake is at 6,450 feet. This is a very popular area for dayhikers, backpackers, and climbers. Middle Green Lake is the largest at 85 acres, and was considered oligotrophic by Johnson in 1981, but oligotrophic/mesotrophic by Gibbons, 1993. Gibbons rated Moraine Lake as oligotrophic/mesotrophic, and North and South Green Lakes as mesotrophic. The lakes do have surface water outlets, which provides for cycling of the water volume, and helps buffer the lakes from nutrient enrichment.

The very popular Green Lakes trail follows Fall Creek from the Cascade Lakes Scenic Byway to its origin at Middle Green Lake. Frequently, hikers venture off the trail for views of scenic falls, resulting in soil compaction or downslope soil movement toward the stream at localized areas. Unbridged crossings of streams also contribute fine sediments.

Heavy recreational use around the lakes in this area also tramples riparian vegetation and compacts soils. Due to the harsh environment, coarse texture and the low nutrients of the soils in this area, vegetation is slow to recover.

Todd Lake Area

Todd Lake is 29 acres and considered mesotrophic (Gibbons, 1993). This lake receives tremendous day use recreational pressure on a year-round basis. The high elevation, cycling of the water volume through the outlet, and the input of many small springs helps buffer the degradation of the water quality.

The phosphorus level in Todd Lake is high relative to other high Cascade lakes, but the concentration was lower in the 1992 sample (0.041 mg/l) than a sample taken in 1982 (0.063 mg/l - Johnson, et al 1985). Nitrate nitrogen concentrations were not detectable in the 1992 sample, and not tested for in the 1982 sample. The other water quality parameters tested for appear similar between the two samples.

The vegetation in the riparian zone along Todd Creek has been trampled and the soils compacted from recreational use in some areas. Mt. Bachelor Ski Corporation withdraws water as a backup system for its water supply at the ski resort. Water temperature data collected in July 1995 showed a range of 52 to 63 degrees Fahrenheit.

Forest Service Road 46-370 provides access to the Todd Lake and upper Tumalo Creek country. Dispersed camping adjacent to this road has trampled riparian vegetation and compacted moist soils.

Devils Lake

Devils Lake is a small (19 acres) but popular roadside destination. Unique is its naturally high concentration of phosphorus (0.094 mg/l in 1992), whose source is probably the springs that feed the lake. Despite the abundance of this nutrient, there is little phytoplankton productivity. Nitrate nitrogen was not detectable in the 1992 sample. The phosphorus concentration was 0.072 mg/l in the sample taken in 1982. The lake bottom is known to leak large volumes of water through fissures, resulting in a short retention time, protecting the water quality, and is the probable answer to the lack of phytoplankton. While the high phosphorus content sways the lake toward mesotrophy, all other indicators point to oligotrophic conditions.

The Recreation/Riparian Landscape Area

This landscape area contains some of the most popular and most intensively used recreation destination points on the Deschutes National Forest. This area is closely associated with the Cascade Lakes Scenic Byway. Since most of these destination points are associated with streams, lakes, or reservoirs, there are impacts to the riparian vegetation and water quality.

The streams within this area include Charlton Creek (partial), Cultus Creek, Cultus River,

Deer Creek, Deschutes River, Quinn Creek, Quinn River, Sink Creek (partial), and Snow Creek. There are several other unnamed springs and intermittent channels. The surface flow in this area is primarily from spring sources. Precipitation from higher elevations is absorbed into the landscape and emerges at several points in this area.

The lakes within this area are Lava, Cultus, Deer, Elk, Hosmer, Little Cultus, and Little Lava. Crane Prairie Reservoir is the destination point of all surface flow in the entire Cascade Lakes Watershed (excluding the Sparks subwatershed, which contributes groundwater). The natural lakes were formed by either glacial action or lava flows. The water bodies range in elevation from 4,950 feet at Hosmer to 4,445 feet at Crane Prairie Reservoir.

Lake water quality monitoring has been conducted on all of the lakes in the Recreation/Riparian Landscape Area. What stands out in the data is the springs feeding Lava Lake and Little Lava Lake have high phosphorus values, which are 500% to 120% respectively, above any of the other natural water bodies in the basin. These mineral rich springs yield moderate alkalinity values (15 to 18 mg/l) as well. Consequently, Lava Lake, Little Lava Lake, and Crane Prairie Reservoir, are the most productive fisheries in the upper basin.

Riparian conditions, floodplain functions, water quality, and channel morphology have been affected from past and current human activities. Activities impacting water quality include: recreation, grazing of livestock, range improvements, road and trail construction, campground and recreation facilities construction, and water impoundment. There has been timber harvest in the past, but currently, timber harvest is primarily limited to campground hazard tree removal and small salvage sales.

Elk Lake

Elk Lake is about 405 acres in size and has a maximum depth of 62 feet. The lake is fed by Elk Creek (an intermittent stream) and numerous springs. Elk Lake has no surface outlet, but because of the extensive seepage through the porous lake bottom, the lake water retention time is approximately one year. This fast water retention time buffers the lake from potential water quality degradation from the development around the lake.

Within the Elk Lake riparian area there are Forest Service developed campgrounds and day use areas, residence cabins, and the Elk Lake Resort with associated cabins. Residence cabins on the lake date back to the 1920's. Water quality monitoring conducted in 1969 indicated some evidence of nutrient enrichment and bacterial contamination derived from improperly functioning sewage facilities. Although most indicators show an oligotrophic status, there are phytoplankton species present that represent a higher trophic status (Johnson, et al 1985). These zooplankton species were also present in sampling completed in 1989 (unknown author, Elk Lake Water Quality Report, 1990). Records of

Elk Lake transparency readings, an indicator of water quality, date back to the early 1940's. There does not appear to be a decline in transparency over the years. An inspection of the resort and its cabins by the Deschutes County Environmental Health Division in 1994 revealed potential sewage facility problems at the resort and its cabins.

Cultus Lake

Cultus Lake is 785 acres, has a maximum depth of 210 feet, and is considered ultraoligotrophic. The source of its water is from the glacial plain of the west, where the landscape is scoured to bedrock and the water supply to the lake is similar to distilled water. Cultus Lake is a big, deep lake with little shoal area, resulting in minimal littoral area available for primary productivity to occur. This lake is susceptible to nutrient enrichment because of its purity and naturally low nutrient level. But because of its large volume, low shoal area, and cycling of its surface waters through transport in the creek, it has a natural buffer.

Cultus Lake is heavily used by recreationists during the summer season and just recently, the human waste disposal systems have been upgraded. Because of the water purity in Cultus Lake, this is a excellent candidate for use as a control study lake to monitor and track the affects of human interaction with lake systems and maintaining healthy aquatic resources.

Little Cultus Lake

This 156 acre glacially scoured lake is considered oligotrophic, tending toward mesotrophic (Johnson, et al, 1985). Alkalinity is considerably higher than in many other lakes (260.6 mg/l measured 8/23/93), providing buffering capacity to acid deposition. The shoal area is relatively high (40%), providing for primary productivity. The maximum depth is 55 feet. Perennial and intermittent streams feed the lake on the west end and the outlet Deer Creek is on the east end. The lakes water retention time is approximately 9 months. There is a primitive campground on the south shore and dispersed camping is popular around the entire lake. Some areas have experienced trampling of vegetation and compaction of soils. The main recreational attraction to the lake is trout fishing.

Deer Lake

The trophic status of Deer Lake is oligotrohic/mesotrophic (Gibbons, 1993), and the lake is low in ionic concentrations. The high shoal area (55%) and shallow depth (26 feet) provides potential for biological productivity. Despite these characteristics, there are no aquatic macrophytes present. Alkalinity is extremely low (1.1 mg/l measured 8/27/92). The inlet and outlet are intermittent. There are no developed sites present but there are several dispersed camping sites scattered along the perimeter of the lake.

Hosmer Lake

This 198 acre lake is biologically more productive than most lakes in the Cascade Lakes Watershed and it is considered mesotrophic. The maximum depth is only 12 feet, and the average depth 3.2 feet. There are abundant aquatic macrophytes present and several marshlands along the perimeter of the lake. Alkalinity concentration is very low (6 mg/l measured on 8/21/81).

Quinn Creek, a spring fed stream, is the only surface inlet to Hosmer Lake. An outlet exists on the eastern shore that flows for just a short distance before disappearing into the lava. A small rock dam with a headgate is found at the outlet. The dam has increased the water level of the lake 1 to 2 feet. The lakes retention time is probably less than 15 days.

There are two developed campgrounds at the lake, and boat-in camping to undeveloped sites is popular. Canoeing, fishing, and bird watching are the most popular recreational activities. Some of the camping in undeveloped sites has resulted in trampling of riparian vegetation and soils.

Lava Lake

Lava Lake is 368 acres and has a maximum depth of 34 feet. The trophic status is classified as eutrophic based on phytoplankton sampling (Sweet, 1994), but other indicators indicate oligotrophic/mesotrophic (Johnson, et al 1985). Shoal area is fairly high (18%). Alkalinity is considerably higher than most other lakes in the watershed (388.9 mg/l measured 9/29/93).

Surface inlets are limited to seeps from Wire Meadow on the southwest portion of the lake. There are springs on the lake bottom, some of which are slightly elevated in temperature (60° Fahrenheit). These springs may be a natural source of phosphorus, an important nutrient for the production of phytoplankton and zooplankton. The only surface outlet is an intermittent channel that flows into Little Lava Lake during high water years.

A developed campground and resort are on the south shore and camping in undeveloped areas around the lake is infrequent. The riparian vegetation is limited to the south and west shores, as the east shore is the lava flow that formed the lake.

Little Lava Lake

Little Lava Lake is similar to Lava Lake in geology, water chemistry, and trophic status. The shoal area is high (61%), and there are abundant aquatic macrophytes and marshlands. The lake is considered to be the headwaters of the Deschutes River. The lake is at its greatest volume in August due to the unique groundwater exchange in the basin.

Crane Prairie Reservoir

The reservoir was constructed to store irrigation water for the central Oregon agricultural industry. The initial dam was constructed in 1922, but was enlarged in 1939 to 1940. Three irrigation districts currently own water rights (Central Oregon, Lone Pine, and Arnold).

At full pool, the reservoir is about 4,750 acres and has a volume of over 55,000 acre-feet. The reservoir may undergo a large fluctuation in volume due to irrigation demands. At the conclusion of the irrigation season in 1994, the reservoir held only 8,000 acre-feet of water (Gorman, 1995, personal communication). Recent consecutive drought years have prevented the reservoir from reaching full pool levels. There are no legal requirements for maintaining a minimum pool volume in Crane Prairie Reservoir (Gorman, 1995, personal communication). The irrigation districts have become more efficient in recent years decreasing water demand (Gorman, 1995, personal communication).

A substantial amount of water leaks through the lava at Crane Prairie Reservoir especially when the capacity is near full pool. There was an average 4,900 acre/feet of seepage loss monthly between the years 1941 and 1978. Dikes were constructed in the 1960's on the east side of the reservoir, preventing stored water from reaching the seep areas, which alleviated some of this water loss, averaging about 1,700 acre/feet monthly when the reservoir is near capacity (McCammon, 1981).

The extensive dispersed camping along the shoreline and the heavy recreational pressure may be sources of non-point water pollution (untreated sewage at dispersed sites, boat gas and oil). The short retention time within the reservoir may act to flush out some of these pollutants.

The average depth of Crane Prairie Reservoir is only 11 feet and the maximum depth is about 20 feet. The trophic status is eutrophic, and algal blooms are common, driving the pH above 9.

The reservoir is fed by many springs and streams, and is the terminus for all surface water flow in the Cascade Lakes Watershed. Deschutes River (the outlet of the reservoir), is not within the watershed, but is affected by management of the reservoir. The Deschutes River flows for approximately 1.5 miles from the outlet downstream before reaching Wickiup Reservoir. For irrigation purposes, the natural flow regime within this section has been altered significantly, from a fairly stable flow to one of high variability. This alteration has affected the integrity of the stream channel, water quality, and habitat for fish and other aquatic species (amphibians, insects, and other invertebrates). Summertime water temperatures occasionally exceed 80° Fahrenheit, decreasing dissolved oxygen. Low flows decreases available habitat for aquatic species and may desiccate aquatic plants and invertebrates within the substrate.

Most of the tributary streams to Crane Prairie Reservoir are gauged, allowing accurate and complete documentation of water quantity.

Table II-1 - Cascade Lakes Watershed - Mean Annual Flood, Maximum High and Minimum Low Flows for Tributaries to Crane Prairie Reservior.

Stream	Mean Annual Flood	Max high	Min Low
Charlton Creek	22 cfs	54 cfs	0
Cultus Creek	125 cfs	336 cfs	0
Cultus River	98 cfs	178 cfs	26 cfs
Deer Creek (est.)	59 cfs	200 cfs	0
Deschutes River	298 cfs	480 cfs	40 cfs
Quinn River	25 - 35 cfs	59 cfs	0

Although permanently inundated now by Crane Prairie Reservoir, Rock Creek has a constant flow of 16 cfs. There is not a gauging station on Snow Creek but the flow was measured at 45 cfs during the stream survey in 1989. Snow Creek is spring-fed and has fairly constant discharge. The Deschutes River above Crane Prairie Reservoir is unique in that the high flow period is in August, rather than during the spring snow melt typical of may streams in the Deschutes basin.

The Outback Landscape Area

The Outback Landscape Area contains 58 named lakes ranging from 130 acres to an acre in size, many unnamed small lakes, ponds, and small perennial and intermittent streams, the majority of which are in wilderness or roadless areas.

In general, the lakes in the Outback Landscape Area were formed from glacial scour, are high in transparency, low in nutrients, and are oligotrophic. The lack of surface streams, which bring in nutrients, is a factor in the oligotrophic nature of these lakes. From a water chemistry standpoint, the lakes are probably not much different from historic conditions. Biologically, many of the lakes are different from historic conditions because of the stocking of fish (See Fisheries and Aquatic Resources Section - Effects of Stocking Fish on Other Aquatic Life).

There are a few small perennial springs, but primarily the channels are small, intermittent, and largely undisturbed from historic conditions. Road and trail crossings constitute the only unnatural disturbances.

Table II-2 - Cascade Lakes Watershed - Outback Lakes

Water Body	Size Acres	Max Depth	Fish Species	Location	Elevation
Barbie Lake, North	3	17	Bk	T20S R6E S24	5650
Big Finger Lake	5	15	Bk	T19S R7E S33	5200
Blaze Lake	2	--		T20S R6E S12	
Blow Lake	55	29	Bk	T19S R8E S06	5070
Blowdown Lake	4	--		T20S R7E S31	5556
Brahma Lake	12	12	Bk	T20S R6E S13	5657
Cathy Lake	3	18	Bk	T20S R7E S18	5570
Charlton Lake	130	74	Bk	T21S R6E S23	5692
Comma Lake	10	6	Bk	T20S R7E S11	4750
Corral Lake, North	8	--		T20S R7E S02	
Corral Lake, South	1	--		T17S R8E S35	6240
Dennis Lake	12	42	Bk	T20S R6E S01	6299
Desane Lake	2	--		T19S R7E S20	5300
Goldeneye Lake	2	20	Bk	T19S R7E S23	5600
Hanks Lake, East	10	27	Bk,Ct	T20S R7E S30	5379
Hanks Lake, Middle	15	30	Rb	T20S R7E S30	5500
Hanks Lake, West	15	13	Bk	T20S R7E S30	5500
Heather Lake	8	10	Bk	T20S R6E S25	5500

Table II-2 - Cascade Lakes Watershed - Outback Lakes - Continued

Water Body	Size Acres	Max Depth	Fish Species	Location	Elevation
Hidden Lake	13	35	Bk	T21S R6E S26	6198
Irish Lake	28	16	Bk	T20S R6E S25	5549
Jay Lake	13	10	Bk	T20S R7E S29	5025
Jezebel Lake	4	--		T20S R6E S13	
Josephine Lake	3	10	Bk	T20S R6E S13	6011
Kershaw Lake	5	13	Bk	T20S R7E S30	5500
Kinnikinnic Lake	2	12	Bk	T20S R7E S30	5500
Lady Lake	2	15	Bk,Ct	T20S R7E S19	5500
Leech Lake	40	--		T19S R7E S33	5640
Lemish Lake	14	13	Bk	T21S R7E S05	5155
Lily Lake	13	44	Bk	T21S R6E S12	5775
Lindick Lake	8	25	Bk	T20S R6E S01	6144
Little Finger Lake	2	--		T19S R7E S33	5260
Lodgepole Lake	4	10	Bk	T20S R7E S30	5500
Lois Lake	4	--		T20S R7E S29	
Long Lake	8	9	Bk	T19S R7E S29	5150
Muskrat Lake	10	17	Bk,Rb,Wt	T20S R7E S09	4800
Navaho Lake	5	--		T20S R7E S20	5250
Phantom Lake	6	6	Bk	T20S R7E S30	5500
Pocket Lake	1	--		T20S R7E S18	
Puppy Lake	8	13	Bk	T19S R7E S21	5200
Pygmy Lake	1	12	Bk	T20S R6E S24	5500
Raft Lake	10	27	Bk	T20S R7E S29	4379
Riffle Lake	9	--		T20S R6E S24	
Rock Rim Lake	4	13	Bk	T20S R6E S11	6034
Senoj Lake	12	--		T19S R7E S14	5400
Simon Lake	2	10	Bk	T20S R7E S19	5700
Snowshoe Lake	18	15	Bk	T19S R7E S33	5040
Snowshoe Lake, Middle	3	13	Bk	T19S R7E S33	5000
Snowshoe Lake, Upper	30	8	Bk	T19S R7E S28	5060
South Lake	2	--		T19S R7E S20	5040
Stormy Lake	4	16	Bk	T20S R6E S11	6045
Strider Lake	4	22	Bk,Rb	T20S R7E S29	5000
Sundew Lake	5	9	Bk	T20S R7E S30	5500
Swede Lake	1	10	Bk	T20S R7E S30	5700
Taylor Lake	34	11	Bk	T20S R6E S25	5550
Teddy Lake South	17	10	Bk	T20S R7E S10	4859
Timmy Lake	3	15	Bk	T20S R6E S24	5500
Tranquil Lake	3	10	Bk	T20S R7E S19	5700
Winopee Lake	40	43	Br,Rb,Wt	T19S R7E S33	4951

The Timber/Forest Products Landscape Area

There are no perennial streams and only one small unnamed fishless lake within this landscape area. There are a few intermittent and ephemeral channels. Charlton Creek is the largest channel. These channels are largely undisturbed from historic conditions, excluding Charlton Creek (See Fisheries and Aquatic Resources Section).

TRENDS

Trends Common to the Recreation/Alpine Tephra, Recreation/Riparian, and Outback Landscape Areas:

Water bodies are a major attraction to recreationists within these areas. With the growing recreational demand, there is a trend of increasing trampling of riparian vegetation associated with the water bodies. Riparian vegetation acts a filter to fine sediments and pollutants that may potentially enter a water body. Riparian vegetation also provides shade, streambank and shoreline stability, nutrients, and wildlife habitat.

There is a natural trend for lakes to increase in trophic status as they age. Nutrient input from human sources can speed this process, known as eutrophication. Within the Cascade Lakes Watershed, there is no documentation of a trophic status change due to human influence.

Trends Specific to the Recreation/Alpine-Tephra Landscape Area:

Stream discharge destined for Soda Creek and Sparks Lake continues to be diverted into the Crater Creek Ditch during the summer months for irrigation demands. The results are less habitat for aquatic species in both water bodies, elevated water temperatures in Soda Creek, and possible elevated water temperatures in Sparks Lake. Efforts to plug leaks in the lake bottom have at least partially offset the loss of water from water withdrawals.

The channelized section of Soda Creek continues to have unnatural sinuosity and channel morphology, degraded fish habitat, and poor recovery of riparian vegetation. Streambank stability along Soda Creek within Sparks Meadow is improving since 1990 with the absence of cattle grazing, based on visual observation.

Trends Specific to the Recreation/Riparian Landscape Area:

There is a trend of continued bacterial contamination and nutrient enrichment of Elk Lake from adjacent septic systems. Water testing has not detected a change in trophic status despite the enrichment. Seepage of water through the lake bottom allows for a rapid exchange of the lake volume, buffering the lake from water quality degradation.

The flow regime at the outlet of Crane Prairie Reservoir continues to be managed to meet irrigation demands. Water quality and habitat for aquatic species continues to be degraded.

Trends Specific to the Timber/Forest Products Landscape Area:

Trend of increasing large wood recruitment, shade, and decreased sediment input to Charlton Creek within the salvage harvest area.

BIOLOGICAL DOMAIN

VEGETATIVE RESOURCES

OVERVIEW

In many parts of the watershed, forest health has dramatically declined. This decline threatens ecosystem stability, habitat sustainability and diversity, scenic quality, recreational experience and, in some cases, visitor safety. Silvicultural treatment is needed as soon as possible to reverse this trend and protect these resources at risk.

The dry mixed conifer plant association group is the area needing priority treatment to protect existing and future resources. There has been a pronounced shift in forest structure, density, and species composition from the relatively open, contiguous, large tree dominated forest which existed historically. This historical, relatively stable and fire resistant forest has/is being replaced by dense, multi-storied forest structures of smaller trees. In addition to forest density and structural changes, species composition has shifted from being dominated by fire climax species like ponderosa pine, to predominantly shade tolerant species such as the true firs. The shift in species composition and size structure has been the result of a combination of fire suppression activity and selective harvest spanning the past 80 years.

This shift has led to an overall lowering of forest health and increased activity of, and overall susceptibility to, various insect and disease agents which attack trees of all sizes. In addition, the mixed conifer dry plant association group is becoming highly susceptible to large catastrophic wildfires.

Temporarily, habitat for the northern spotted owl and other late-successional species has been enhanced. In the short-term, shade tolerant tree species are able to achieve a higher canopy closure that is favored by the owl, as many of the large trees from the historic forest (favored for nesting and roosting) still remain. In the near future however, it is inevitable that habitat suitability will DRAMATICALLY DECLINE as forest structure, density and species compositions change further under the continuing impacts of various insects and diseases. It is expected that canopy closure will be considerably less; the combined result of root disease, defoliators, and bark beetles. There will be a steady decline in the fire resistant intolerant species and large sized trees of both species; the combined result of bark beetles, root diseases, and regeneration inhibitors. Catastrophic fires, if they occur, will cause a dramatic and immediate reduction in overall forested areas.

Mountain pine beetle attack of the lodgepole pine forests as well as the lodgepole component of the mixed conifer forests has intensified over the past 5 years. Mortality is high along scenic corridors and around developed recreation areas such as Cultus Lake and the Cascade Lakes Scenic Byway. This mortality is resulting in a progressive loss of scenic quality, and an

increase in hazard trees both along the scenic highway and in developed recreation areas. If left untreated, it is expected that this trend will continue in the remaining green trees.

The death of trees due to the mountain pine beetle epidemic has also created a loss of lodgepole pine connective habitat between the mixed conifer types and the high elevation mountain hemlock types. The green lodgepole pine provides habitat for the goshawk and great grey owls and this habitat is decreased as the green trees are killed by the beetle. Dead lodgepole from the mountain pine beetle activity has provided a large flush of prime woodpecker habitat over the last few decades. However, as these stands are progressively attacked and replaced by younger stands, and as the dead trees loose root support and fall over, it is expected that this woodpecker habitat will dramatically decline.

The majority of the mountain hemlock plant association group has been excluded from management by Forest Plan direction of Intensive Recreation Management Areas and by Congressional Withdrawal into wilderness areas. The mountain hemlock has developed naturally (with the exception of fire suppression) over time. Laminated root rot is a natural disturbance agent within the hemlock ecosystem.

Vegetation analysis within the watershed focuses on historic, present, future and potential vegetative patterns. Forest vegetation patterns (including structure, density, species composition, and openings) are critical factors in evaluating and predicting the physical, biological, and social processes taking place. The functioning of most of the processes can be directly correlated to these elements. The way these processes work will significantly affect the resource values, outputs, and ecosystem viability. Silvicultural treatments which change these patterns can restore, enhance, and maintain forest ecosystem health.

Forest succession, i.e. changes in vegetation patterns over time, are the combined result of climate, disturbance events, seed supplies, and time. Climate and topography remain fairly constant over time as compared to other processes. Disturbance events include insect attacks, disease infestation, wind storms, fire, and management activities of humans. Successional processes are usually typified by invasion of seral species, followed by vertical structure development to the point where mid and late seral species increase and, in some cases, replace the earlier seral species. If these structures are left somewhat undisturbed, the establishment of mid to late seral species will result until another disturbance occurs and sets the process back to an earlier successional stage.

The pattern and condition of the forest vegetation within the watershed is a key factor of concern identified by the team. The purpose of this analysis is to critically look at this issue, identify areas where important resources and habitats are at risk because of vegetative condition. Once these are identified, treatment opportunities can be explored which protect at risk resources, habitat function, and restore or improve those which have been damaged.

ANALYSIS METHODS

Historic Range of Variability: The Standard Reference Point

Our standard reference point for acceptable landscape vegetation patterns was "historic range of variability" i.e. the range of potential vegetation patterns that could have been produced by historic (1850-1910) processes.

Seral Stage vs. HRV In order to make relative comparisons of seral stage to HRV, vegetation was grouped by site potential (denoted by plant association groups (PAG's)), size/structure, and species composition (if appropriate).

Vegetative plant association groups (PAG's) within the watershed were identified for the Deschutes National Forest in the Watershed Evaluation and Analysis for Viable Ecosystems (WEAVE) Guide (1994). The PAG mapping was also based on the Deschutes National Forest Soil Resource Inventory (SRI) (1976). This inventory identifies the potential vegetative condition that a particular soil type is capable of supporting. An assumption by the SRI is that the current vegetative characteristics on the landscape have been developing under climatic climax regimes and not historic fire climax regimes (See Exhibit 16, Plant Association Groups). Seven PAG's were identified for the Cascade Lakes Watershed:

1) Dry Mixed Conifer This PAG is 35,490 acres in size. A majority of this PAG falls within the southeastern area of the watershed. The mixed conifer dry PAG is composed of various tree species including ponderosa pine (Pinus ponderosa), lodgepole pine (Pinus contorta), white fir (Abies concolor), douglas fir (Pseudotsuga menziesii var. glauca). Other species also included but in minor amounts are western white pine (Pinus monticola) and mountain hemlock (Tsuga mertensiana).

Human management activities have taken place within this PAG since the late 1950's. The Forest Plan classification for this PAG is a mix of General Forest, Scenic Views, Old Growth allocated areas, Wilderness, Osprey and Bald Eagle Management Areas. Most of the land allocation is within the General Forest Management Area. The Northwest Forest Plan land allocations are a mix of Matrix and Late-Successional Reserve areas with the majority being Matrix.

2) Wet Mixed Conifer This PAG is 7,407 acres in size. It is primarily concentrated in the south-central part of the watershed but there are also portions in the northern sections around Lava Lake and Elk Lake. The wet mixed conifer PAG is composed of various tree species including ponderosa pine, lodgepole pine, white fir, and douglas fir. Other species also present in this PAG but in minor amounts are western white pine and mountain hemlock. Engelmann spruce (Picea engelmannii) is also found in very small amounts in association with wet bottomlands. The engelmann spruce bottomlands are a unique feature within the watershed.

This PAG falls mainly within the Forest Plan allocations of General Forest and Dispersed Recreation. The Northwest Forest Plan allocations are mainly a mix of Matrix and Administratively Withdrawn.

3) Dry Lodgepole Pine This PAG is 20,227 acres is size. Lodgepole pine is considered highly seral and climax throughout central Oregon. This species is very opportunistic and can be found in pure stands of lodgepole pine and also as a component of the ponderosa pine, white fir, and mountain hemlock series. The dry lodgepole pine occupies well drained, ashy soils on low, flat or concave topography. These sites have generally low but variable productivity based on ash depth, aspect, and other features of the microsite.

This PAG lies within Recreation and General Forest land allocations as per the Forest Plan. The Northwest Forest Plan allocations are a mix of Matrix and Administratively Withdrawn areas.

4) Wet Lodgepole Pine This PAG is 17,179 acres in size. The wet lodgepole pine occupies sites with imperfectly drained soils. These sites are very productive, have highly diversified vegetation, and are very resilient to vegetative treatments.

This PAG lies within the Forest Plan land allocations of General Forest, Scenic Views, Recreation, and Wilderness. The Northwest Forest Plan allocations are a mix of Matrix and Administratively Withdrawn areas.

5) Mountain Hemlock This PAG is 69,855 acres in size and occurs primarily along the Cascade crest and to the northwest of Mt. Bachelor. The mountain hemlock PAG is composed of various trees species, including mountain hemlock and lodgepole pine, with minor amounts of western white pine, white bark pine, fir species, and shasta red fir (Abies magnifica var. shastentisis). Lodgepole pine is the most important seral species within the mountain hemlock PAG.

Very little management has occurred in this PAG because it falls into Congressionally Withdrawn (wilderness) land allocations as per the Forest Plan. This PAG is also included within Administratively Withdrawn areas of the Northwest Forest Plan in addition to Congressionally Withdrawn allocations.

6) Sparsely Vegetated This PAG is 5,533 acres in size and occurs primarily at high elevations within the Three Sisters Wilderness and on the top of Mt. Bachelor. It includes areas of rock and areas with a minor shrub or tree component. Shrubs and trees (mountain hemlock, white bark pine, subalpine fir) found within this area will be of old age and very stunted in form and growth (krummholz) due to extreme weather conditions at the higher elevations.

Most of this PAG lies within Congressionally Withdrawn land use allocations.

7) **Meadow** This PAG is 1,302 acres in size with the meadow groups are scattered throughout the watershed. The meadows are usually associated with lakes and along wet moist areas and shorelines, and are also found at as high elevations in wet soil types. Most meadows are concentrated within the Many Lakes Basin and in the Upper Deschutes Drainage. The Three Sisters Wilderness supports numerous meadows usually found surrounding the sparsely vegetated areas and rocky areas.

Meadows within the watershed are typically utilized by recreationists while hiking, biking, snowmobiling, cross country skiing, and horseback riding. Meadows adjacent to lakes are good viewing places for wildlife species, scenic mountains and provide important habitat diversity for wildlife species.

Plant association groups are found across the watershed landscape and across the landscape areas defined for the Cascade Lakes Watershed. The following table (Table II-3) shows the acre distribution of the various PAG's by landscape area.

Table II-3 - Cascade Lakes Watershed - Acre Distribution by PAG within Landscape Areas

LANDSCAPE AREA PAG	Recreation Alpine Tephra	Outback	Recreation Riparian	Timber/Forest Products
Water	671	955	6,969	24
Sparsely Vegetated	4,964	569	0	0
Meadow	508	221	524	49
Lodgepole Pine Dry	3,514	4,322	7,396	4,995
Lodgepole Pine Wet	0	4,700	7,293	5,186
Mixed Conifer Dry	513	4,183	4,789	26,005
Mixed Conifer Wet	618	2,732	2,990	1,067
Mountain Hemlock	20,308	45,707	870	2,970

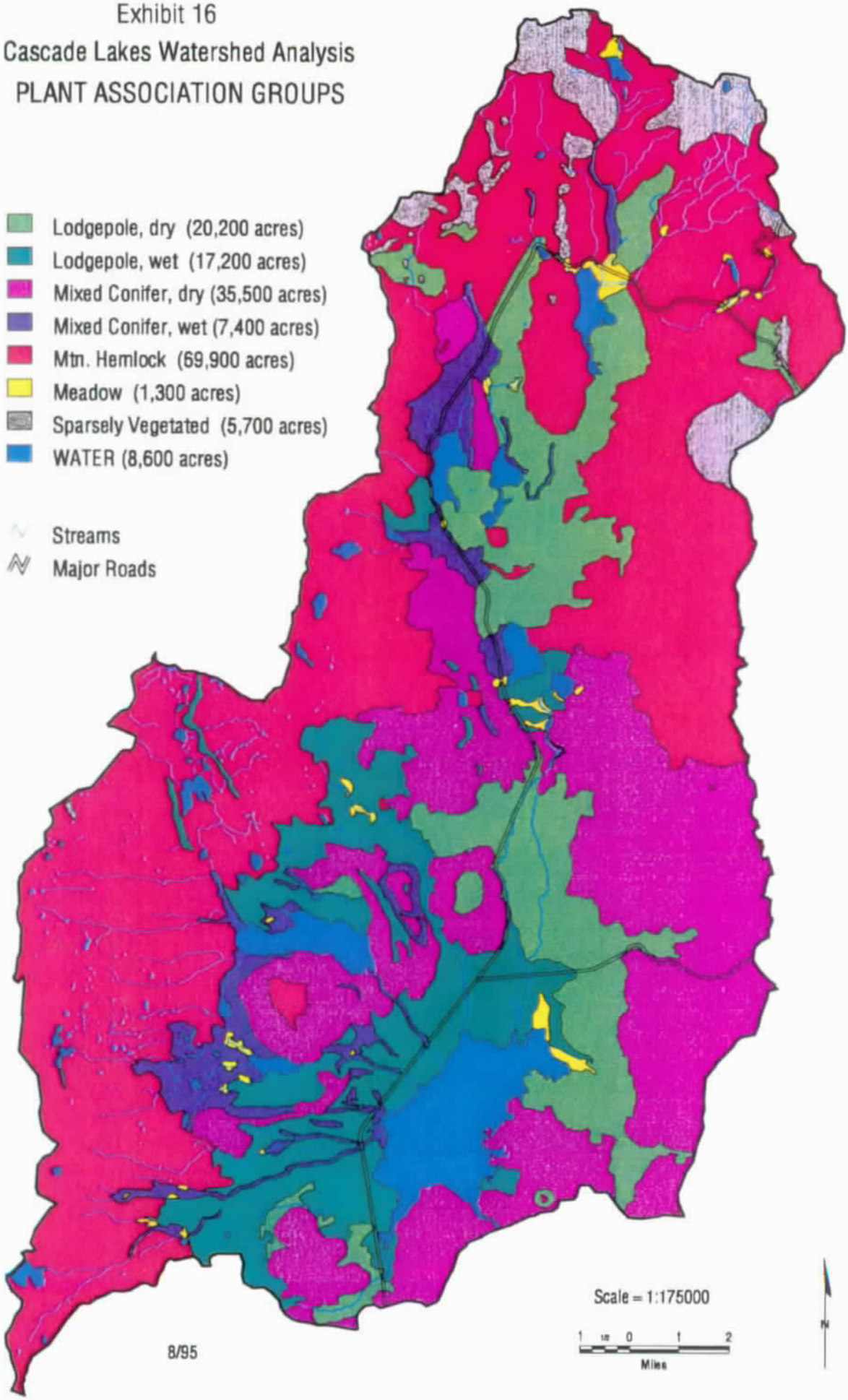
Utilizing the Ochoco National Forest Viable Ecosystem Management Guide (1994) as a model, the next step was to classify all existing plant communities that occur within a plant association group based on size/structure and species composition. There are five size/structure stages recognized: 1) grass/forb/shrub, 2) seedling/sapling, 3) pole, 4) small trees, 5) medium/large trees.

The species composition was then used to further subdivide PAG vegetation into three seral stages: 1) pioneer, 2) mixed, 3) climax. In the pioneer stage, shade intolerant species dominate. Mixed seral stages are dominated by mid-tolerant trees or by mixtures of shade

Exhibit 16

Cascade Lakes Watershed Analysis

PLANT ASSOCIATION GROUPS



tolerant and shade intolerant tree species. Climax seral stages are dominated by shade tolerant tree species. For purposes of this analysis mixed and climax seral stages were combined because there was insufficient data to distinguish between mixed and climax.

This site potential/structural/seral classification scheme serves as our model for describing historic conditions and defining future management opportunities.

Each seral/structural stage is not a uniform condition across the landscape, but varies by species composition, number of canopy layers, and densities (stocking levels). Limits of each seral/structural stage were arbitrarily determined. These stages are useful for assessing the successional progress of a stand and predicting the next plant community to occupy the site.

The existing vegetative condition was mapped and summarized by utilizing data from 1988 Integrated Satellite Imagery (ISAT) and 1991 aerial photography interpretation. (See Exhibit 17, Integrated Satellite Imagery, 1988). ISAT data using size structure and species composition, and aerial photo interpretation were used to develop the current vegetative condition for each PAG (See individual PAG Current Condition and HRV Tables II-3 to II-10). ISAT imagery is useful for landscape level, coarse scale comparisons, and less useful for site specific vegetative analysis.

Historic vegetative condition was defined at a very coarse scale from 1903 Cascade Forest Reserve Surveys, 1901-1910 mapping and historical atlas information, and 1882-1884 cadastral maps and notes. Comparisons between current vegetative characteristics and historic characteristics were also estimated at a coarse level across the landscape. (See Exhibit 18, Historic Forest, circa 1908, Exhibit 19, Historic Forest, circa 1953, and individual PAG current condition and HRV Tables II-3 to II-10 for comparisons).

The dominant natural disturbance agents by PAG within the Cascade Lakes Watershed are displayed in Table II-4. The time frame from 1850 through 1910 is used to reference natural conditions prior to European Settlement (WEAVE Document, 1994).

Watershed Overview Patches and Patterns vs. HRV Landscape patterns and patches are difficult to determine within a historic frame of reference. Suggested patch sizes are based on historic disturbance processes including fire and insect and disease agents (See Table II-4). These patches and the resulting pattern they created would be spread across the landscape within the various vegetative types. The number of patches, the size of the patches, and how they are situated on the land. These patches were then compared to those existing today, many of which have been created by harvest activity.

Table II-4 - Cascade Lakes Watershed - Dominant Historic Disturbance Agents by PAG

Potential Vegetation PAG	Dominant Disturbance Factors	Intensity of Disturbance Regime	Average (Acres) Disturbance or Patch Size Created	Geomorphic Zone*	Typical Elevation Range	Aspects
Water	Floods	Low	1-100	All except Bach//Sher	4,500 ft. +	All
Meadows	Fire	Low	1-50	All except Bach/Sher	5,200 ft. +	All
Sparsely Vegetated	Fire	Low	1-50	Tephra, Crest, Bach/Sher	6,000 ft. +	All
Lodgepole Pine Dry	1) Fire 2) Insect & Disease	High Moderate	50-1,000 10-1,000	Morainal & Outwash	4,500 ft. +	All
Lodgepole Pine Wet	1) Fire 2) Insect & Disease	Moderate Moderate	50-500 10-1,000	Morainal & Outwash	4,500 ft. +	All
Mixed Conifer Dry	1) Fire 2) Insect & Disease	Moderate Low	20-300 1-5	Morainal, Bach/Sher, Lookout/Ketch	5,000 ft. +	All
Mixed Conifer Wet	1) Fire 2) Insect & Disease	High Moderate	100-500 100-500	Morainal & Crest	5,000 ft. +	All
Mountain Hemlock	1) Fire 2) Insect & Disease	High Moderate	50-150 50-200	Tempra, Crest, Bach/Sher	5,500 ft. +	All

* Reference Geology and Climate Section

Low severity disturbance regime: 1-25 year return interval, 0-20% tree mortality
Moderate severity disturbance regime: 26-100 year return interval, 26-70% tree mortality
High severity disturbance regime: >100 year return interval, >70% tree mortality

Exhibit 17

Cascade Lakes Watershed Analysis

INTEGRATED SATELLITE IMAGERY OF EXISTING VEGETATION, 1988

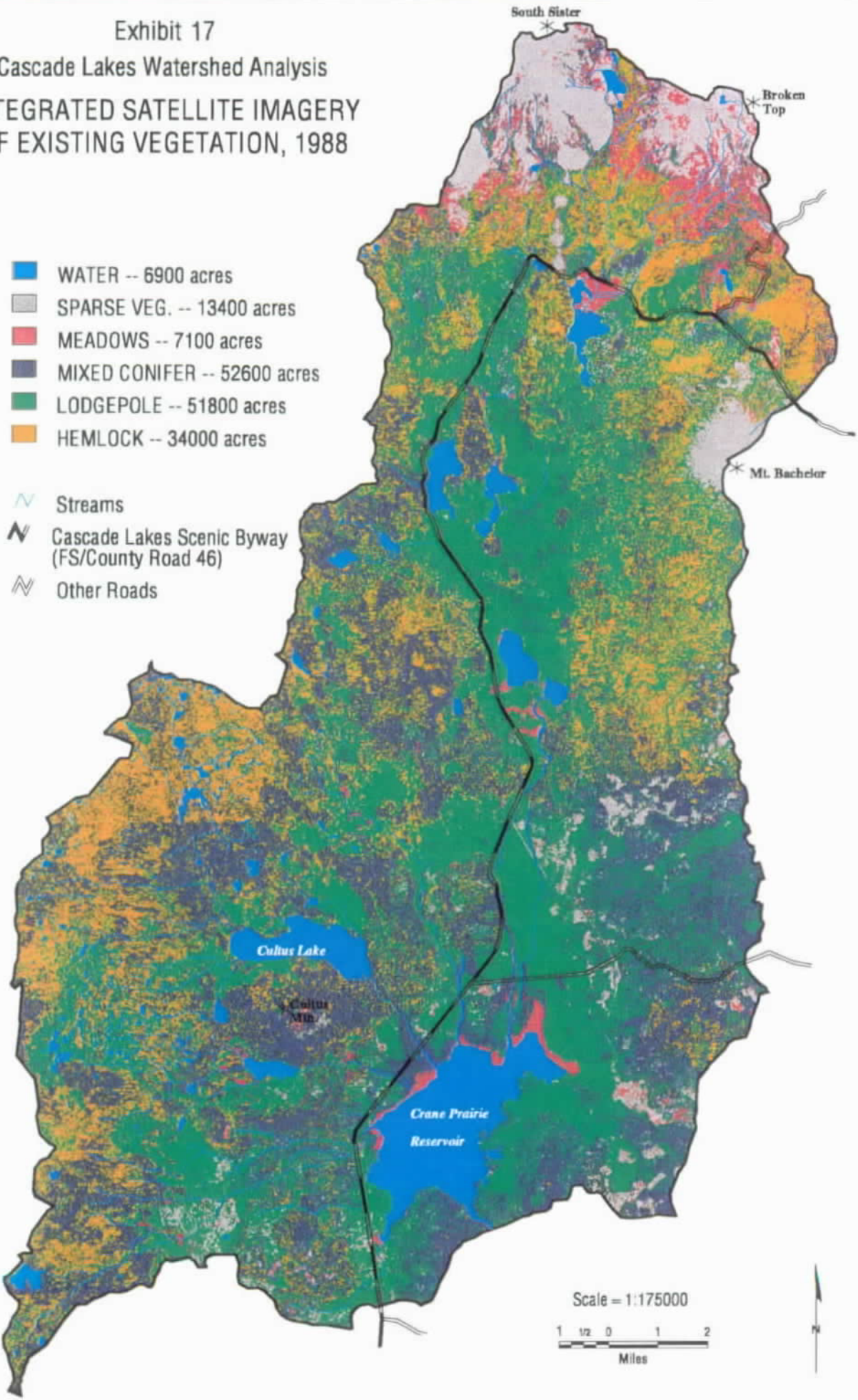


Exhibit 18

Cascade Lakes Watershed Analysis

HISTORIC FOREST, circa 1908

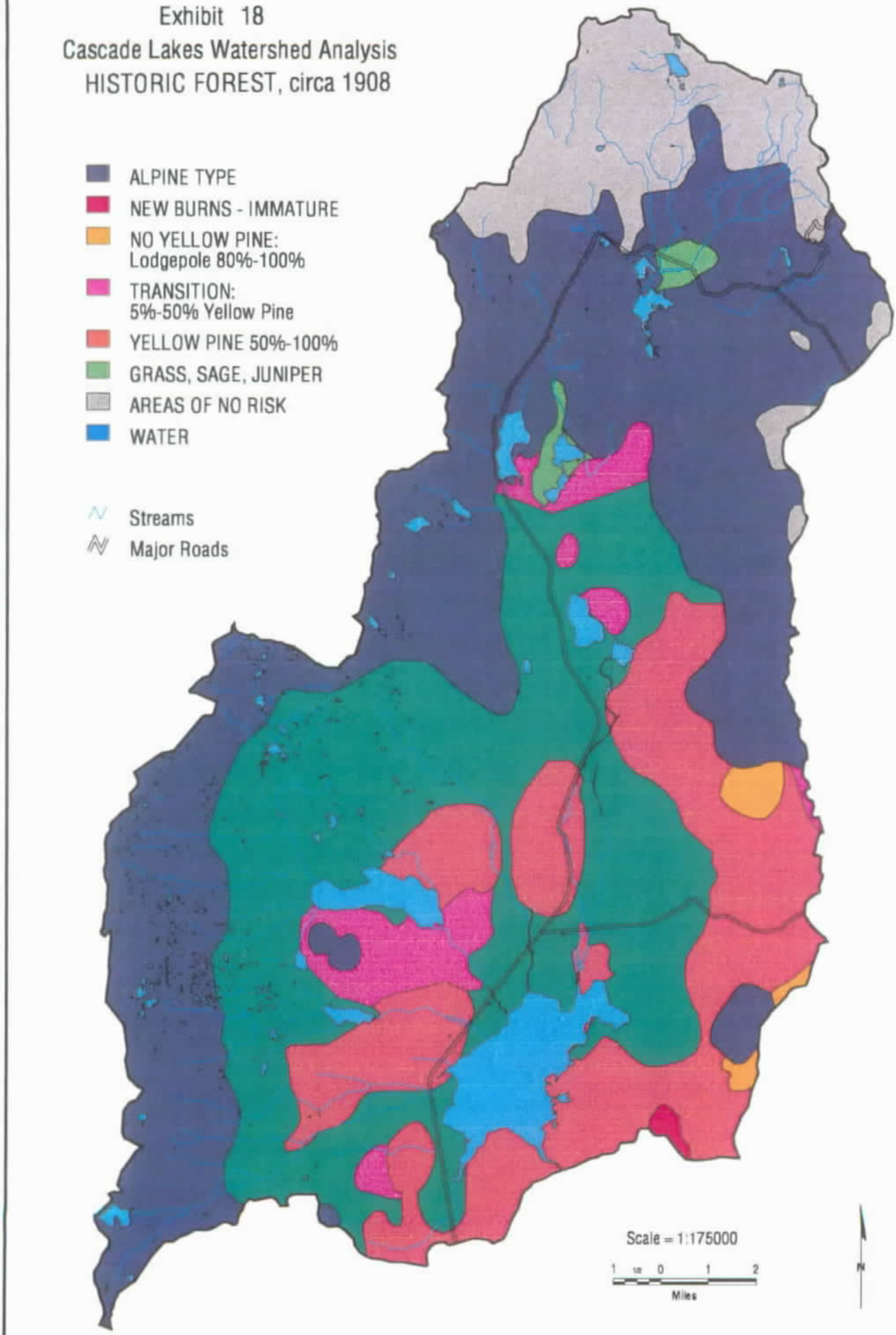
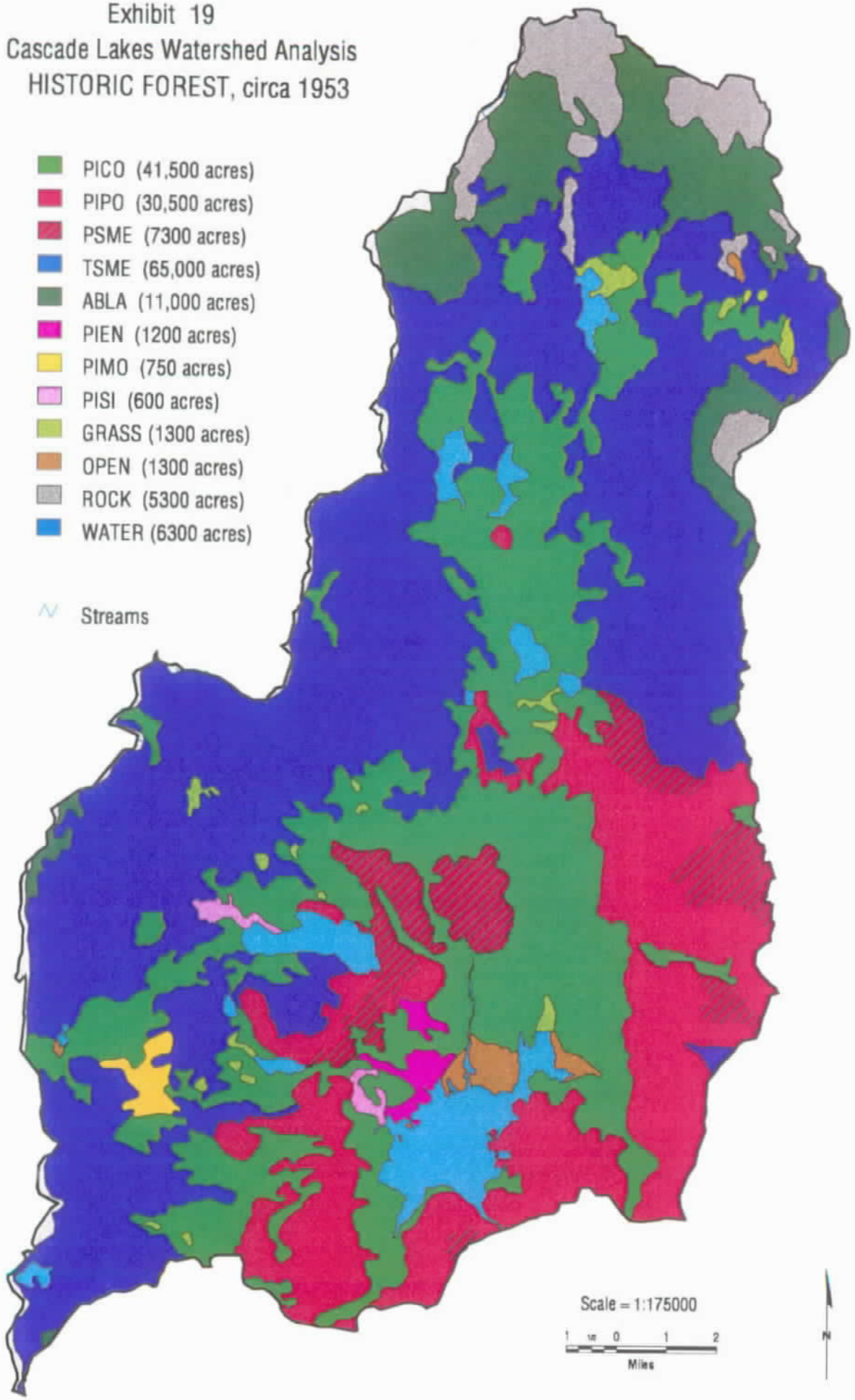


Exhibit 19

Cascade Lakes Watershed Analysis

HISTORIC FOREST, circa 1953



RESULTS, TRENDS AND RECOMMENDATIONS

Watershed Overview...Harvest Activity

Harvest activity within the watershed has been concentrated within the mixed conifer dry plant association group and has been focused within the Forest Products Landscape Area of the PAG (See Exhibit 20, Timber Harvest Units). The Forest Products Landscape Area overlays the Snow, Charlton, Headwaters, Lava and Cultus subwatersheds (Table II-5). Less than 600 acres have been harvested within the Lava subwatershed and approximately 800 acres have been harvested within the Cultus subwatershed. Harvesting is suspected to have begun as early as the 1930's. Available records show broad area selection and salvage harvesting occurring in the 1950's through the 1960's. Stands were re-entered in the 1970's through the 1990's with some areas receiving an additional 1 to 3 treatments. Cumulative effects of this intensive harvesting on these soil types include compaction over large areas, loss of long-term site productivity, and possible loss of rooting depth. These factors will affect the ability of the site to naturally regenerate itself. Artificial regeneration may also be difficult for re-establishing a new stand (See Soil Resource Section).

Table II-5 - Cascade Lakes Watershed - Acres Harvested by Prescription within the Snow, Charlton, Headwaters, Lava, and Cultus Subwatersheds

Early 1970's to Present:

Prescription	Total Acres	Comments
HPR	16,596	Partial Removal
HSV, HCU	1,722	Salvage, Cull, Blow Down
HSH	6,323	Shelterwood
HCC	2,133	Clearcut
HFR	6,812	Final Removal
HTH	2,383	Commercial Thinning
HOR	829	Overstory Removal
HSL	382	UEAM Selection Cut
HSP	57	BEMA - LP Only Harvest
HCP	364	Harvest Crop Tree Protection
TOTAL:	37,601	

Mid 1950's to Mid 1960's:

Prescription	Total Acres	Comments
Salvage	39,694	Broad Area Salvage
Clearcuts	920	Includes Right of Way Acres
Selection	27,738	Large Area (2000 - 4000 acre size), 75%-80% volume removed is PP
TOTAL:	68,352	

* Note: There is a data gap from the mid 1960's to the early 1970's for harvest information. Acres by harvest activities are higher than those shown.

Watershed Overview Canopy Closure vs HRV Canopy cover and closure has most likely increased over historic levels due to fire suppression in some areas and possibly decreased in other areas due to management activities. For example, within some parts of the mixed conifer PAG's canopy cover and closure have increased as the shade tolerant species have grown in due to lack of frequent ground fires. Yet in other areas, high harvest activity levels have resulted in a significant reduction in canopy cover. The fir areas on buttes and mountains were probably as dense as they are today unless management activities have reduced the stocking level. The lodgepole pine areas have denser canopies than historically due to lack of fires that would have created large open areas. The mountain hemlock areas are moving towards a more 'climax' seral stage indicating increased canopy cover and closure over time.

VEGETATION PATTERNS VS HRV (7 PAGs, Trends, & Recommendations)

1) Dry Mixed Conifer PAG

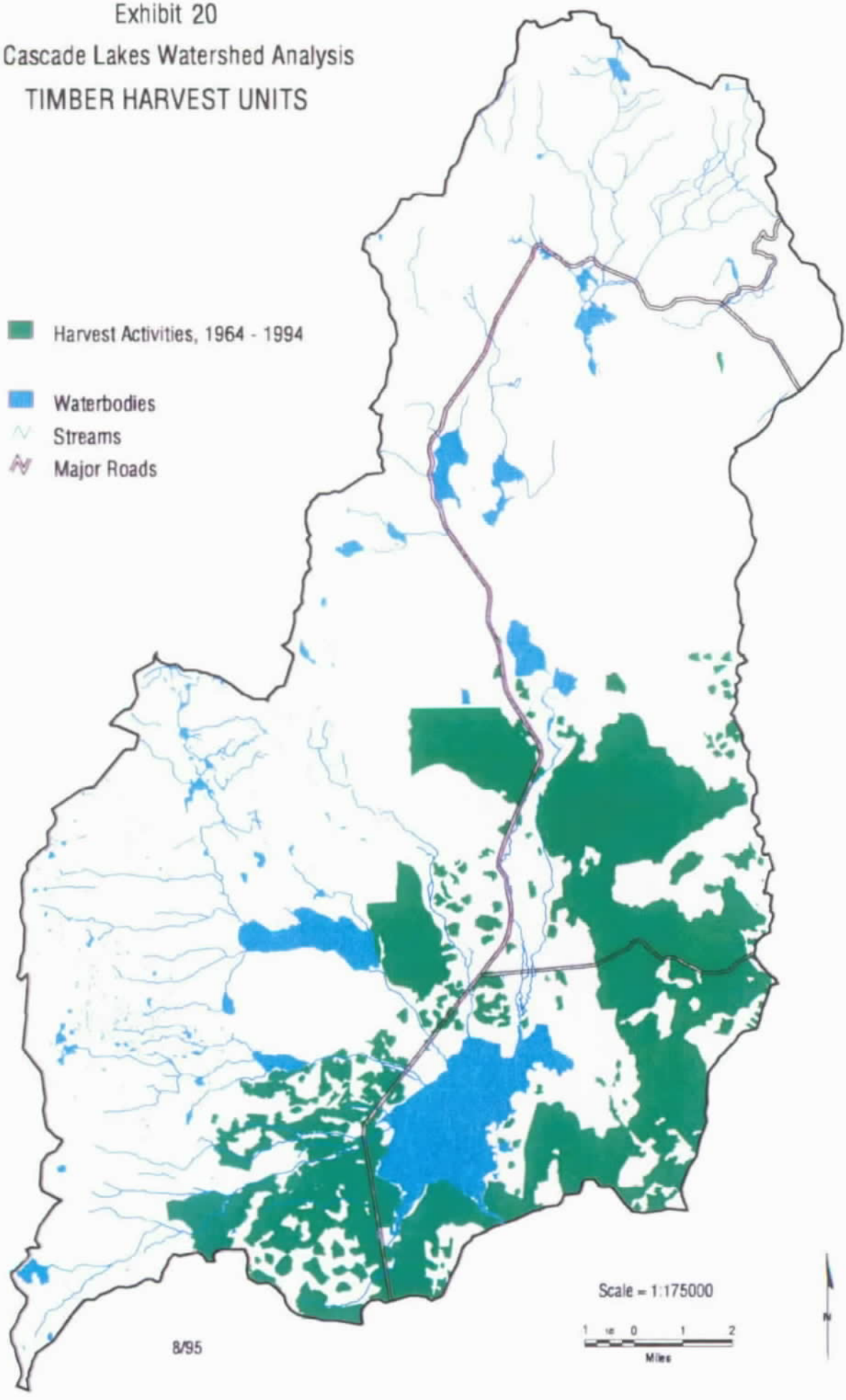
Historic Vegetation Patterns and Disturbance Processes

Historic vegetation patterns were shaped by the frequent fire activity which characterize this PAG. Most stands were open in appearance (canopy cover of 40% or less) and were dominated by ponderosa pine and only reached a true mixed confer composition on higher elevation buttes and north facing slopes receiving more precipitation. Cascade Reserve Forest Survey notes of 1903 describe this PAG with heavy yellow pine and minor amounts of lodgepole pine of no commercial value. Other species were noted such as mountain hemlock. The entire area appears to have been forested with contiguous stands. In some areas, huckleberry, laurel, manzanita, willow and alder were noted. Survey notes did mention large areas of fire scarred trees. The Cultus Mountain (Saddle Mountain in the survey notes) area was noted for having a scattering of large ponderosa pine trees on its east side and also

Exhibit 20

Cascade Lakes Watershed Analysis

TIMBER HARVEST UNITS



mentions a large fire that covered almost one half of the township and range. Spruce, heavy pine and chaparral are noted on Cultus Mountain from a cadastral survey in 1882-1884.

Frequent, low intensity fires kept the forest open so that it was less likely to burn intensely even under severe weather (Agee, 1993). As the low intensity fires burned they removed understory ladder fuels and consumed debris on the forest floor. Fires that occurred after an extended fire-free period would generally have been more intense and consumed more trees and forest floor debris (fuels) while creating patches or openings where 70 to 80% of the overstory trees were killed by the fire. These openings would vary in size based on weather, fuel and vegetation at the time of the fire.

Present Vegetation Patterns, Processes, and Trends

Vegetation patterns of the dry mixed conifer PAG is significantly outside the historic range of variation in terms of seral stage, canopy closure and patch size and distribution. Departures from HRV by this PAG are probably the most dramatic of any of the seven PAG's.

Medium/Large tree dominated early seral stages fall consistently below the amount expected given historic processes (Table II-6). It also falls outside this HRV for small diameter mixed and climax seral stage. This shift is primarily the result of a combination of fire suppression and selection harvesting.

Table II-6 - Cascade Lakes Watershed - Mixed Conifer Dry Current and Historic Size and Structure

	Mixed Conifer Dry	Total Acres: 35,507			
Size/Structure/Class	**Year/Time Frame**	**Pioneer Acres:**	**Mixed & Climax Percent:**	**Acres:**	**Percent:**
Grass/Forb/Shrub	1991	0	0	—	—
	Historic	355-2,486	1-7	—	—
Seed/Sapling 0-4.9"	1991	2,841	8	1,775	5
	Historic	701-5,326	2-15	355-3,551	1-10
Pole 5-8.9"	1991	4,616 13	1,420	4	—
	Historic	1,775-7,456	5-21	710-5,236	2-15
Small 9-20.9"	1991	2,840 *	8*	13,848*	39*
	Historic	4,261-14,203	12-40	2,130-10,652	6-30
Medium/Large 21+"	19910	0*	0*	8,167	23
	Historic	5,326-14,913	15-42	1,775-9,915	5-28

This is causing the relatively open large tree dominated historical forest, to be replaced by dense, multi-storied forest structures dominated by smaller trees. In addition to density and structural changes, species composition has shifted from being dominated by fire climax species of ponderosa pine, to predominantly shade tolerant ture fir species. This shift has caused an increase in overall canopy cover over what occurred historically. Today, much of the canopy is over 70%.

The shift in structure, density and species composition has lead to an overall increase in overall susceptibility to various insect and disease agents. For example, the proliferation of host type as well as the selection cutting has provided a large food base for the root decay fungus, Armillaria ostoye. As a result, the root disease is spreading rapidly and is able to successfully attack and kill live trees (even those like pine which are somewhat resistant) more readily than it could have under historic conditions.

The increased densities are also causing increased susceptibility to bark beetle attack. Large pines are highly susceptible to attack by western pine beetle in overstocked conditions such as these. Lodgepole pine is also highly susceptible to attack by mountain pine beetle. Mountain pine beetle attack of the lodgepole component of this plant association (as well as other associations) has been occurring increasing intensity over the past five years around the Cultus Lake area. Attacks around Lava Lake, Elk Lake and Hosmer Lake have been reported as increasing over the last several years (See Exhibit 21, Mountain Pine Beetle Activity, 1990-1995). True fir is susceptible to attack by fir engraver and defoliators.

The present structural character of the stands has, in many cases, enhanced the ability of western dwarf mistletoe to spread and intensify. For example, in the southeastern portion of the watershed, near lookout mountain, are mistletoe infected ponderosa pine shelterwoods that support fully stocked understories of young ponderosa pine. These infected overstories and infected trees surrounding the shelterwoods have been and will continue to contribute to the infection of the new plantation growing in. This is not likely to have existed historically and is a condition created by human management activities. If mistletoe infested trees are allowed to remain in the overstory above plantations, then conditions will be created that would not have occurred historically.

More harvest activity has occurred in this PAG than in any other in the watershed. Not only has the harvesting contributed to dramatic shifts in structure density and species composition, it has also contributed to the dramatic departure in stand size and openings. What was described by the Cascade Forest Survey as fairly contiguous stands of fire climax pine dotted with 1/2 to 20 acre openings, is now a highly fragmented landscape with regularly spaced openings generally ranging from 20 to 40 acres in size. (See Exhibit 22 (a-d), Landscape Fragmentation from Past Harvest Activities, 1964-1994).

Exhibit 21

Cascade Lakes Watershed Analysis

MOUNTAIN PINE BEETLE ACTIVITY 1990 - 1995

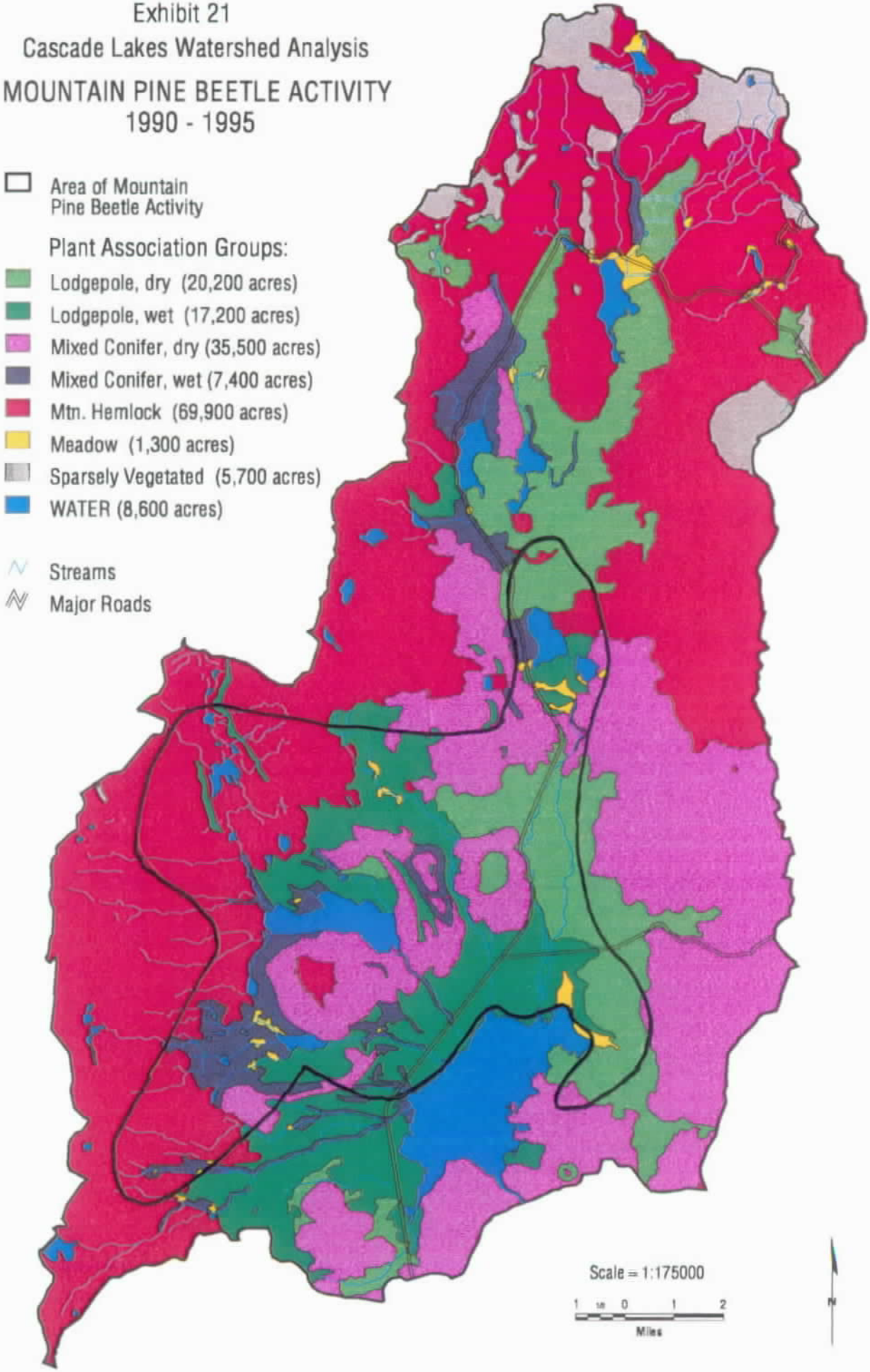


Exhibit 22-A

Cascade Lakes Watershed Analysis

FRAGMENTATION BASED ON MANAGEMENT ACTIVITIES

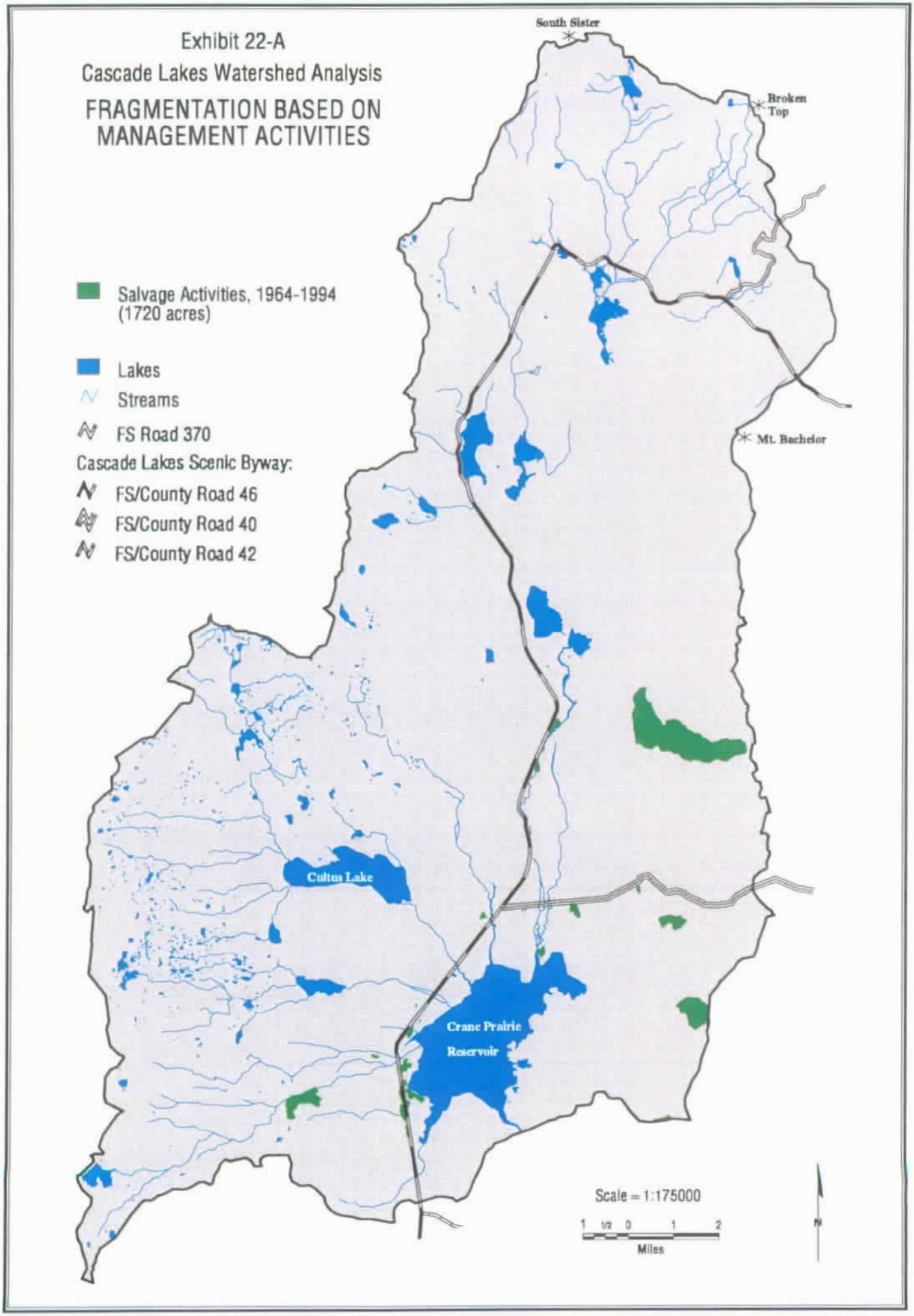


Exhibit 22-B

Cascade Lakes Watershed Analysis

FRAGMENTATION BASED ON MANAGEMENT ACTIVITIES

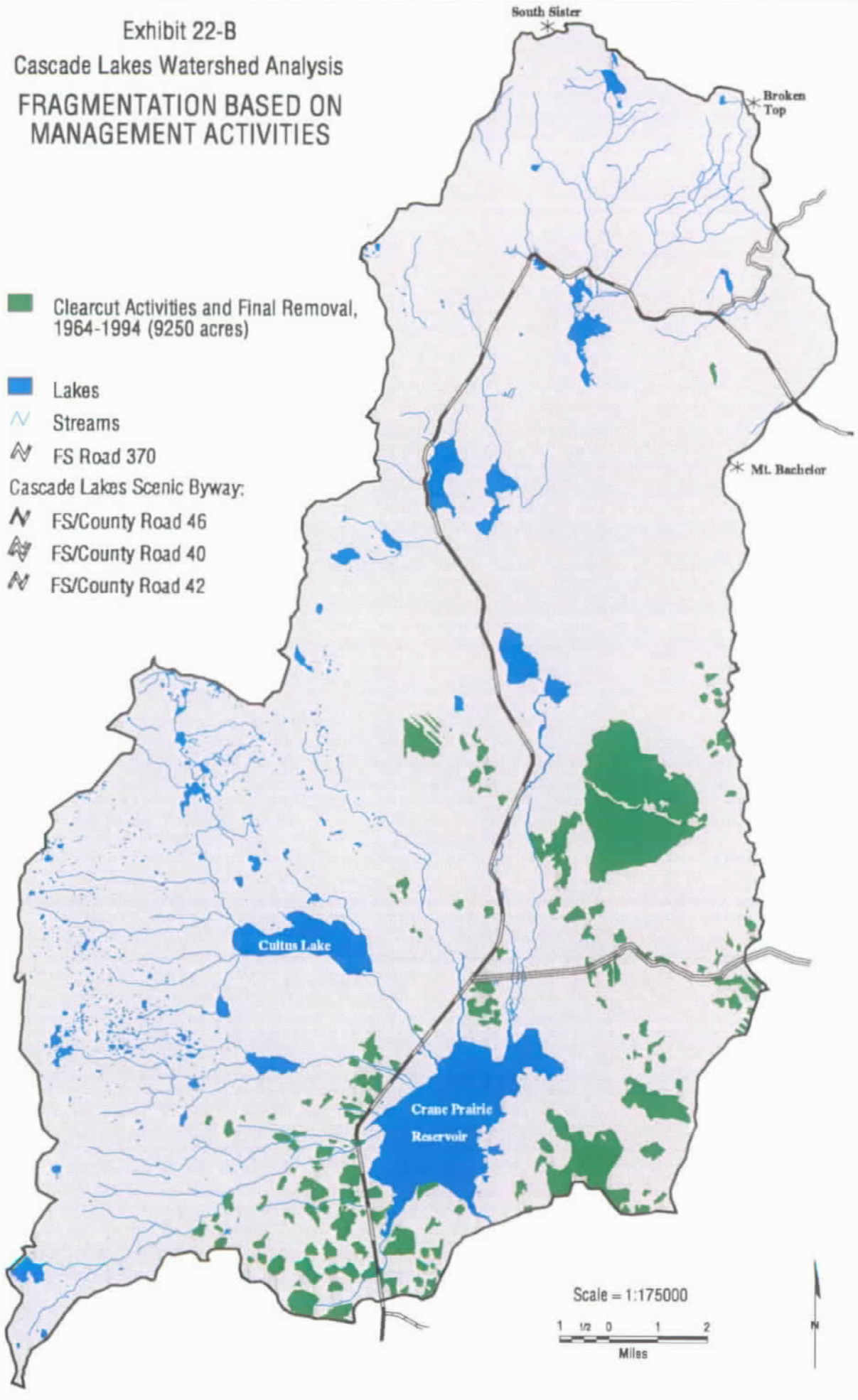


Exhibit 22-C

Cascade Lakes Watershed Analysis

FRAGMENTATION BASED ON MANAGEMENT ACTIVITIES

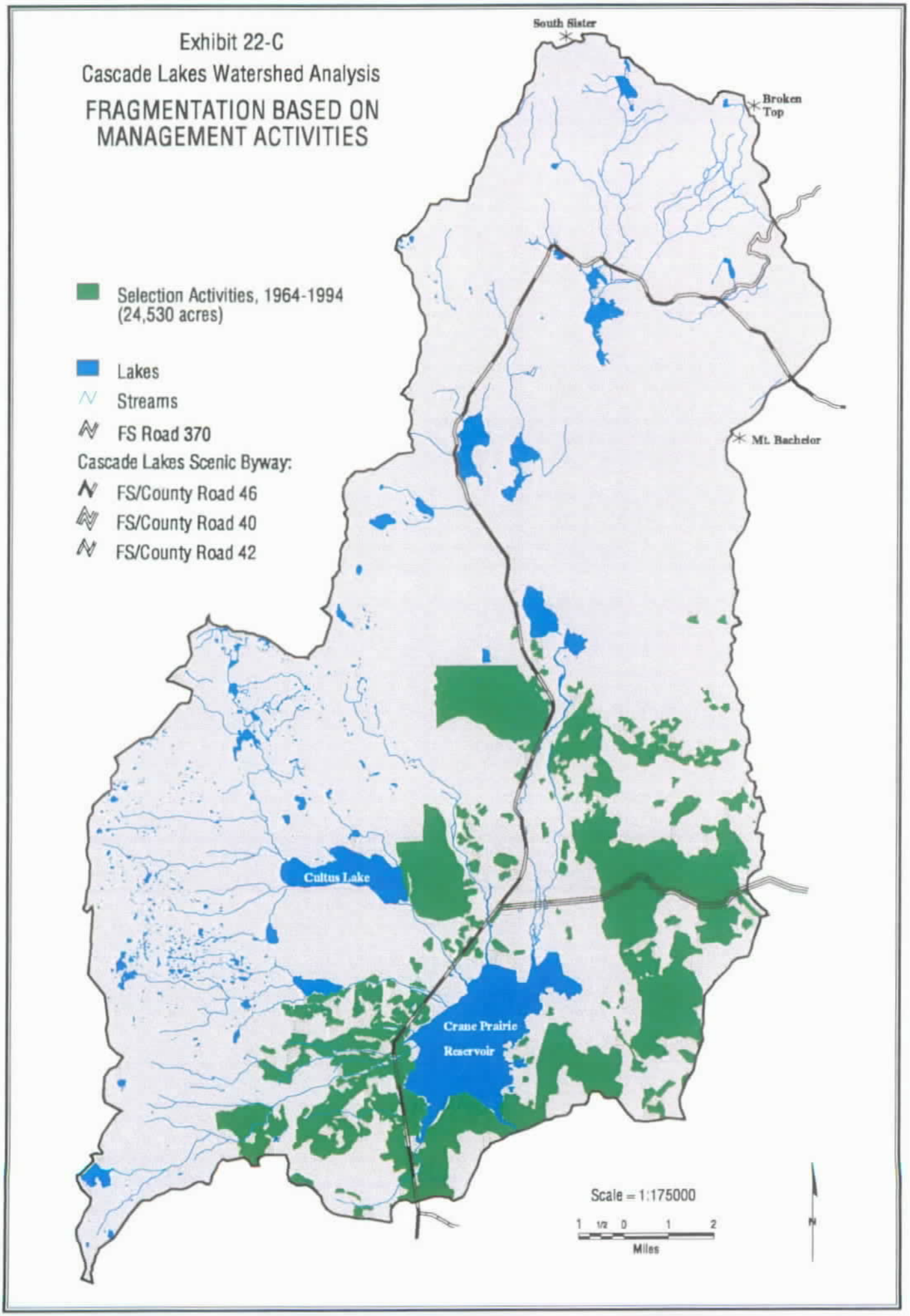
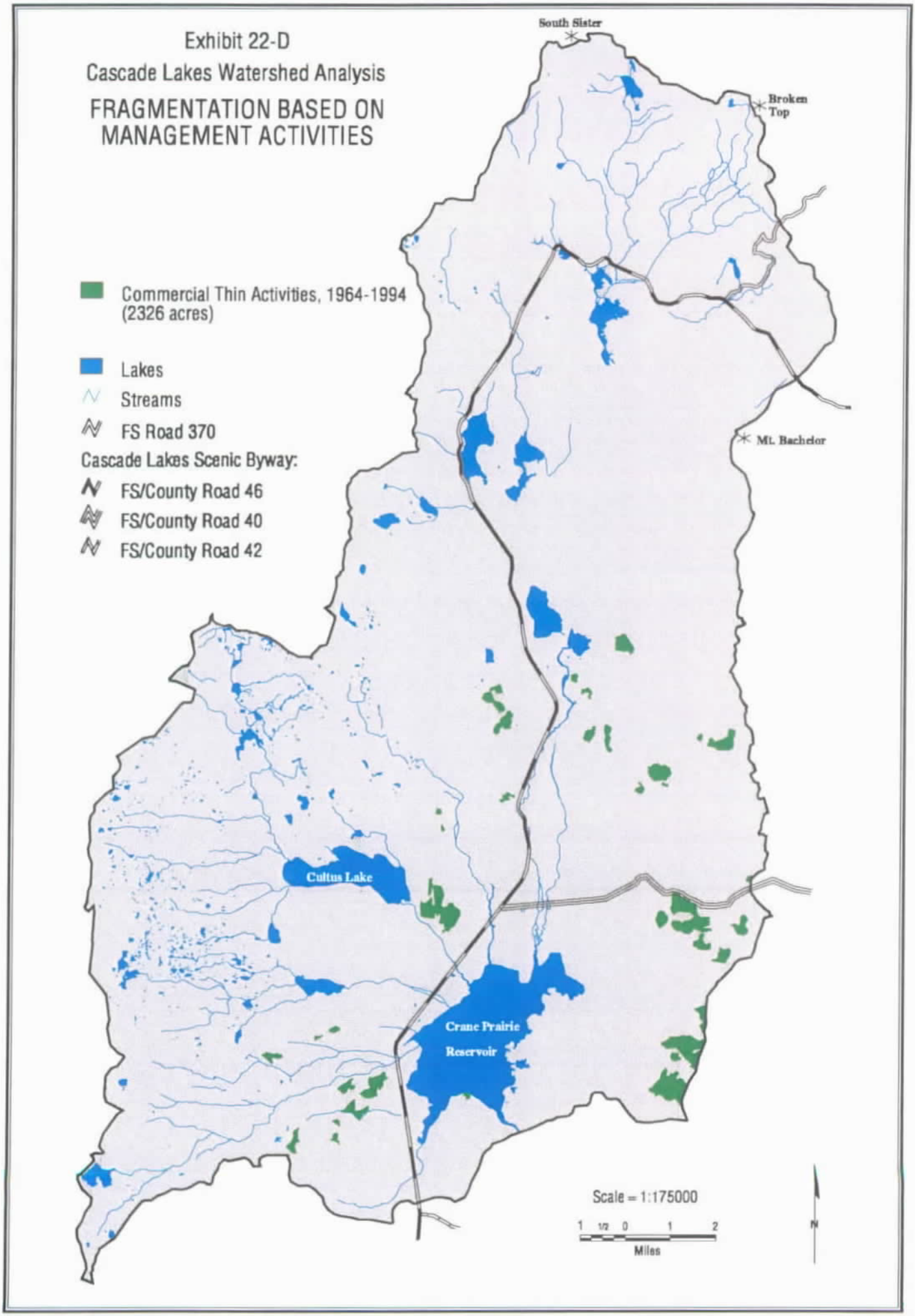


Exhibit 22-D

Cascade Lakes Watershed Analysis

FRAGMENTATION BASED ON MANAGEMENT ACTIVITIES



This fragmentation of the landscape has created a combination of problems that need restoration and mitigation if we are to sustain a viable ecosystem into the future. It has compromised wildlife corridors (See Wildlife Resource Section). Soil compaction and long-term site productivity have also been compromised in some areas and need restoration and rehabilitation treatments. Forest vegetation in non-harvest areas and within the understory of some harvested areas has become very dense and overstocked creating conditions favorable for insect outbreaks. Fire exclusion and management practices has alllowed less fire-resistant species such as lodgepole pine and true firs to become established within the mixed conifer areas and has lead to the development of complex fuel beds as these areas become dense and mortality begins to occur. Fires, when they do occur, will most likely be stand replacing fires such as the Pringle and Labor Fires of 1995. The mixed conifer dry plant association group is now more susceptible to large catastrophic wildfires than it was historically (See Fire Processes/Fuels Resource Section).

This shift has TEMPORARILY enhanced habitat for the northern spotted owl and other late-successional species from historic levels of suitability. In the short-term, shade tolerant tree species are able to achieve the higher canopy closure that is favored by the owl, as many of the large trees from the historic forest (favored for nesting and roosting) still remain. In the near future however, it is inevitable that habitat suitability will DRAMATICALLY DECLINE as forest vegetation patterns continue to change under the continuing impacts of various insects and diseases. It is expected that canopy closure will be considerably less, the combined result of root disease, defoliators and bark beetles. There will be a dramatic decrease in the number of large trees (both seral and climax), the combined result of bark beetles, mistletoes and root disease. These agents will also inhibit the ability of the forest to regenerate and grow future big trees. Catastrophic fires will, if they occur, cause a dramatic and immediate reduction in overall forest area.

Summary of Trends (C-Causes, EP-Environmental Processes, RA-Resources Affected)

1) Change in forest species composition, structure and canopy closure from predominately ponderosa pine (historic) to a mix of true firs and some ponderosa, western white pine and douglas fir (current).
   C - fire exclusion, selective harvesting practices, lack of stocking level control, drought.
   EP - natural succession, nutrient cycling, historic fire regimes, altered insect and disease cycles.
   RA - large seral tree species such as ponderosa pine, loss of fire climax habitat, loss of stand resiliency and ability to maintain and recover from disturbance events, loss of wildlife habitat/species due to fragmentation and road densities, loss of economic benefits related to large diameter trees.

2) Overall decrease in forest health resulting from insect and disease infestations.
   C - shift in forest structure and densities due to natural succession, fire exclusion and selective logging.

EP - natural succession processes, fire control.
RA - loss of big game habitat, loss of goshawk nesting habitat, loss of fur bearer habitat, loss of healthy lodgepole pine forests, loss of recreation facilities located within lodgepole pine forests, short-term increase in cavity nester habitat yet long-term loss of cavity nester habitat, increased recruitment of down woody material into streams, scenic quality along Cascade Lakes Scenic Byway.

Recommendations

Reintroduce fire into the ecosystem to maintain a more historic disturbance regime. This will help to perpetuate and maintain the large ponderosa pine tree character and associated structural characteristics.

Reduce stocking levels through thinnings from below in overstocked stands to retain the large tree character, thereby reducing tree competition and allowing for more nutrients and water to be concentrated on a smaller number of trees. This will help the stands to more become more healthy, vigorous and be better able to withstand insect and disease attacks, climatic drought conditions, stand replacement fires, and other environmental stresses.

Manage the understories through precommercial thinnings for preferred species composition (moving towards historic species composition), desired stocking levels, and desired large tree structure in pioneer seral stages.

Assess the opportunity to implement broad scale, large area treatments that are designed to meet various objectives, allow for a variety of treatments, and then leave the area for 30 years before re-entering with the next treatment activities. The exception would be to re-enter in the case of catastrophic fire events. Allow time for the proper planning of these types of broad scale treatments.

Within the armillaria disease areas some management options are available such as; 1) maintain and/or increase host vigor by seeding of preferred tree species, minimizing practices that lead to poor root development, 2) manage for disease tolerant species on mixed conifer sites, 3) minimize site disturbance during harvesting and avoid injuring host trees, 4) avoid frequent salvage entries, 5) sanitation thinning in pole and small size stands with less than 25% of the area infested and remove infested trees, 6) consider early final harvest and stump removal in pole and small size timber with more than 25% of the area infested and reforest with disease tolerant species, 7) remove large stumps thereby reducing the inoculum and regenerate with disease tolerant species.

Remove mistletoe infected overstory ponderosa pine trees within old shelterwood and seed tree plantations, and the area surrounding the plantations. The infected overstory needs to be

treated now by removal, pruning, or blasting (if deficit in snags) to allow for a healthy new stand of ponderosa pine to grow into the future.

Create openings and regenerate with ponderosa pine, rust resistant western white pine, and douglas fir to sustain and retain these historic species and their historic ranges across the landscape.

5) Mixed Conifer Wet PAG

Historic Vegetation Patterns and Disturbance Processes

Historically, mature stands within this PAG were primarily composed of early seral species of ponderosa pine mixed with climax species of fir and spruce. The 1882-1884 cadastral notes indicate heavy spruce, fir, and pine with understories of chaparral for the PAG areas southwest of Little Cultus Lake. The PAG areas in the northern portion of the watershed indicate heavy fir and pine with some spruce and hemlock. Small pines, buckbrush and good pinegrass were noted in the understory. The 1903 Cascade Forest Reserve notes mention the area southwest of Little Cultus Lake as mostly yellow pine of which only about 1/4 is of good quality the rest being rough and scrubby. Brush species mentioned were laurel, willow, and huckleberry. The Reserve notes mention scrubby lodgepole pine and hemlock, and scattered bodies of good quality yellow pine in the northern area of this PAG. The volume summaries also include "Lovely Fir" but makes no mention as to what species "Lovely Fir" was. The understory species noted include willow, buckbrush, and small lodgepole pines.

Historic fire regimes within the mixed conifer wet PAG are fairly complex and include both low and high intensity fires. The usual disturbance scenario involved approximately 30% of the stand being removed every 60 years either by fire or insects. Fires created small or large patches depending on the vegetation and weather conditions. Under severe weather conditions, fires created large patches (250 to 500 acres) on the landscape. Intermediate and low intensity fires separated the stand replacing ones, dividing the large patches into smaller patches, and thinning according to tree density. This tended to result in a clumpy, uneven-aged structure.

Present Vegetation Patterns, Processes, and Trends

The mixed conifer wet PAG is outside its HRV in two classifications; the small diameter pioneer and mixed/climax seral stages (Table II-7). This PAG has received minimal harvest activities and has structurally developed over time in response to fire exclusion and other natural processes.

Table II-7 - Cascade Lakes Watershed - Mixed Conifer Wet Current and Historic Size and Structure

	Mixed Conifer Wet		Total Acres: 7,406		
Size/Structure Class	**Year Time Frame**	**Pioneer Acres**	**Percent**	**Mixed & Climax Acres**	**Percent**
Grass/Forb/Shrub	1991 Historic	—	—	—	—
Seed/Sapling 0-4.9"	1991 Historic	0 0-1,481	0 0-20	0 0-1,852	0 0-25
Pole 5-8.9"	1991 Historic	370 222-1,481	5 3-20	1,333 370-2,222	18 5-30
Small 9-20.9"	1991 Historic	1,259* 0-815	17* 0-11	3,111* 740-2,370	42* 10-32
Medium/Large 21+"	1991 Historic	0 0-815	0 0-11	1,333 592-2,074	18 8-28

Current forest species composition and size/structure is much the same as the mixed conifer dry PAG. Site productivity is a little better and will allow both for higher densities and a greater proportion of fir species to be present and supported across the PAG landscape. It appears that there are no large scale or epidemic insect and disease problems associated with this PAG at this point in time. The moister soil conditions of this PAG have probably allowed the vegetation to remain in a healthier condition than surrounding areas and thus be more resilient to withstanding epidemic problems to date. The potential for these disease to become major problems does exits though. Insects to be aware of include the western spruce budworm (Choristoneura occidentalis) and douglas fir bark beetle (Dendroctonus pseudotsugae) which will affect the true firs and the douglas firs, the mountain pine beetle in lodgepole pine and the western pine beetle (D. brevicomis).

The exclusion of natural fire processes from these stands over the past 80 years or more has contributed both to this increase of mixed/climax seral species and larger size structure and to the development of complex fuel beds as tree and brush mortality increase. Fire exclusion has allowed non-fire resistant species such as lodgepole pine and true firs to become established within these mixed conifer areas.

Summary of Trends

Note: Severity of trends within the mixed conifer wet PAG is not as extreme as within the mixed conifer dry PAG.

1) Change in forest species composition, structure and canopy closure from predominately ponderosa pine (historic) to a mix of true firs and some ponderosa, western white pine and douglas fir (current).
   C - fire exclusion, selective harvesting practices, lack of stocking level control, drought.
   EP - natural succession, nutrient cycling, historic fire regimes, altered insect and disease cycles.
   RA - large seral tree species such as ponderosa pine, loss of fire climax habitat, loss of stand resiliency and ability to maintain and recover from disturbance events, loss of wildlife habitat/species due to fragmentation and road densities, loss of economic benefits related to large diameter trees.

2) Overall decrease in forest health resulting from insect and disease infestations.
   C - shift in forest structure and densities due to natural succession, fire exclusion and selective logging.
   EP - natural succession processes, fire control.
   RA - loss of big game habitat, loss of goshawk nesting habitat, loss of fur bearer habitat, loss of healthy lodgepole pine forests, loss of recreation facilities located within lodgepole pine forests, short-term increase in cavity nester habitat yet long-term loss of cavity nester habitat, increased recruitment of down woody material into streams, scenic quality along Cascade Lakes Scenic Byway.

Recommendations

Treat areas of disease problems with the most current management practices known that will reduce the spread of the diseases. Site specific analysis is needed for implementation.

Re-introduce fire into the ecosystem to maintain a more historic disturbance regime. This will help to perpetuate and maintain the large ponderosa pine tree character and associated structural characteristics.

Reduce stocking levels through thinnings from below in overstocked stands to retain the large tree character, thereby reducing tree competition and allowing for more nutrients and water to be concentrated on a smaller number of trees. This will help the stands to more become more healthy, vigorous and be better able to withstand insect and disease attacks, climatic drought conditions, stand replacement fires, and other environmental stresses.

Manage the understories through precommercial thinnings for preferred species composition (moving towards historic species composition), desired stocking levels, and desired large tree structure in pioneer seral stages.

Assess the opportunity to implement broad scale, large area treatments that are designed to meet various objectives, allow for a variety of treatments, and then leave the area for 30 years before re-entering with the next treatment activities. The exception would be to re-enter in the case of catastrophic fire events. Allow time for the proper planning of these types of broad scale treatments.

Create openings and regenerate with ponderosa pine, rust resistant western white pine, and douglas fir to sustain and retain these historic species and their historic ranges across the landscape.

3) Dry Lodgepole PAG

Historic Vegetation Patterns and Disturbance Processes

Historically, the lodgepole pine areas were a mix of open land recently disturbed by fire, areas of regenerating lodgepole, areas of pole sized trees, of mature trees, as well as areas of susceptible stands undergoing mountain pine beetle attack. Very few lodgepole pine would have achieved large size diameters, the exception being those trees growing on better sites. Within these constraints there was a great range of possible seral condition distribution, depending on beetle activity, and fire. Fire regimes varied slightly based on site. Most fires historically were the result of lightning strikes on the buttes where large trees were hit and then climatic conditions drove the fires downslope off the buttes into the lodgepole pine (Hopkins, 1995). Stand replacing fires of variable size appear to be the main resulting fire pattern in the area. This pattern suggests that while fires were small, large fires occurred at 20 to 30 year intervals and affected 50 to 1000 acres. These fires usually affected greater than 70% of the basal area (Refer to Fire Processes/Fuels Resource Section).

Lodgepole pine dwarf mistletoe (Arceuthobium americanum) was also an important agent which affected vegetation pattern in the historic forest reducing growth and inducing mortality. Dwarf mistletoe probably contributed to habitat diversity by providing small openings in the relative "sameness" of the lodgepole pine forest. The witches brooms and dead trees in mistletoe centers were probably a cause of extremely hot burns, again, creating variety on the landscape.

Present Vegetation Patterns, Processes, and Trends

The present vegetation patterns of this PAG are probably not outside the range of historic variation (Table II-8). While we will expect to see a significant shift in seral distribution from

mature trees to small trees because of the current outbreak, this expected change will still be within historic range.

Table II-8 - Cascade Lakes Watershed - Lodgepole Pine Dry Current and Historic Size and Structure

Lodgepole Pine Dry	Total Acres: 20,229		
Size/Structure/Class	**Year/Time Frame**	**Pioneer, Mixed, Climax**	
		Acres	**Percent**
Grass/Forb/Shrub	1991	1,416	7
	Historic	0-12,137	0-60
Seed/Sapling	1991	4,450	22
0-4.9"	Historic	0-10,115	0-50
Pole	1991	4,248	21
5-8.9"	Historic	2,022-16,183	10-80
Small	1991	10,115	50
9-20.9"	Historic	2,002-12,137	10-60
Medium/Large	1991	0	0
21+"	Historic	0+	0+

Note: Not reflected within the above table are the number of acres that have been affected by the mountain pine beetle. An estimate would be approximately 40% of the total acreage of this PAG.

At least half of the lodgepole pine within the watershed is structurally composed of mature stands (9 to 20.9 inch diameter class trees). Within this size class, the lodgepole does show variability with trees at the upper end of the range found on better sites, such as within riparian areas. A majority of the lodgepole within this class however, is probably found at the lower end of the small diameter range.

Much of the larger size lodgepole stands (small sawtimber size on table is dense and either is/or will be undergoing dramatic change in the near future. This overstocked condition is very conducive to epidemic outbreaks of the mountain pine beetle (Dendroctonus ponderosae). At present, mountain pine beetle activity is heavy in the southern half of the PAG over the past 5 years (See Exhibit 21). We expect that stands at risk or under present attack will be dramatically altered over the next decade. Since mountain pine beetle attacks in lodgepole commonly result in 80% or more mortality, a majority of these stands will revert to early seral conditions. The dead trees will provide habitat for some wildlife species in the short-term.

Timber harvest activities are, have been, for the most part salvage operations which removed beetle killed lodgepole from the 1980's beetle kill. These areas, in most cases, are now regenerating with an over-abundance of lodgepole seedlings. Since these salvage operations took only dead trees, residual mistletoe infected trees were often left in the overstory. As discussed in the previous PAG, well spaced live infected trees were not likely a common occurrence historically. More likely these would have been consumed in the ensuing fire. This practice is likely to result in wider mistletoe distribution over the landscape. In addition to the salvage, other silvicultural treatments, including commercial thinnings which removed the small diameter trees to create a well spaced stand of lodgepole that provides good habitat for goshawks have also occurred to a minor extent.

Although this PAG is within its HRV, it is at the stage in time where nature would burn the insect induced mortality, creating new openings and allowing for the regeneration of a new stand. Dead standing trees with red needles and red needled witches brooms become instant candles when fire reaches the brooms. Dead trees that have fallen over or blown down create massive acreage of jackstraw timber that become high fire hazard areas. These stands usually have an associated overstocked understory thus creating and helping to fuel the fire ladder. The risk of catastrophic loss due to fire within the lodgepole pine type is very high.

While these disturbance regimes are a part of the natural ecological processes that shape our forests, the extensive mortality may not be socially acceptable especially along the scenic corridors and around the developed recreation areas and access to these areas. In general, the public does not like to see red needled trees and dead standing trees. The high fire hazard as well as the hazard trees present a safety hazard to recreationists within the watershed. Silvicultural treatments can, in many cases protect critical high use areas from additional mortality.

Summary of Trends

1) Increase in insect activity and associated mortality in lodgepole pine forests.
   C - natural development of dense, overstocked stands due to fire suppression, lack of stocking level control within dense stands creating conditions favorable for epidemic insect outbreaks.
   EP - natural succession, fire control, decline in forest health and vigor.
   RA - loss of big game habitat, loss of goshawk nesting habitat, loss of fur bearer habitat, loss of healthy lodgepole pine forests, loss of recreation facilities located within lodgepole pine forests, short term increase in cavity nester habitat yet long term loss of cavity nester habitat, increased recruitment of down woody material into streams, decreased scenic quality along the Cascade Lakes Scenic Byway.

2) Overall increase in dwarf mistletoe incidence and severity.
   C - shift in forest structure and densities due to natural succession, fire exclusion and selective logging.

EP - natural succession processes, fire control.
RA - loss of big game habitat, loss of goshawk nesting habitat, loss of fur bearer habitat, loss of healthy lodgepole pine forests, loss of recreation facilities located within lodgepole pine forests, short-term increase in cavity nester habitat yet long-term loss of cavity nester habitat, increased recruitment of down woody material into streams, decrease in scenic quality along the Cascade Lakes Scenic Byway and recreation areas, hazards to public along travel corridors and developed recreation sites.

Recommendations

Initiate pro-active protection measures such as stocking level control in green stand of lodgepole pine through commercial thinnings of the overstory in a timely manner to 'beetle' proof the stands, provide wildlife connective habitat for late successional species, replacement and recruitment snags for woodpecker species, and provide economic products to the community.

Manage the lodgepole pine understory through pre-commercial thinnings to maintain stocking level control, promote healthy stands, and to provide for a variety of wildlife habitat conditions.

Salvage the dead standing and down lodgepole pine except as where needed for wildlife snags and associated habitat, for coarse woody debris and long term site productivity, and to reduce the fire hazard while providing economic products to the community.

Initiate a fuels management program to reduce the risk of wildfire events while still providing for long-term site productivity.

4) Wet Lodgepole Pine PAG

Historic Vegetation Patterns and Disturbance Processes

Historically, the lodgepole pine areas were a mix of open land recently disturbed by fire, areas of regenerating lodgepole, areas of pole sized trees, of dense mature stands of trees, as well as areas of susceptible stands undergoing mountain pine beetle attack. Fire regimes within the lodgepole pine wet area occurred every 30 to 40 years and involved removal of approximately 30% of the stand. Fires created small or large patches depending on the vegetation and weather conditions. Under severe weather conditions fires created large patches (250 to 500 acres) on the landscape. Intermediate and low intensity fires often occurred in between stand replacment fires and divided the large patches into smaller patches. (See Fire Processes/Fuels Resource Section).

Present Vegetation Patterns, Processes, and Trends

As with the dry lodgepole PAG, the present vegetation patterns of this PAG are probably not outside HRV. While we will expect to see a significant shift in seral distribution from mature trees to small trees because of current outbreak, this expected change will still be within historic range. Over 40% of the wet lodgepole pine within the watershed is structurally composed of mature stands (i.e. small sized diameter trees, Table II-9). Within the wet lodgepole pine areas, trees will attain diameters in the upper limit of the small size class due to better growing site conditions.

The wet lodgepole pine stands are very dense and exceed stocking levels necessary to maintain lodgepole as a mature forest component. This overstocked condition is very conducive to epidemic outbreaks of the mountain pine beetle due to an overabundance of food that the trees provide for the beetles. Even large diameter trees (20 inches) along riparian areas that may have reduced densities are being attacked by the mountain pine beetle, although these attacks do not always result in mortality due to better resiliency of the trees. The mountain pine beetle is currently affecting approximately 60% of the wet lodgepole pine.

Table II-9 - Cascade Lakes Watershed - Lodgepole Pine Wet Current and Historic Size and Structure

	Lodgepole Pine Wet	**Total Acres: 17,182**	
Size/Structure/Class	**Year or Time Frame**	**Pioneer, Mixed, Climax**	
		Acres	**Percent**
Grass/Forb/Shrub	1991	0	0
	Historic	0-10,309	0-60
Seed/Sapling	1991	687	4
0-4.9"	Historic	0-10,309	0-60
Pole	1991	9,450	55
5-8.9"	Historic	1,718-13,746	10-80
Small	1991	7,045	41
9-20.9"	Historic	0-10,309	10-60
Medium/Large	1991	0	0
21+"	Historic	0+	0+

Note: Not reflected in this table are the number of acres that are presently affected by the mountain pine beetle epidemic and are undergoing dramatic change. Aerial survey maps indicate that almost all of the larger lodgepole is presently being affected or will soon be affected.

In general, vegetation patterns and trends are similar to those of the lodgepole dry PAG. The main difference is that this PAG can carry higher densities of trees before incurring significant risk to MPB. In addition, the likelihood of catastrophic fires is not as great in this PAG.

Recommendations

See Lodgepole Pine Dry PAG.

Summary of Trends

See Lodgepole Pine Dry PAG.

5) Mountain Hemlock PAG

Historic Vegetation Patterns and Disturbance Processes

The structural patterns, densities, and species composition of the mountain hemlock PAG developed slowly over many hundreds of years. These patterns developed along with overall changes in climate and topography. Dickman and Cook, 1988, propose that the system is still reestablishing its equilibrium following the transition form the warm dry conditions of the hypsithermal and the Mazama ash, which took place 3,500 years ago, to the recent cooler climatic conditions. The hypsithermal favors pines both directly and indirectly by promoting fires, and the Mazama ash also favors pine growth. The cooler climatic conditions favor a more abundant, broader distribution of mountain hemlock, and therefore laminated root rot. Since equilibrium is established slowly, it may never be reached since climatic shifts may redirect vegetation patterns in a different direction.

Laminated root rot is a natural component of the mountain hemlock ecosystem and has developed over time in conjunction with this vegetation type. This root rot is the major disturbance agent occurring within the mountain hemlock vegetation type and contributes to the varied structural characteristics present. The root rot centers expand at a rate of about one linear foot per year and each year the trees on the edges of the openings become infected. Openings in the stand are colonized by species resistant to the root disease such as lodgepole pine and western white pine. Mountain hemlock will also re-establish itself within these openings but will probably not attain a large size within the root disease pocket. The western white in turn is affected by an introduced pathogen, white pine blister rust, caused by the fungus Cronartium ribicola. Intensity of this exotic disease is quite variable, and depends on the suitability of environmental conditions for species of Ribes, the alternate host for the white pine blister rust. As the vegetation within the root rot center becomes established it provides cover for wildlife, diversity in stand structure, and soil stability. This disturbance process should be allowed to continue as it is a natural component of the ecological process and helps to create patterns and patches on the landscape. (See Exhibit 23, Patterns Caused by Laminated Root Rot in Mountain Hemlock, 1991).

Hemlock dwarf mistletoe, Arceuthobium tsugense, is an occasional gap-former which also affects the mountain hemlock component of the stand. Infected trees eventually die and create small openings in the stand. Fir, spruce and pine in association with the mountain hemlock is mentioned throughout the range of the mountain hemlock PAG by the 1882-1884 cadastral survey notes. This vegetation is referred to as scrubby or small in size. The Cascade Forest Reserve notes also indicate these species as having little value for lumber and also little value for any purpose. A scattering of white pine is noted west of what is now Little Cultus Lake. Understory shrub species include will, huckleberry, alder, buck brush and laurel. Some small lodgepole pine and dense firs were also noted.

Present Vegetation Patterns, Processes, and Trends

Vegetation patterns within this PAG fall within HRV. At present, the mountain hemlock plant association groups within the watershed are shifting towards a more 'climax' mountain hemlock forest type and an associated increase in the abundance and size of laminated root disease mortality centers. This shift is thought to be part of historic processes and has not been influenced to any significant degree by human intervention (Dickman and Cooke 1988). Very little management has occurred in this PAG because it falls into Congressionally Withdrawn (wilderness) and Administratively Withdrawn (dispersed recreation) land use allocations.

This forest is characterized by dense stands with closed canopies of pure mountain hemlock to stands with mixes of tree species where mountain hemlock is still a dominant or co-dominant tree specie. Shasta red fir is also found at the higher elevations within this PAG. Structurally, the majority of the mountain hemlock type is composed of medium/large size structures and are multi-sized and multi-storied. This determination is based on ISAT data and brief seral definitions of mountain hemlock. Compositionally, the old growth encompasses both older forests of early seral species, such as fire dependent species, and forests in later successional stages dominated by shade tolerant species.

Exhibit 23

Cascade Lakes Watershed Analysis

PATTERNS CAUSED BY LAMINATED ROOT ROT IN MOUNTAIN HEMLOCK, 1991

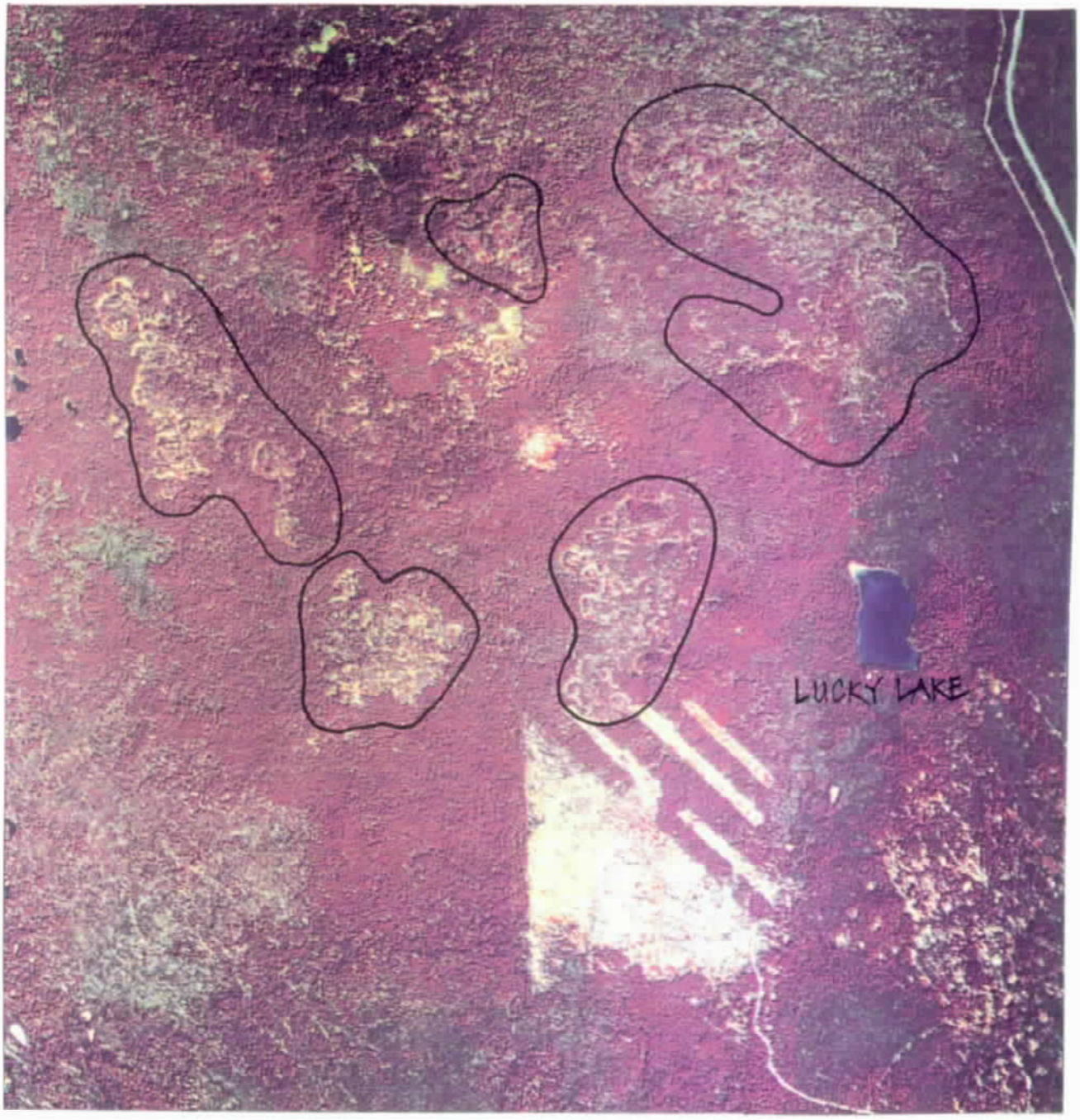


Table II-10 - Cascade Lakes Watershed - Mountain Hemlock Current and Historic Size and Structure

Mountain Hemlock		Total Acres: 69,886			
Size/Structure/Class	**Year or Time Frame**	**Pioneer**		**Mixed & Climax**	
		Acres	**Percent**	**Acres**	**Percent**
Grass/Forb/ Shrub	1991	699	1	—	—
	Historic	0-3,494	0-5	—	—
Seed/Sapling 0-4.9"	1991	1,398	—	1,398	2
	Historic	0-3,494	0-5	0-2,097	0-3
Pole 5-8.9"	1991	2,097	3	23,062	33
	Historic	0-3,494	0-5	0-27,954	0-40
Small 9-20.9"	1991	2,097	3	30,750	44
	Historic	0-2,097	0-3	3,494-34,943	5-50
Medium/Large 21+"	1991	699	1	7,687	11
	Historic	0-699	0-1	3,494-13,977	5-20

Note: Approximately 20% of the lodgepole pine associated with the mountain hemlock is dead due to the mountain pine beetle.

Note: Very little work has been done to date to define seral stages for the mountain hemlock areas due to insufficient data for the central Oregon mountain hemlock area and also these areas are not managed for timber production. All of the mountain hemlock PAG within the watershed is located within Congressionally and Administratively Withdrawn areas. Field verification of data interpretation is recommended.

Summary of Trends

1) Mountain hemlock types are moving towards late-successional forests which provide unfragmented and unroaded refugia for wildlife species.
   C - natural ecological processes, exclusions of fire, management protection through land base allocations, low economic value of timber.
   EP - forest succession.
   RA- maintains optimal wolverine habitat, provides outstanding recreation opportunities and scenic quality, provides north-south and east-west travel corridors for spotted owl, fur bearers, and big game, provides habitat for late-successional species.

Recommendations

Allow ecological processes to continue.

6) Sparsely Vegetated PAG.

Historic Vegetation Patterns and Disturbance Processes

Historically, fire played a large role in shaping the vegetation of this PAG. Fires resulted in the establishment of seral white-barked pine communities over the fire intolerant mountain hemlock communities. Insect and disease activity may have had a role in shaping "between fire" successional rates and patterns. Glaciation and current snow packs/avalanche also had an effect.

Present Vegetation Patterns, Processes, and Trends

Fire suppression has resulted in a slow progression toward the replacement of white-barked pine with late seral mountain hemlock. Concentrated recreational use in this vegetation type near lake shores and on Mt. Bachelor is damaging native vegetation, decreasing plant diversity and precluding regeneration.

Summary of Trends

1) Natural processes and fire suppression are moving vegetation structure and composition towards mid to late seral stages.
   C - long time intervals between fire events.
   EP - natural succession.
   RA - plant and animal communities.

2) Recreational users are damaging native vegetation in high use areas.
   C- increasing recreation use associated with wilderness and dispursed recreation areas.
   EP - natural succession.
   RA - plant and animal communities.

Recommendations

Consider the re-introduction of prescribed fire into the wilderness

Protect fragile plants and soils around lakes and at Mt. Bachelor by redirecting and/or restricting user access and travelways.

Provide educational and interpretive information describing the environment and ecosystem and why it needs protection.

7) Meadow PAG

Historic Vegetation Patterns and Disturbance Processes

Present Vegetation Patterns, Processes, and Trends

Historically, fires played a larger role in the maintenance of the open character of the meadows by controlling shrub and tree succession into the edges of the meadows. With fire exclusion, tree species such as lodgepole pine, mountain hemlock, and englemann spruce have become established along the edges and interior of most meadows, thus, decreasing the size of meadow openings.

The creation of Crane Prairie Reservoir and other activities which have channeled water into different flow patterns than existed historically, has affected meadow distribution. The creation of Crane Praire Reservoir itself resulted in a major reduction in meadow area within the PAG.

Little or no management has occurred within the meadow areas and some have become severely impacted by recreation activities. Impacts may be enough to set the meadow back to an earlier seral condition and may have long term detrimental impacts to the meadow plant diversity, associated soil quality and vegetative structure. Introduction of exotic species has become a problem in some meadow ecosystems.

Summary of Trends

1) There are fewer acres of meadows now then there were historically due to fire suppression and encroachment of tree species such as lodgepole pine into the meadow area. This trend is expected to continue unless an effort is made to reverse it.
   C - drought, encroachment of conifers into meadow ares, impounding of water, drainage ditching across meadows, increased recreation use, exclusion of fire.
   EP - Natural plant succession, surface water flows, ground water flows.
   RA - Meadow and riparian wildlife and plant species, meadow habitat.

2) Change in composition of wetlands.
   C - creation of Crane Prairie Reservoir, channeling of water plow, grazing, invasion/introduction of exotic species, recreation use, compaction of soil resource, fire exclusion.
   EP - natural plant succession, natural soil restoration/rejuvenation, surface water flows.
   RA - wetland plant and animal species.

Recommendations

Restoration of natural water flows and meadow complexes in the Deschutes River and Snow Creek areas between Crane Prairie and Lava Lake.

Remove conifers encroaching within meadow areas.

Direct recreation use to specific areas.

Promote prescribed fires within meadows.

Restore natural vegetation to meadow and riparian areas.

Consider prescribed fire within meadows.

Initiate activities and protection to reduce compaction.

UNIQUE VEGETATIVE FEATURES

Engelmann Spruce Bottomlands

Engelmann spruce is present within lodgepole pine wet PAG's and riparian habitats within the watershed. Approximately 100 acres of spruce bottomlands are present within the watershed today based on ISAT data. A 1950's imagery map shows approximately 1800 acres of engelmann spruce (See Exhibit 19). This indicates that the spruce areas within the watershed, associated with wet bottomlands have decreased in acreage. Field verification and current mapping is recommended for these spruce areas.

Forested Lavas

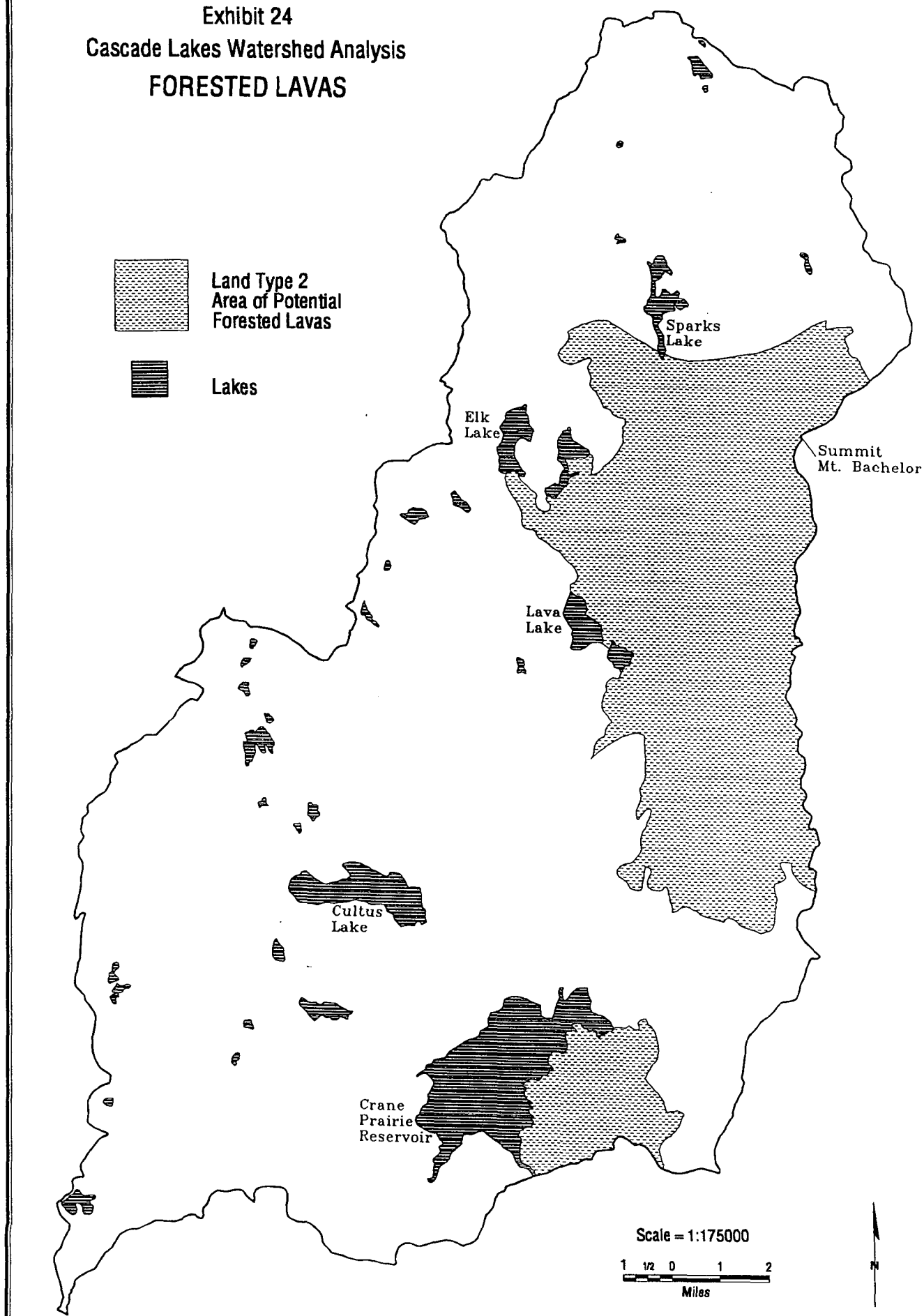
The forested lavas comprise approximately 33,000 acres of land within the watershed (approximately 20% of the watershed land base). The lavas are found within the mountain hemlock PAG on the northwest to southwest side of Mt. Bachelor and within the mixed conifer dry PAG to the south and southwest of Mt. Bachelor. (See Exhibit 24, Forested Lavas).

The stand development and vegetation supported by the lavas is varied in species, structure, composition, regeneration potential, and disease problems which are the result of the complex geologic formation of this land type. A range of surface and subsurface rocky soil gradients exist on the lavas. (See Soil Resource Section and Geology and Climate Section). Some forested lavas where the productive potential and regeneration suitability of the site is good have been successful with natural regeneration. Other sites though, with very shallow soils that

Exhibit 24

Cascade Lakes Watershed Analysis

FORESTED LAVAS



are sensitive to disturbance and have a resulting lower productive potential, have not been fully successful in regeneration whether it be natural or artificial.

The forested lavas are experiencing armillaria problems due to past harvesting which has promoted the spread of the armillaria inoculum. A concern for this area also is the potential for a western spruce budworm outbreak due to the high stocking levels of fir trees which were not present historically. This could greatly affect the sustainability of the forested lava ecosystem. This unique area is very fragile and management activities should be undertaken with care.

Thinnings from below should be initiated as soon as possible to reduce stocking levels. Monitoring should be associated with these thinnings to clarify the effectiveness of the treatments under varying stand conditions and disease levels.

A research study initiated by PNW in conjunction with Oregon State University was started in the summer of 1994 to gain a more in-depth understanding of this forest development. This research will also help identify the different ecological processes occurring on these lands to facilitate appropriate management activities.

Western White Pine and Shasta Red Fir

Along the high flanks of the cascades, Mt. Bachelor, and other high elevation buttes/mountains, white bark pine, western white pine, and shasta red fir can be found. These tree species are located mainly within the range of the mountain hemlock PAG. Western white pine also is found within the mixed conifer wet and dry PAG's. Western white pine is showing a decline in numbers due to losses from the white pine blister rust and mountain pine beetle.

It is recommended that when these species are found within activity areas that they are treated as a preferred specie and retained within the stand. Where feasible, rust resistant western white pine and shasta red fir should be planted to retain and maintain these species within their natural range across the landscape.

SENSITIVE PLANTS, SURVEY & MANAGE PLANTS AND NOXIOUS WEEDS

OVERVIEW

There are four Sensitive plants and three Watch List plant species that are known to occur within the Cascade Lakes Watershed. In general, these species are doing well however, fire supression is contributing to the decline of available habitat for Jepson's monkeyflower and Newberry gentian. Visitor trampling may be responsible for small observed declines in the population size of the pumice grapefern. Most Survey and Manage Species known to occur with the watershed are of undetermined status. Those known to occur in the Outback Landscape Area are presumed to have population sizes similar to historic conditions. The mountain hemlock PAG which covers this landscape area falls well within its range of historic variability for processes, structure and patch pattern.

Sensitive Plants:
Pumice grapefern - Botrychium pumicola: 2 sites, Recreation/Alpine Tephra Landscape Area
Shasta arnica - Arnica viscosa: 1 site, Recreation/Alpine Tephra Landscape Area
Newberry gentian - Gentiana newberryi: 1 site, Recreation/Alpine Tephra Landscape Area
Jepson's Monkeyflower - Mimulus jepsonii: 5 sites, Recreation/Riparian & Timber/Forest Products Landscape Areas

Watch List:
Golden alpine draba - Draba aureolus: 2 sites, Recreation/Alpine Tehpra Landscape Area
Buxbaum's sedge - Carex buxbaumii: 1 site, Recreation/Riparian Landscape Area
Stiff club moss - Lycopodium annotinum: 1 site, Recreation/Riparian Landscape Area

All of these species are adapted to specialized environments:

Full sun, sparsely vegetated alpine environments: Pumice grapefern, Shasta arnica, and Golden alpine draba.
Full sun, bare soil openings in wet mixed conifer, dry mixed conifer and lodgepole wet and dry plant association groups: Jepson's monkeyflower.
Full sun, wet to moist meadows in montane to subalpine forests: Newberry gentian and Buxbaum's sedge.
Closed to partially closed canopy mountain hemlock forest on rotting logs: Stiff clubmoss.

Several other Sensitive plants have moderate to low potential habitats that exist in the watershed. Five "Survey and Manage plants" listed in the Northwest Forest Plan for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl are known to occur within the watershed (See Appendix A-3).

HISTORIC AND CURRENT CONDITIONS

The Recreation/Alpine Tephra Landscape Area

Sensitive and Watch List species known from the sparsely vegetated areas of the Recreation/Alpine Tephra Landscape Area were historically quite similar in extent to current observations. Population size may have been greater where disturbances such as trampling from forest visitors, trail construction, ski area development would have been absent or low frequency and individual or small groups of plants were not lost.

Current monitoring of population size of the pumice grapefern indicatate that populations are decreasing slowly on the summit of Mt. Bachelor and remaining stable on the side slopes of Broken Top. Monitoring has been completed for three years however, trends are still too early to establish with certainty. Trampling by visitors to the summit of Mt. Bachelor during the summer is the primary suspected cause for the observed decline. Monitoring of the Newberry gentian and Watch species has not been completed. Habitat suitability for the Newberry gentian is declining with the exclusion of fire in meadows. Populations of this species are potentially threatened by visitor trampling in meadows adjacent to high use lakes (Todd Lake).

The Recreation/Riparian and Timber/Forest Products Landscape Areas

Historically habitat conditions for certain Sensitive, Watch List, or Survey and Manage plant species may have provided more extensive area and better growing conditions for flowering and vegetative reproduction. Natural disturbances such as fire in the lodgepole PAGs, mixed conifer PAGs would have created full sun openings and in some cases bare soil for early seral species, Jepson's monkeyflower. Natural fire frequencies in these forest PAGs would have promoted more resiliency to insect, disease and fire disturbance events that would make the probability of large scale noxious weed infestations low. Fire would have also maintained the open character of moist meadows and riparian ecotones for species such as Newberry gentian and Buxbaum's sedge. Until recently, the riparian ecotones were weed free and plant biodiversity was predominantly high except in concentrated areas of recreational use such as Elk Lake Resort. Current populations of Jepson's monkeyflower in the wet and dry mixed conifer PAG's appear to be declining. In some years, populations disappear. Increased shade, soil litter, and lack of fire are contributing to this decline.

The Outback Landscape Area

Historically the distribution and abundance of Allotropa virgata may have been similar to current conditions within the mountain hemlock PAG where small openings warmed the organic layer and promoted growth of this saprophytic species. These openings may have been maintained by laminated root rot pockets.

Trends:

Decline in available habitat for Jepson's monkeyflower in lodgepole pine and wet and dry mixed conifer PAG's.
Decline in available habitat, absence of natural fire and increased trampling in moist meadows where the Newberry gentian and Buxbaum's sedge occurs.
Slight decline in population size of pumice grapefern on the summit of Mt. Bachelor from trampling during summer months. Data inconclusive at this time.
Increase in noxious weeds along the road prisms and riparian areas of the watershed. Potential for spread into unstable adjacent forests after ground disturbance or wildfire is very high.

Recommendations:

Integrate vegetation management treatments in the wet and dry mixed conifer PAG's and the lodgepole PAG's that include removal of heavy fuel loads, open the canopy where needed (including meadows) and do not heavily mix the soil (deep burial of existing native seed banks). Mimic role of natural fire or implement prescribed fire in these PAG's.

Continue monitoring of pumice grape fern populations. Reassess population status and protection strategies to address concerns over population declines. Camouflage and discourage use of a user created trail adjacent to the Broken Top pumice grapefern population.

Assess current status of known populations of survey and manage species. Develop a literature search that stratifies habitat requirements for groups of survey and manage species so that future management and vegetation restoration procedures can be designed by plant association not species by species.

Control noxious weeds aggessively along road prisms where they occur within and adjacent to the watershed. Control canary reed grass aggressively in reparian areas where it occurs. Use of herbicides is recommended where appropriate.

FIRE PROCESSES/FUELS RESOURCE

OVERVIEW

Fire is an important disturbance process in the watershed. Fire intensity ranges from moderate to high intensities expected in a small portion of the southeast boundaries to moderate intensities in the northeast and central, and low intensities in the higher elevations on the western boundary.

After interpreting all the information and data from this analysis, the following can be concluded:

1. Historic fire records indicate that fire occurrence was moderate and that fires affected larger areas in the Cascade Lakes Watershed. Burned acreage appeared to be greater (30,000 acres historic vs. 2,000 acres current).

2. Currently, the landscape has a fire return interval that is prescribed by management rather than by fuels and the environment. Fire suppression has resulted in extended fire return intervals and increased fire intensities, particularly in the moderate fire regime.

3. The fire return interval in all but the high elevation portion of the watershed has been lengthened significantly. There are significant increases in the fuel accumulations in the wet and dry lodgepole pine PAG's. The combination of large dense patches and heavy fuel accumulations in the central lodgepole and eastern dry mixed conifer PAG contribute to increasing potential for catastrophic fire events across the landscape.

4. Hazards associated with fire suppression have increased to the point where much larger areas can be expected to burn, especially in the dry lodgepole stands. Additionally, suppression cost can be expected to increase.

5. Changes in fire occurrence patterns indicate that the distribution and frequency of fire on the landscape has been altered. Roading and recreation have increased the number of ignition sources by approximately 50% since the 1950's. Areas of particular concern include the undeveloped camping areas along the Deschutes River, Cultus Lake, and Crane Prairie Reservoir.

6. Fire suppression has moved vegetation towards the later seral stages and has resulted in the almost total elimination of high elevation early seral habitat.

CLIMATE

The Cascade Lakes Watershed's major geographical area is represented by Oregon's high plateau, a region that is bordered by the Cascades on the west and several minor mountain ranges on the south and east. Due to generally high elevations, the plateau has cool temperatures and receives a significant amount of snow in the winter. Its distance from the coast, coupled with its location downwind of the Cascades, causes its annual precipitation to be lower than in the mountainous areas surrounding it. The temperatures vary considerably during each day and throughout the year. At the Wickiup Dam weather station, operated by the State of Oregon meteorological department which has an elevation of 4,360 feet, the average maximum temperatures are from the high 70's in the summer and range to the mid 40's in winter. Average minimum temperatures range from near 40 in the summers to the high teens in the winter. Precipitation at Wickiup Dam is around 0.7 inches in the summer months and averages 21 inches for the year (Oregon Climate Zone Summary, 1993).

The weather data collected from Round Mountain remote automated weather station (RAWS), indicates that the winter lows average in the low twenties and the summer high temperature are in the mid-eighties. Precipitation means for 31 years of data at Round Mountain is at 42 inches a year. The wind speeds in the summer average about 7 to 10 miles per hour and are quite windy during the winter months of January, February, and March. The primary wind direction is from the south-southeast in the beginning of the year and average west-southwest during the summer months. The average means for herbaceous fuel moistures shows mid-March to be representative of a quick green-up with fuel moistures at 200% and then dropping in late May below 30%.

The elevation at the RAWS station is at 6,400 feet and is located approximately 15 miles southwest of Bend, Oregon. The climate in the Cascade Lakes contribute to the frequency, intensity, size, and distribution of fire on the landscape. The relatively mild climate in the Cascade Lakes, with a high probability of thunderstorms and lightning during July and August. More than 70% of recorded lighting starts within the watershed occurred during this period. The combination of these factors contribute to the area's inherent fire susceptibility. Drought trends, as experienced during the late 1800's, 1920's, 1980's, and the 1990's, induce higher intensity, larger scale burning as well.

HISTORIC CONDITION

Fire and Vegetation

The following is a description of the probable historical role fire played in the watershed, including a description of the associated fire behavior and effects likely exhibited in the absence of management activities.

Fires affected larger areas in the Cascade Lakes Watershed. Burned acreage appeared to be greater (30,000 acres historic vs. 2,000 acres current). Before fire suppression, fires burned, with less intensity in those areas influenced today by human use. In areas where expanses of continuous high hazard stand conditions exist, large, exceptionally intense fires burning on the landscape could remove extensive patches of vegetation and organic matter (stabilizing root mass).

Estimates from the current successional development, stand age, and evidence of fire in current stands as obtained from the Deschutes National Forest Fire Atlas, suggest that approximately 12,000 acres were affected by fire by the turn of the twentieth century in the Cascade Lakes. Large fire occurrence after organized fire suppression began around 1910 was rare. Since 1910, the largest recorded fire to occur was the 1994 Four Corners Fire.

When high intensity burns occur in riparian areas, most vegetation is destroyed. The area becomes subject to bank and surface erosion without the stabilizing and filtering nature of riparian vegetation. Lower intensity fires however, can actually increase riparian vegetation. Many of the deciduous species found on these wet sites resprout following fire, and some put up new sprouts for each burned plant thus increasing plant density. Because relatively little is known about specific interactions between Pacific Northwest riparian habitats and fire, further research is needed to determine the effects of burning in riparian areas.

High Elevation and Mountain Hemlock PAGS

Fires burning on these relatively harsh sites tended to be of low intensity and often smoldered through larger fuels until reaching a natural barrier or going out on their own. Stand replacement occurred in areas where fuels were heavier and more continuous. Fire ignitions are frequent due to the number of lightning strikes the areas receive but most burns were rarely more than 5 acres (Hopkins, 1995). Larger fires burned infrequently, with an average return of frequency of 60 to 80 years and rarely exceed 100 acres in size (Hopkins, et al 1994). Stand replacement events were not uncommon and were a function of fuels and climatological conditions. Fires, therefore, have significantly influenced the structure and development of these stands. Fires created small patches on the landscape, thinning or destroying stands according to fuels and fire intensities. Additionally, the non-forested types such as mountain meadow, shrubfields, parkland, and subalpine fescue-sedge may have been similarly influenced. A variable spatial and temporal landscape pattern emerged over time in these areas.

There are approximately 56,118 acres of this PAG in the analysis area.

Sparsely forest areas and the moist meadow series can also be grouped into this disturbance regime. These stands are located in the northern portion of the watershed and in sparsely forested areas of the Cascade crest. They have had a minimal effect on overall landscape pattern.

There are approximately 5,654 acres of this PAG in the analysis area.

Mid Elevation Wet Lodgepole and Wet Mixed Conifer PAGS

In the disturbance regime, 20 to 70 percent of the basal area is typically affected by fires. These areas are the most complex because both low and high severity fires burned in these regions. The usual disturbance scenario involved approximately 30% of the stand being removed every 60 years by either fire or insects (Hopkins, et al 1994). Fires created small or large patches, depending on the vegetation and weather conditions. Under severe weather conditions, fire created large patches (250 to 500 acres) on the landscape. Intermediate and low intensity fires separated the stand-replacing ones, dividing the large patches into smaller patches and thinning according to tree density. This tended to result in a clumpy, unevenaged structure.

There are approximately 33,740 acres of these PAGS in the analysis area.

Dry Lodgepole PAG

Dry lodgepole pine in the La Pine Basin is classified as climax as is distinguished from other lodgepole pine stands by the lack of other species and absence of understory shrubs. These sites have a moderate severity fire regime (Agee, 1993), though fires of low, moderate and high severity can occur. Agee's estimated fire return interval is 60 to 80 years.

There are approximately 23,308 acres of this PAG in the analysis area.

Dry Mixed Conifer PAG

Fire disturbances on these sites are typified by low intensity fires burning quite often. Partial stand-replacing fires of variable size and intensities appear to be the resulting fire pattern in these areas. These fires were a function of dead fuel accumulations and understory development. The pattern further suggests, that while there were many small fires, large fires occurred at 20 to 30 year intervals and effected 50 to 1000 acres (Hopkins, et al 1994). These fires usually effected no greater than 50 to 70 percent of the basal area.

There are approximately 37,177 acres of this PAG in the analysis area.

Fire and Soil Erosion

Historic catastrophic fires probably resulted in periodic increases in surface erosion and inputs of fine sediment. Over the last 90 years, large fires have been suppressed and sediment levels have not been impacted significantly by wildfire.

Fire and Large Woody Debris

Wildfires create large woody debris by creating snags which are eventually recruited as down logs. Fire suppression has significantly decreased the number of acres burned through time. The decrease in burned acres slows down the process of large wood recruitment to soils and stream channels. Areas of particular concern include the moderate fire regime zone (east), where fires historically burned larger areas more frequently than evidenced over the past 50 years.

Fire and Wildlife Habitat

Historically, fire was the major disturbance event in the watershed. As discussed previously in the section on vegetation, these fires were either low intensity underburns or stand replacement fires. Frequent low intensity fires maintained large diameter, fire resistant species such as ponderosa pine, and douglas fir, which provided habitat for species such as pileated woodpecker and flammulated owls. Stand replacement fires, when they occurred, usually covered large acreages and converted the existing stands to earlier seral conditions. These fires usually provided a large number of snags both as short-term foraging habitat for species such as woodpeckers and over the long-term as nesting habitat for snag dependent species and dead and down woody material for other species. These snags provided structure in the new stands that gave these stands more diversity. Stand replacement and low intensity fires reduced forage immediately after a fire, but generally within a short period of time, forage quality improves.

CURRENT CONDITIONS

Active fire suppression in the Cascade Lakes Watershed began between 1900 to 1930. Occurrence trends suggest that suppression efforts significantly decrease fire size (See Exhibit 25, Large Fires, 1900-1994). The role of fire has been altered with respect to shaping the existing vegetation pattern in the watershed.

Since 1970, approximately 2,000 acres have burned. 75% of the aforementioned 2,000 acres was burned by the Four Corners Fire in 1994. This was ignited by lightning in a stand of mature lodgepole pine that had significant mountain pine beetle kill. This fire exhibited extreme fire behavior including 200 to 300 foot flame lengths and horizontal roll vortices.

The Lookout Mountain Fire accounts for the majority of the remaining 25%. This 600 acre fire burned on the west flank of Lookout Mountain in logging debris and mixed conifer stands.

Currently, the landscape in the Cascade Lakes Watershed has a fire return interval that is prescribed by management rather than by fuels and the environment. Fire suppression has resulted in extended fire return intervals and increased fire intensities, particularly in the

moderate fire regime. The landscapes which were once dominated by early seral tree species that are fire, insect and disease resistant are now dominated by late seral, shade tolerant tree species with the associated high fuel accumulation. Increases in density have led to intensification of competition for site resources. Limited resources potentially affect plant vigor and the ability of the vegetation to withstand the effects of disturbance (resiliency). The resulting increase in mortality significantly contributes to fuel loads. In summary, the increase in tree densities of late seral, shade tolerant species coupled with an increased competition for limited site resources, has resulted in large increases in insect and disease populations, fuel accumulation and the associated risk of high intensity fire.

Vegetation and Wildlife

Fire suppression has occurred for 80 or more years in the watershed and has had several effects on vegetation and wildlife. The increase in fuels, both dead and down and the ladder fuels, result in a higher risk of catastrophic fire, which when it occurs, will probably burn more acres than would have burned under a more natural fire regime. This increased loss of habitat results in greater impacts on wildlife, both in terms of direct loss of habitat and over the long term, leaving little in the way of structure for the next stand. There are several areas in the watershed where stand replacement fires occurred that have few, if any, snags and very little in the way of down woody material.

Fire has been used as a management tool for the treatment of logging slash. This activity does adversely affect a number of species, especially those species that dwell on the forest floor, including small mammals, amphibians, and arthropods. These species that use down woody material are negatively affected when this material is consumed by fire. This points out a need to leave a certain amount of material on site after burning activities are done. High intensity burns, including natural fire, have the potential to affect soils and the species that dwell on and under the soil surface.

Suppression has also moved vegetation towards the later seral stages. This favors those species whose habitat needs are met by those conditions. Included here are species such as marten, wolverine, northern spotted owl, and flying squirrels among others. This shift towards later seral conditions reflects not only a shift in stand conditions, but a shift in tree species as well. Over time the larger diameter early seral species favored by some species for habitat are lost from the stand. Other species which can tolerate lower light levels below the canopy do well while those that are shade intolerant are reduced or eliminated.

Fire suppression has resulted in the almost total elimination of high elevation early seral habitat. This results in habitat loss for species that relied on early successional stands for all or parts of their habitat needs. This potential loss of habitat is especially important considering that some of the habitat at risk is habitat for threatened, endangered, or candidate species of wildlife, which are generally listed because their habitat has been reduced to levels where viability of the species becomes a concern.

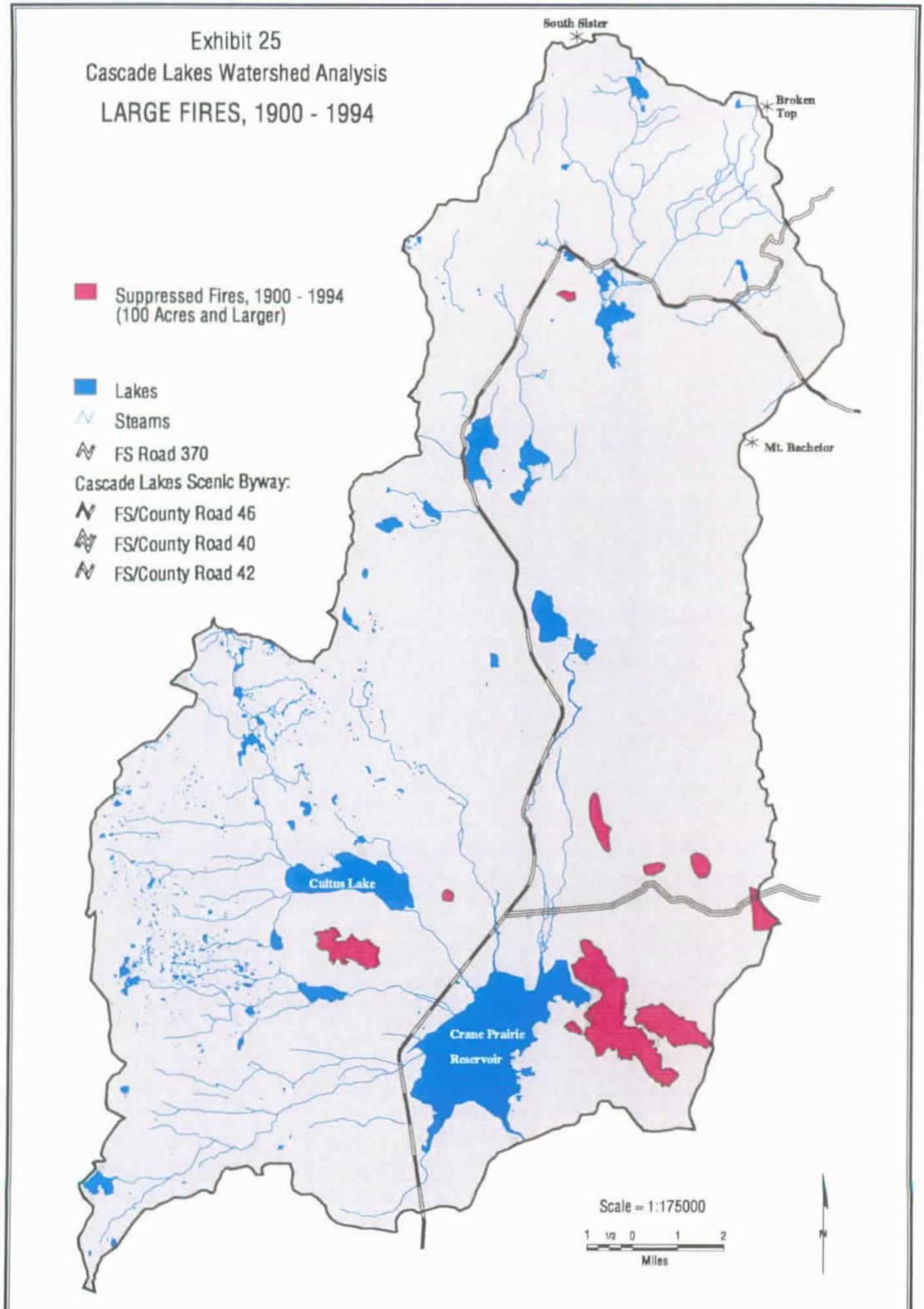


Exhibit 25
Cascade Lakes Watershed Analysis
LARGE FIRES, 1900 - 1994
Suppressed Fires, 1900 - 1994
(100 Acres and Larger)
Lakes
Steams
FS Road 370
Cascade Lakes Scenic Byway:
FS/County Road 46
FS/County Road 40
FS/County Road 42
South Sister
Broken Top
Mt. Bachelor
Cultus Lake
Crane Prairie Reservoir
Scale = 1:175000
1 1/2 0 1 2
Miles
N

The suppression of fire also affects the non-forested plant associations as well. As stand crowns close ground vegetation diminishes and herbaceous species used as forage decreases. As forage decreases, the effort to find adequate forage increases. This decreases foraging efficiency as the animal are forced to spend more time and energy searching for food. The less forage, generally the lower the carrying capacity of a given land base.

As discussed earlier, the shift towards later seral stages has resulted in a decline in the early seral stages, both in the high elevation and mixed conifer habitat. Historically this habitat was fairly evenly split in the watershed, but with the advent of fire suppression, the forested acres are skewed towards the mid and late seral stages (with the exception of forest management).

Landscape Patterns and Fire Regime

Fire suppression and human use have been identified as the primary factors contributing to changes in fire frequency, intensity, distribution, and size. Fire occurrence trends and existing vegetation characteristics suggest that the role of fire, with respect to its influence on shaping landscape element components, has been altered. More specifically, the alteration of fire as a natural disturbance process has resulted in an increase in overall tree density with a reduced proportion of fire-tolerant species. This change is directly associated with an increase in the vulnerability of the watershed to catastrophic fire.

The frequency, intensity, size, and distribution, of fire on the landscape are influenced most significantly by three major factors: climate, ignition source, and fuels. Climate is an inherent characteristics that remain relatively static over time; fuels are altered by fire suppression and harvest; and ignition sources change with changes in human use.

While roading and timber harvest have the most noticeable effect on landscape pattern, fire suppression, has the opposite effect. Fire suppression reduces the heterogeneity (biological diversity) of the landscape by reducing the frequency of occurrence of landscape element types which are dependent on fire for their maintenance. Reduction or elimination of these components consequently contributes to increasing the patch size of the remaining element types. For example, as a result of suppression in the lower western portion of the watershed, high elevation early successional communities have virtually been eliminated leaving late successional vegetation as the dominant component. Current vegetation information further suggests that early successional patches within the central portion of the watershed are also lacking as mid to late-successional vegetation begins to dominate the landscape. In addition, the mid-successional component, located in the eastern portion of the watershed, has increased.

Fuels and Fire Regime

The important interactions of fire suppression, patterns of species composition, and structure, and the associated insect and disease susceptibilities, have been discussed in Historical and Current Roles of Insects and Pathogens in Eastern Oregon and Washington Forested

Landscapes (Hessburg et. al. 1994). This literature gives particular emphasis to composition and structure changes, insect and disease susceptibilities, and the subsequent consequences of increased fuel accumulation

Fuel is a primary factor influencing the intensity, distribution, and size of fire on the landscape. Intensity, distribution and size is directly associated with the physical size of the individual fuel components, the total amount of fuel (i.e., fuel load), the linear arrangement of the fuel bed, and the vertical structure of live fuel. Alteration of these fuel characteristics subsequently changes how fire functions on the landscape. Activities identified within the Cascade Lakes Watershed which significantly alter fuel characteristics include fire suppression and insect damaged stands. There are significant increases in the fuel accumulations in the wet and dry lodgepole pine PAG's. The combination of large, dense patches and heavy fuel accumulations in the central lodgepole and eastern dry mixed conifer PAG contribute to increasing potential for catastrophic fire events across the landscape.

Fire Ignition and Occurrence Patterns

Changes in fire occurrence patterns indicate that the distribution and frequency of fire on the landscape has been altered. Changes in distribution and frequency become particularly evident when lightening occurrence patterns are compared to human-caused occurrence patterns.

Historically, lightning was the major ignition source of large fires in the watershed, with some influence by Native Americans. Generally, weather patterns brought thunderstorms in July and August, at a relatively high frequency for the Deschutes Basin. Provincially, the Cascade Lakes watershed is in a high lightning frequency zone (Matzen et. al. 1993). The lightning fires that have occurred in the past 23 years have been located in the general vicinity of the large fires. This suggests that historically, lightning caused fires played a significant role in shaping the vegetation in the watershed. Estimates of historically burned areas indicate large areas of intensely burned patches. Intensely burned patches comprised approximately one-third of the watershed.

Today, the majority of fire occurrences in the Cascade Lakes Watershed are a result of lightning or recreational use and are usually suppressed at less than one-quarter of an acre in size. Roading and recreation have increased the number of ignition sources by approximately 50% since the 1950's. Areas of particular concern include the undeveloped camping areas along the Deschutes River, Cultus Lake, and Crane Prairie Reservoir. These areas have unusually high occurrence rates and likely display the most significant change in fire frequency.

Fire occurrence on the Deschutes National Forest, on the Bend Ranger District, and in the Cascade Lakes Watershed was analyzed (See Appendix A-4).

Fire occurs within the protection areas of the Deschutes National Forest at a mean of 168.8 fires a year. A standard T test was used on data collected from the years 1971 to 1994 (25 years). A confidence interval was established using an alpha of .05. The outcome of the T test shows that 95% of the time, the Deschutes experiences between 136 to 201 fires.

Fire occurs on the Bend Ranger District of the Deschutes National Forest at a mean of 48.6 fires a year. A standard T test was used on data collected from 1970 to 1991 (21 years) and using again an alpha of .05%, a confidence interval shows that 95% of the time between 38 to 60 fires can be expected to occur on the district.

Fire occurs within the boundaries of the Cascade Lakes Watershed at a mean of 39 fires a year. A standard T test was used on data collected from 1988 to 1994. Using an alpha of .05%, a confidence interval shows that 95% of the time between 20 to 57 fires a year can be expected to occur within the boundaries of the watershed.

WILDLIFE RESOURCE

OVERVIEW

The quality and quantity of wildlife habitats in the watershed are diverse. Forested habitats include lodgepole pine (wet and dry), mixed conifer (wet and dry), and mountain hemlock. Riparian habitats are abundant as well as are water bodies. Sparsely vegetated areas dominate the highest elevations areas such as Mt. Bachelor and Broken Top. Within these habitats are special and/or unique areas such as meadows, talus slopes, snags, down wood, and caves. There are a variety of seral and structural stages within each of the forested habitats. A majority of the watershed is wilderness/unroaded. The habitats in these areas have not been impacted by harvest activities and are influenced by natural disturbances such as fire, wind, and insects. Areas that have been impacted by harvest activities are heavily fragmented and have gone from a small - large tree landscape to a pole - medium tree landscape. Late-successional interior habitats are poorly connected in the watershed.

The area supports a variety of wildlife and wildlife habitats. There are 262 species of wildlife known or suspected to utilize this watershed at some time during the year. Of these, 220 species will use riparian areas as primary habitat (for breeding, foraging, and resting). Quantity and quality of habitat and the types of disturbances that occur will affect species and how they will use the habitat.

The following TES species and selected species have suitable or potential suitable habitat within the Cascade Lakes Watershed: peregrine falcon (E), bald eagle (T), northern spotted owl (T), wolverine (S), sandhill crane (S), long-billed curlew (S), Townsend's big-eared bat (S), Preble's shrew (S), black-backed woodpecker, white-headed woodpecker, pileated woodpecker, three-toed woodpecker, northern goshawk, great gray owl, flammulated owl, marten, fisher, spotted frog, and cascade frog. All of these species, with the exception of the ferruginous hawk and the Preble's shrew, have been observed in the watershed.

HISTORIC AND CURRENT CONDITIONS

Factors affecting wildlife habitat and populations include species composition, structure, and landscape patterns of the vegetation and the amount of human activity (recreation).

The Recreation/Alpine Tephra and Outback Landscape Areas - The wilderness and unroaded areas provide contiguous habitats, affected only by natural disturbances (fire, wind, and insects). The habitats in these landscape areas are probably similar to what they were historically. The major change has been the increase of recreational use. This increase use may be displacing those species that depend on habitats that have not already been impacted by human influence such as the wolverine, which is shy to human presence.

The Recreation/Riparian Landscape Area - Riparian areas are overall in good condition, comparable with historical conditions, with problems mostly in localized areas. Recreational impacts in these habitats are increasing, as is the disturbance to wildlife (i.e. waterfowl, deer, elk, fisher). These disturbances can affect a species ability to forage, disperse, or reproduce.

The Timber/Forest Product Landscape Area - Areas dominated by timber harvest are heavily fragmented. Past harvest activities and salvage logging of lodgepole pine infested with the mountain pine beetle has reduced forest connectivity in the south-southeast portion of the watershed. Interior forest and late structural habitat required by the spotted owl, northern goshawk, marten, and fisher has been reduced. Also impacted are habitats used by black-backed woodpeckers and neotropical migratory birds. Fragmentation has improved habitat for some species such as deer and elk, American crow, jays, and non-native species such as the barred owl and the brown-headed cowbird.

The mixed conifer dry PAG has been impacted by fire suppression and has created dense stands that are at high risk for developing forest health problems and being lost by catastrophic fire. Suppression of fire has created favorable security cover for deer and has increased the amount of suitable habitat for spotted owls. There is a potential for loss of the large tree structure, which is important for many species including bald eagles, osprey, and some woodpecker and bat species.

Trends

An increase in recreational use and opportunities has led to riparian habitat degradation in localized areas (campgrounds, dispersed campsites, trails, fish stocking), and has increased the amount and intensity of disturbance to wildlife leading to possible displacement of certain species (waterfowl, raptor species, big-game, amphibians, and some furbearer species).

Fire suppression in the lodgepole pine and mixed conifer PAG's has increased stand densities creating forest health problems in entire stands. This has created unstable conditions in stands currently suitable for species such as the spotted owl and the northern goshawk. There is also the potential for losing the large tree structure that bald eagles, osprey, other raptor species, and certain woodpecker and bat species depend upon.

Timber harvest and associated activities (roads and landings) have created a fragmented forest environment leading to a loss of suitable habitat for interior forest species such as the marten and fisher, and nesting habitat for some raptors such as the great gray owl, spotted owl, and the northern goshawk. It has also increased the parasitism and predation on certain species by crows, jays, and non-native species such as the barred owl and the brown-headed cowbird.

Recommendations

Camping in undeveloped areas needs to be relocated along the Deschutes River between Crane Prairie and Little Lava Lake and from areas along water bodies such as Crane Prairie Reservoir, Hosmer Lake, the Lava Lakes that provide nesting habitat for waterfowl. These and other recreational activities need to be limited in the vicinity of nesting bald eagles and osprey especially during the critical periods of egg laying, incubating, and the first weeks of rearing young (May thru July).

Eliminate/obliterate roads that are not necessary. This includes roads leading to riparian areas and through the key elk areas.

Riparian corridors need to be identified for amphibian movements N/S and E/W along the Cascades. Critical lakes for amphibians and their movements need to be identified and it should be decided whether or not to continue stocking by ODFW with non-native fish species.

Additional recreational trails affecting sensitive wildlife habitat areas should not be developed.

Provide education/interpretation about the importance, sensitivity, and fragile nature of wetlands.

Vegetation management treatments in the lodgepole and mixed conifer PAG'S would be similar to those recommended in the Vegetative Resource Section. Harvest techniques, patch sizes and number of patches, canopy closure levels, and corridor widths would vary depending on the site and the species utilizing the area.

Reduce fragmentation by various vegetative manipulation activities such as thinning regeneration areas to enhance height and diameter growth.

WILDLIFE ANALYSIS

INTRODUCTION

A total of 262 wildlife species are known or suspected to use the Cascade Lakes Watershed during the year. The Wildlife Section (Appendix A-5), contains Table A5-1: a list of these species with their scientific names; Table A5-2: a list of these species and the habitat(s) (PAG'S) they are associated with; Tables A5-3 - A5-7: lists of these species and the plant association groups and the structural stage(s) that they utilize for breeding, foraging, and/or resting habitat. Also included in Appendix A-5 are habitat needs for species addressed throughout this section.

HISTORIC AND CURRENT CONDITIONS

PETS SPECIES AND SELECTED SPECIES

The Cascade Lakes Watershed will be analyzed from a habitat suitability viewpoint for focal species as considered by the Deschutes National Forest Proposed, Endangered, Threatened and Sensitive (PETS) species list and selected species. Species included on this list are as follows:

Table II - 11 - Cascade Lakes Watershed - Listed Species and Federal Status

Species		Federal Status
American Peregrine Falcon	Falco peregrinus anatum	E
Northern Bald Eagle	Haliaeetus leucocephalus	T
Northern Spotted Owl	Strix occidentalis caurina	T
California Wolverine	Gulo gulo luscus	S, C2
Greater Sandhill Crane	Grus canadensis tabida	S,V
Ferruginous Hawk	Buteo regalis	S, C2
Long-Billed Curlew	Numenius americanus	S, 3C
Townsend's Big-Eared Bat	Plecotus townsendii	S, C2
Preble's Shrew	Sorex preblei	S, C2

E= Endangered, **T**= Threatened, **S**= USFS Region 6 Sensitive; **C2**= USFWS needs additional information before proposing as endangered or threatened; **3C**= USFWS taxa which have proven to be more abundant or widespread than previously believed and/or which have no identifiable threats. This status is based only on the most recently published Candidate Notice of Review; **V**= listing as threatened or endangered can be avoided through adequate protective measures and monitoring.

Table II - 12 - Cascade Lakes Watershed - Selected Species

Species	
Black-Backed Woodpecker	Picoides articus
White-Headed Woodpecker	Picoides albolarvatus
Pileated Woodpecker	Dryocopus pileatus
Three-Toed Woodpecker	Picoides tridactylus
Northern Goshawk	Accipiter gentilis
Great Gray Owl	Strix nebulosa
Flammulated Owl	Otus flammeolus
Marten	Martes americana
Fisher	Martes pennanti
Spotted Frog	Rana pretiosa
Cascade Frog	Rana cascadae

The Cascade Lakes Watershed contains suitable habitat for several species on the aforementioned list. Species that are associated with habitats contained within the watershed will be briefly reviewed in this document.

PETS SPECIES (Terrestrial and Avian)

American Peregrine Falcon

Historic Condition - Suitable habitat existed as it does today. Past population densities are unknown. Toxic pesticides reduced raptor populations including peregrine falcons, osprey, bald eagles, golden eagles, and other hawks and owls feeding on prey that had consumed pesticides. The pesticides reduced shell strength and during incubation many eggs were crushed. Nestlings that hatched were weak and had low survival rates. ..

Current Condition - The peregrine falcon is a rare species known to have nested on the Forest in only one location. For the last several years, that site has been unoccupied. Suitable cliff nesting sites are rare. There have been infrequent sightings of what are considered to be unmated individuals along the Deschutes River and the Cascade crest. Documented sightings have occurred along the Deschutes River, Crane Prairie Reservoir (most recent sighting, May, 1993), and in the Three Sisters Wilderness (Broken Top and South Sister).

A ban on toxic pesticides established in the United States has helped increase populations but these pesticides are still being used in Central and South America. For species migrating south, these pesticides still pose a threat affecting populations and breeding capabilities.

Trends - There are no trends specific to this watershed but there is a possible increase in peregrine falcon populations throughout the United States. The ban on toxic pesticides along with successful hacking and recovery efforts has led to successful breeding and juvenile survival.

Northern Bald Eagle

Historic Condition - Historical bald eagle populations are unknown. The creation of Crane Prairie provided a new source of foraging opportunity as did stocking of lakes without fish. Bald eagles probably still existed in the Lava Lakes area and along the Deschutes River prior to the reservoir, feeding on native fish such as bull trout, red band trout, rainbow trout, and whitefish and waterfowl. Bald eagles were first sighted at Crane Prairie Reservoir in 1968 (Anderson, 1983).

Current Condition - A permanent Oregon resident, most of the large lakes, reservoirs and rivers provide suitable habitat. Foraging habitat is usually associated with these same

rivers and lakes. Nesting habitat for seven known pairs are located at Crane Prairie, Hosmer Lake, Lava Lake, and Benchmark Butte (Bald Eagle Management Areas are located adjacent to these sites). In mild winters, some of the eagles may reside year round. During colder winters, they may migrate to the Klamath marsh area or other areas with abundant waterfowl.

At Crane Prairie and the Lava Lakes, the prey base has changed with the introduction of fish species and the poisoning of others. Other lakes are available for foraging today that were not available historically. Hosmer, Elk, and Sparks Lake historically had no fish. In the fall, the Deschutes River below Crane Prairie provides a food source with the introduced kokanee salmon. With the onset of changes occurring with native fish species, eagles may have had to increase their energy expenditure for the same amount of fish. Where a successful hunting trip would entail capturing one large bull trout, rainbow or whitefish, several trips may have to be made to acquire the same poundage of chubs and smaller fish to maintain their same fitness level.

Current Bald Eagle Management Area boundaries are in need of adjustment to include new nesting territories as well as new information for perching and foraging area preference. The majority of BEMA's are in ponderosa pine associated plant communities. Some are also in mixed conifer PAG's. In general, all BEMA's have existing forest health concerns associated with high basal area of understory trees stressing the overstory component that now serves as suitable habitat. The stands also lack sufficient mid-age class ponderosa pine trees for replacement nest trees. Another existing threat associated with heavy understory stocking is loss of stands to catastrophic wildfire from high ladder fuel accumulation.

Human disturbance associated with recreational camping, fishing, hiking and motorized use is variable across certain BEMA's with the greatest disturbance existing around the nest sites closest to Crane Prairie Reservoir (bald eagles are moderately sensitive to high human activity). Some eagle pairs continue to successfully nest and rear young each year despite the very high human use going on inside and adjacent to the nesting territories. Management measures including road closures and camping restrictions have been implemented at a number of BEMA's to limit human disturbance around the core nest zone. These areas need to be monitored to see if these measures have been effective.

Trends - There has been a loss of ponderosa pine stands and large ponderosa pine trees (loss of nesting habitat) because of high-grade logging and fire suppression; Increased recreational uses around and on lakes can potentially effect nesting and foraging eagles which can effect bald eagle reproductive success.

Northern Spotted Owl

Historic Condition - According to Bill Hopkins, Area 4 Ecologist, the historic range of the spotted owl was similar as it is today. His theory is based on large douglas-fir stumps that extended in this area east of the watershed. The amount of suitable habitat was less extensive than it is today because frequent low intensity fires have kept the stands more open. Fire suppression has created later seral, dense, white fir dominated stands. Historically, south and east facing slopes of the buttes consisted of a more open canopy dominated by ponderosa pine. Suitable habitat for the owl (mixed conifer) occurred only in the higher elevations on the buttes and north facing slopes that received more precipitation. Openings were created by natural disturbances (fire, wind, insects) in the mixed conifer habitats at a larger scale but fewer in number versus current patch openings created by timber harvest. Historic population densities for spotted owls are unknown, but it is concluded that they are lower than current densities.

Current Condition -

1. Location Within Range:

Five of six spotted owl pairs located on the Bend Ranger District are found in the Cascade Lakes Watershed. These sites have not been monitored annually, so productivity has not been established. The owls are generally located in mixed conifer stands associated with buttes. Northern spotted owl habitat which are likely dispersal corridors occur along the mid-elevational mixed conifer zone. On the west side of Cascade Lakes Scenic Byway, this dispersal corridor or band of suitable habitat, ties together the buttes where spotted owl nest sites and activity centers occur. This corridor runs from the north (west of Elk Lake) to the southwest and southeast (Charlton Butte, Cultus Mountain, and Benchmark Butte). On the east side of the Cascade Lakes Scenic Byway, this corridor is patchy, occurring on the upper west slopes of Mt. Bachelor south to the west slopes of Sheridan Mountain, south to Lookout Mountain, then southwest to Browns Mountain.

2. Relative Population/Habitat Within Range:

Spotted owl populations are decreasing throughout its range. Eastside owl populations and Cascade Lakes Watershed densities are low in comparison with the entire owl range. Eastside populations are sometimes considered fringe species but are highly important when considering adaptability and species tolerance. This becomes important as species and their desired habitats decline. The habitats that the eastside spotted owls utilize do not always reflect the typical habitats that the westside spotted owls are associated with. The birds have adapted to a slightly different stand structure, vegetation species, and prey base. For example, owls in the Cascade Lakes Watershed utilize stands that contain a larger component of ponderosa pine and lodgepole pine. The understory is dense in some areas (with a white fir component) and fairly open in others. There is one pair that uses a

stand that is almost pure mountain hemlock with a white fir and lodgepole pine understory. Instead of the main dietary species being flying squirrel, it may be douglas' squirrel, gophers, and woodrats. Although not documented, owls may utilize lodgepole pine habitat for dispersal and foraging given the availability, abundance, and proximity of this habitat type within owl pair home ranges.

This watershed contains 39,840 acres of suitable habitat (See Exhibit 26), representing 24% of the total watershed acres. Table II - 13 contains the amount of suitable northern spotted owl habitat within each of the Northwest Forest Plan Allocations (NWFP).

Table II - 13 - Cascade Lakes Watershed - Suitable Northern Spotted Owl Habitat Within Each NWFP Allocation.

NWFP Allocation	NWFP Acres Within the Watershed	Suitable Owl Acres
Congressionally Withdrawn Lands	54,489	15,967
Administratively Withdrawn Lands	40,279	7,464
Late-Successional Reserves	27,165	10,226
Matrix	43,816	6,183
Total Acres	165,749	39,840

Each spotted owl pair was analyzed for possible incidental take situations (Table II-14). This includes analyzing a 0.7 and 1.2 mile radius around each owl pair. Recommended minimal levels of suitable habitat within 0.7 miles (1000 acres, core area) is 500 acres and within 1.2 miles (2955 acres) is 1182 acres, or 40% of the median home range.

Table II - 14 - Cascade Lakes Watershed - Incidental Take Analysis

Site Number	0.7 miles	1.2 miles
1001	839 acres	1840 acres
1002	548 acres	1109 acres
1003	554 acres	1476 acres
1004	680 acres	1655 acres
1006	651 acres	1589 acres

Only site numbers 1002 and 1003 are close to minimal levels of suitable habitat within 0.7 miles of the activity center. Site number 1002 is below recommended levels of suitable suitable habitat within 1.2 miles of the activity center. This site along with all other sites falls within the Cultus Mountain LSR. The only treatments that may occur within LSR's are those that will protect and enhance 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 (Northwest Forest Plan, 1994).

Critical spotted owl habitat is encompassed by the Cultus Mountain LSR which is located on the west side of the watershed. This LSR is adjacent to Congressionally Withdrawn, Administratively Withdrawn, and Matrix areas (Exhibit 5). The preceding two help tie together other LSR's up and down the east side of the Cascades. Portions of two other LSR's (Sheridan and Browns Mountain) also occur. Matrix lands dominate between the three LSR's. Fragmentation is heavy in the lower half of the watershed with the heaviest occurring north and east of Crane Prairie in the mixed conifer dry PAG. Spotted owls likely travel through the fragmented areas to the unfragmented upper slopes and disperse through the lodgepole pine and mountain hemlock PAG's. However, optimal dispersal habitat would occur throughout the mixed conifer zone if it were not so heavily fragmented. Very limited amounts of late-successional old growth remain within the Matrix allocation emphasizing that these stands are critical for connectivity between LSR's (not just for spotted owls, but for all late successional, interior forest species). The Brown's Mountain LSR may be a critical dispersal link between Cultus Mountain and Davis Mountain (Odell Watershed) LSR's.

Most dispersal habitat on the east side of the Cascades does not meet the Interagency Scientific Committee's (ISC) definition of dispersal habitat. Dispersal habitat, or connective habitat, is a measure of the extent to which intervening habitat truly connects blocks of suitable habitat to allow individuals, usually juveniles, of the species in question to disperse between them. Provision of habitat features that enhance dispersal between blocks is essential (ISC, 1991). This makes the LSR's and Riparian Reserves within this watershed critical for dispersal habitat.

The proceeding dispersal habitat (50-11-40) information was completed by office review of high elevation aerial photos in previous years and recent stand exams. Not all quarter townships have been analyzed. This analysis does not include canopy closure loss from recent mountain pine beetle mortality. Connectivity/dispersal habitat is poor between the LSR's. Only four of the analyzed quarter townships are above 50%.

Exhibit 26

Cascade Lakes Watershed Analysis

SUITABLE NORTHERN SPOTTED OWL HABITAT

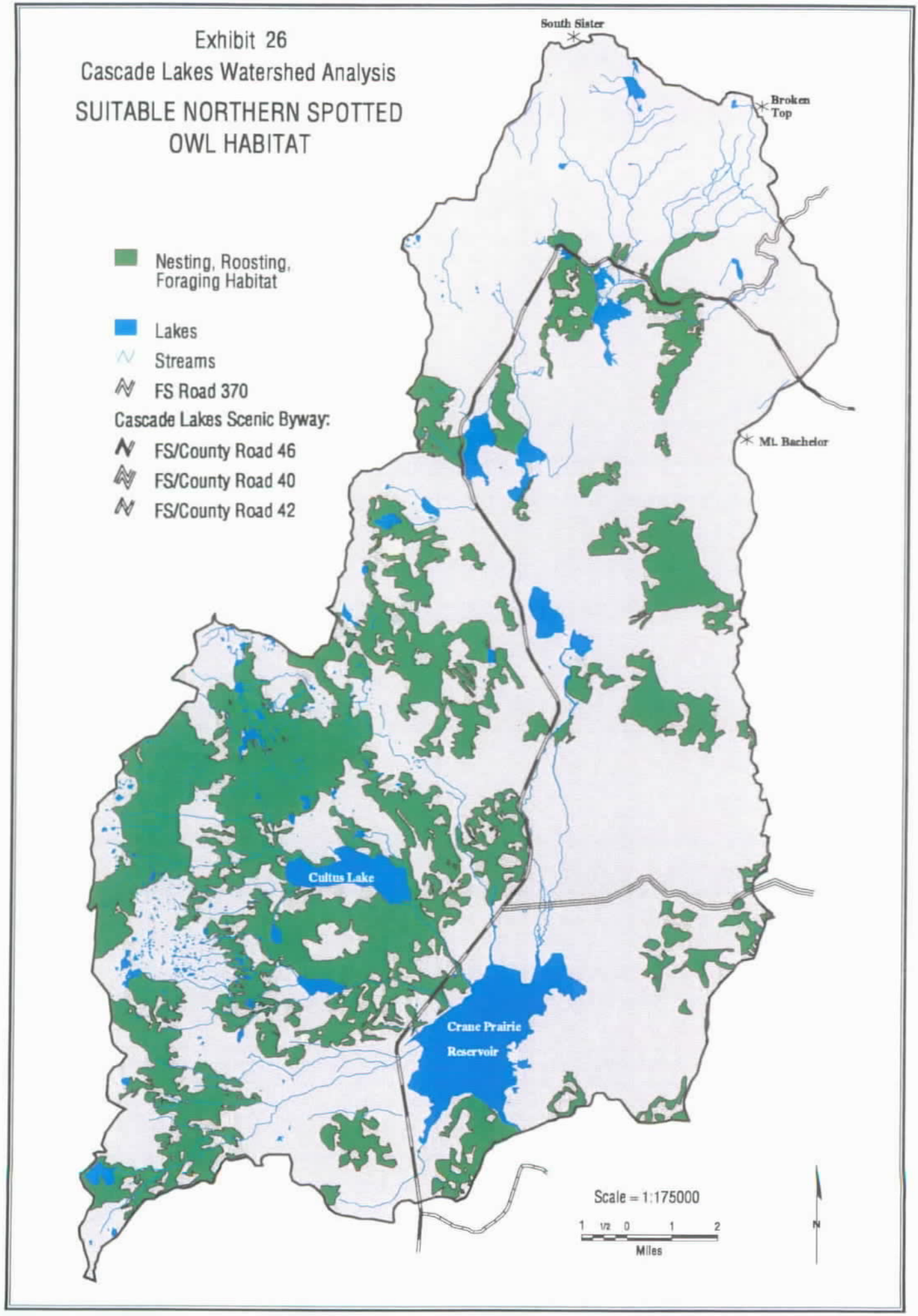


Table II - 15 - Cascade Lakes Watershed - Dispersal Habitat Analysis (50-11-40).

Quarter Township		50-11-40
T19S, R08E	NW	49%
	SE	48%
	SW	62%
T19S, R09E	SW	69%
T20S, R08E	NW	10%
	NE	28%
	SW	38%
	SE	26%
T20S, R09E	NW	47%
	SW	55%
T21S, R07E	NW	52%
	NE	30%
T21S, R08E	NW	47%
	NE	25%

Additional dispersal habitat requirements should be provided by the Matrix land allocation. This allocation connects all forest LSR's and provides the N/S and E/W movement link of late successional old growth related species. The Congressionally Withdrawn areas provide connectivity between the Deschutes, Willamette, and Umpqua National Forests and some LSR's within the Forest. Of conern are the Matrix lands between the Sheridan Mountain and Cultus Mountain LSR's, and the Matrix lands between Cultus Mountain and Davis Mountain (Crescent Ranger District) LSR's.

Restoration goals include forest health and dispersal habitat objectives. Residual stands that provide dispersal habitat and are not at risk to short term "catastrophic" loss are to be maintained and enhanced.

Increasing demand for mushrooms by the public may create a decline in the prey base for spotted owls. Many mushroom species are utilized by small mammals, such as the douglas' squirrel. Loss of an important fall forage component may cause fatalities among the small mammals reducing the owl prey base. Current use by mushroom pickers is not heavy but this is expected to change in the future.

Trends - Past timber harvest has reduced and fragmented remaining patches of suitable spotted owl habitat. This has occurred throughout the range of the owl and hence its status as a threatened species. Habitat loss and fragmentation within the mixed conifer plant associations reduces available habitat for optimal numbers of spotted owl territories. It also increases the expenditure of energy to successfully reproduce thus reducing individual fitness. Competition increases as does predation amongst other raptors such as

great horned owls, goshawks and barred owls. Barred owls have recently extended their range from the east to the west coast. They are adapted and successful in more fragmented environments, are known to compete for space and prey, and may potentially consume spotted owls as prey. Habitat fragmentation in the mixed conifer zone has reduced dispersal corridors, whereas corridors occurring through the mountain hemlock zone are stable.

In the low elevation mixed conifer series, past high grading of ponderosa pine and fire suppression have resulted in a dense understory of white fir. These activities have created better quality spotted owl habitat. However, this habitat is generally not stable overtime, given the fire history of the area, prolonged drought, and insect and disease infestation. When fire occurs in these areas, it will most likely be a large scale stand replacing fire. Prior to fire suppression, the fire cycle was typically short duration, small scale, ground fires which would have maintained the overstory ponderosa pine and thinned the understory white fir. Fire was historically a controlling agent for current epidemics of disease and insects which are currently affecting stands. The lodgepole pine PAG's have been heavily fragmented due to the insect outbreaks and salvage harvest of these stands. This has reduced available dispersal habitat and connective blocks between LSR's here and on other Forests.

In the event of a large scale disturbance or fragmentation within the spotted owl preferred habitat, there is high potential for loss of connectivity between LSR's and between Forests, thus the loss of genetic material between populations.

California Wolverine

Historic Condition - Historically, wolverine were more abundant than today although population densities are unknown. Historical distributions in the three Pacific coast states extended from Canada south throughout Washington, from central Oregon west to the coast, and throughout central and northern California. Heavily trapped in the 1920's and 1930's, local populations were reduced.

Current Condition - Today, distribution in the Pacific coast states is limited to the Cascades in Washington and Oregon, and the Sierras in California. Dispersal corridors to connect preferred habitat has been severely fragmented.

As a solitary and territorial species, not much is known about their life history within the watershed or within central Oregon. It is a rare species showing moderate sensitivity to low levels of human activity and high sensitivity to high levels of human activity. They prefer higher elevation habitats with high canopy cover and continuous cover and remote areas lacking human disturbance. Corridors likely occur through (north to south and east to west) the wilderness and along high elevations in the Charlton Lake, Cultus Lake, and Bachelor Butte area. Infrequent sightings have been made over the years in the vicinity of

Broken Top and South Sister. Recent sighting have also been reported near Benchmark Butte, Crane Prairie, and Cultus Lake.

Habitat has been heavily fragmented due to timber harvest and has probably decreased populations. They require large refugia representative of the vegetation zones that have historically occupied and that are connected by adequate travel corridors. The populations that do occur have been relegated to wilderness areas where there has been no development, modification, or easy access by humans. Other rising conflicts are the increased recreational use of the wilderness areas, and increasing winter disturbance from snowmobile users. This disturbance can cause the animals to react in adverse terrain conditions (movement through snow) and may reduce foraging areas within heavily travelled recreation areas during the winter months. Their prey base such as elk populations are available year round with populations at Crane Prairie during the winter. Deer populations are available spring through fall.

Fire regime in suitable wolverine habitat has not been influenced by fire suppression so catastrophic large scale fires would not adversely affect wolverine habitat. This species has adapted to this type of disturbance. They encompass a large home range, so fire is not likely to result in a total loss of habitat.

Trends - Historically, the wolverine was trapped for its fur which decimated local populations. Increased recreational use of wilderness and roadless areas, as well as encroachment in roadless areas may displace or disrupt use patterns of the wolverine. Winter recreation, particularly snowmobiles, have a high likelihood of harassing wolverine. Establishment of LSR's may enhance wolverine habitat by decreasing fragmentation and increasing their range.

Greater Sandhill Crane

Historic Condition - Historically, sandhill cranes were probably more abundant than today. Species wide population declines have occurred due to overharvesting and habitat degradation. Historical habitat has been lost due to the damming of the Deschutes River at Crane Prairie and ditching that has occurred in the meadows north of Crane Prairie. Habitat loss and degradation have been occurring since the late 1800's from sheep and cattle grazing. Historical sightings have also occurred near the Lava Lakes.

Judge John Breckenridge Waldo: *Diaries and Letters from the High Cascades of Oregon, 1880-1907* (Williams, 1985):

> Deep (Deschutes) River, August 26, 1883.

"Crane Prairie is not easily traversable in any direction, or in a straight line at all. It is traversed by numerous clear canal-like streams - not fordable in the lower part of the

prairie where two or more have united. There are numerous swampy spots, beaver land and bogs in the western portion of Crane Prairie (You would appreciate the pertinence of this name if you could hear, as we have, the deep sounding tone of the sandhill cranes, morning and night, and during the day)."

Current Condition - Sandhill cranes are uncommon in the Cascade Lakes Watershed, and show moderate sensitivity to high levels of human activity. Sandhill Crane reproductive activities begin in May and last through July. This is also when recreational activities are high around the rivers and lakes.

Crane Prairie provides suitable nesting habitat, mainly in available habitat that is not frequented by recreationists. Each nesting pair requires a large area. Foraging habitat is also available for the cranes in the early morning and late evenings, or when there is low disturbance at the lake area. Suitable habitat in some meadows in the watershed, including Crane Prairie, are being encroached by lodgepole pine (on a watershed level, from data that is available, it is estimated that at least 20% of the meadows have been lost).

During the spring and summer, sandhill cranes are typically observed at Crane Prairie. Four sandhill cranes were observed at Winopee Lake on July 29, 1995. Sightings have also occurred at the Blue Lagoon.

Trends - There has been a decrease in undisturbed habitat due to the increase in recreationists utilizing the riparian areas around the lakes.

Ferruginous Hawk

Historic Condition - Historic conditions of ferruginous hawk habitat and distribution was probably similar as current conditions.

Current Condition - The ferruginous hawk has not been sighted in this watershed, but is known to migrate through the area. The ferruginous hawk is moderately sensitive to low levels of human activity and highly sensitive to high levels of human activity.

Trends - No known trends.

Long-Billed Curlew

Historic Condition - Historic habitat conditions for the long-billed curlew existed as it does today, with the exception of the creation of Crane Prairie Reservoir. This has led to both creation and destruction of long-billed curlew foraging habitat. Distribution numbers may have been higher as there was less human activity historically.

Current Condition - Foraging habitat exists around Crane Prairie, but there are no known nesting areas. Historical sightings of long-billed curlews have occurred at Crane Prairie. The long-billed curlew shows high sensitivity to high levels of human activity.

Trends - Decrease in undisturbed habitat because of an increase in recreational use within riparian habitats. This may not be significant as nesting habitat is not available in the watershed.

Townsend's Big-Eared Bat

Historic Condition - Historic conditions of big-eared bat habitat and distribution were similar to current conditions

Current Condition - Several caves exist in the watershed. There has been a big-eared bat sighted in one of the caves, but these caves are not believed to be used for hibernation or nursery purposes. Elevation may be a limiting factor for bats not utilizing these caves.

Trends - No known trends.

Preble's Shrew

Historic Condition - Preble's shrew habitat likely occurred along the Deschutes River prior to the creation of the reservoir and at various wetlands and lakes that contained a component of willow and down wood.

Current Condition - The Preble's shrew is suspected to occur on the Deschutes National Forest, but no surveys have been conducted within the watershed. Conifer encroachment and previous cattle grazing may have reduced primary habitats in some locations.

Trends - Loss of Preble's shrew habitat due to and increase of conifer species encroachment into wetlands.

SELECTED SPECIES

A. AVIAN

1. Cavity Dependent Species

There are approximately 39 species of birds that utilize cavities for nests that are known or suspected to occur in the watershed. Current information on hard snags, down logs, and down woody material is not available for this watershed analysis. Due to past and

previous insect outbreaks, and root rot problems, habitat for cavity nesters is not lacking. An exception falls into those areas that have been harvested, where many of the snags and down wood have been removed. As these stands of dead trees begin to fall, it is important that there are currently trees that are representative for future snag needs.

Black-Backed Woodpecker

Historic Condition - The historic abundance of habitat for the black-backed woodpecker was most likely greater than the amount currently available and therefore, the number of woodpeckers was also probably greater. Humans have utilized these beetle-killed trees that provide necessary habitat for the black-backed woodpecker as a source of fuel and pulpwood. These harvesting activities have led to fragmentation of the habitat and removal of a food source.

Current Condition - Black-backed woodpeckers have been sighted throughout the watershed. Abundant habitat currently exists in the lodgepole pine (dry and wet) and in the mountain hemlock plant association groups. Most of the mixed conifer plant association groups have been fragmented as has a lot of the beetle infected lodgepole pine. Epidemic levels of beetles have killed much of the lodgepole dry, creating large acres of primary habitat. As these stands start falling apart in the next 5 to 15 years, or are logged to prevent catastrophic loss to wildfire, these acres will probably go from primary habitat to secondary or foraging habitat. The amount of acres that will be converted will depend on how many large trees survived the epidemic of beetles. These acres will cycle back into desirable habitat within 40 to 50 years. During the cycling period, black-backed woodpeckers may relocate to adjacent suitable mixed conifer or lightly infected lodgepole stands.

Trends - Black-backed woodpecker habitat has been increasing for the short term over the years with the abundant beetle kill lodgepole pine. This habitat is beginning to fall apart and will continue as the trees fall down, reducing foraging and nesting habitat creating loss in the long term.

White-Headed Woodpecker

Historic Condition - Documented provincial declines in this species indicate historical populations to be greater than now exists. Habitat for this species was also greater, given that areas in the mixed conifer dry PAG were adapted to fire, and were dominated by mid-late seral ponderosa pine stands. Much of these ponderosa pine stands have been removed through broad scale selection and salvage operations since the 1950's.

Current Condition - To date, there have been no sightings of white-headed woodpeckers which exist in the eastern portion of the watershed and around Crane Prairie and Cultus Mountain in the mixed conifer dry plant association group. The loss of many of the

large ponderosa pines may have reduced existing populations. Another factor within the mixed conifer dry habitats is the active fire suppression that has occurred since the early 1900's. This has moved this PAG out of its historic range of variability. Within the mixed conifer dry areas, the understory of white fir has become the dominant stand component, with ponderosa pine and douglas-fir still being the large tree component, but not the dominant stand component.

Trends - There has been a decrease in the large ponderosa pine stands due to high grading timber harvest. Increased mixed conifer competition has also led to a decrease in large ponderosa pine stands that are being replaced by true fir stands due to fire suppression. Losing this large ponderosa pine structure has led to a decline in primary and secondary habitat for this woodpecker species and others. Short-term habitat is being created with the Armellaria root rot problems.

Pileated Woodpecker

Historic Condition - Prior to timber harvest activities, the historic abundance of habitat for the pileated woodpecker was greater. Timber harvest activities led to the reduction of large diameter trees and snags and also caused increased fragmentation. It is probable that the number of pileated woodpeckers was also greater historically, but population density information is not available.

Current Condition - Several pileated woodpeckers have been sighted with a majority of the sightings occurring near Benchmark Butte and Cultus Mountain. The potential for loss of habitat for rests in the loss of existing mixed conifer associations in the event of landscape level disturbance (fire, disease and insect invasion). Currently, habitat is available in the mountain hemlock, mixed conifer wet, and upper elevations of the mixed conifer dry PAG's. Timber harvest has selected for large diameter trees including white fir, eliminating patches of large diameter trees, creating fragmentation. Reduction of snags and down logs in some areas has reduced nesting and foraging habitat.

Trend - There has been a loss of suitable habitat in the Timber/Forest Products Landscape Area from harvest of the large tree component (firs) and loss of dead and down logs from timber harvest and past firewood cutting Present firewood restriction to designated areas only will help alleviate future losses of snags and down wood.

Three-Toed Woodpecker

Historic Condition - Historical conditions for the three-toed woodpecker are similar to the black-backed woodpecker.

Current Condition - Three-toed woodpeckers have been sighted. A small scattered population of nesting three-toed woodpeckers was located in a mature lodgepole pine

forest around Ketch Ketch Butte, Lemish Butte, and Cultus Mountain. The proximity of similar stands of lodgepole pine to the confirmed nest locations strongly supports the hypothesis that a small population of this woodpecker species is present. Likely areas are in the unlogged lodgepole pine and engelmann spruce stands around Crane Prairie's west and north shore, northward to the Deschutes Bridge. They would probably be found elsewhere since it has been found exclusively in mature lodgepole pine stands above 4,500 feet in elevation. The areas previously mentioned are at the lower end of this limit of this elevation gradient. No research shows that this species will be found in the mixed conifer types containing a component of mature lodgepole pine. The range of this species appears very restricted (Milano, 1991). It is important to maintain large blocks of mature lodgepole pine forest with a fir understory greater than 200 acres. There could be an adverse affect on local populations with the conversion of mature lodgepole pine forests to young-aged stands.

Trends - same as black-backed woodpecker.

2. Raptors

Northern Goshawk

Historic Condition - Historically, the abundance of habitat for the northern goshawk was greater than today. Suitable habitat in the mixed conifer and lodgepole pine PAG's has been reduced by extensive timber harvest activities in the southern half of the watershed. These activities have fragmented the habitat and has removed appropriate nest sites.

Current Condition - Surveys for goshawks have been conducted. Several sightings of goshawks have occurred, but no nesting pairs have been found. It is suspected that goshawks will utilize the area throughout the year with their winter distribution limited to the lower elevations. Goshawks are moderately sensitive to high levels of human disturbance.

Goshawk habitat has been fragmented by past timber harvests and firewood cutters. Some areas of intact lodgepole pine stands still provide primary and secondary habitat along the Deschutes River and between the Lava Lakes and Elk Lake. Mountain hemlock PAG's provide unfragmented primary and secondary habitats. Areas of primary habitat still exist within the mixed conifer PAG but at a lower density level (due to fragmentation).

Epidemic levels of beetles have killed much of the lodgepole pine dry. At this time, these stands are still considered primary habitat as long as the standing dead and live comprise a canopy cover of 50% or above. As these stands start falling apart in the next 5 to 15 years, these acres will probably go from primary habitat to secondary or foraging habitat. The amount of acres that will be converted will depend on how many large trees survive the epidemic of beetles. These acres will cycle back into desirable habitat within 40 to 50

years. During the cycling period, goshawks may relocate to adjacent suitable mixed conifer or lightly infected lodgepole pine stands.

Trends - There has been an increase in loss of habitat from timber harvest and beetle mortality. Goshawk populations are likely to continue declining as the cumulative effects of timber harvest and insect mortality change dense mature forests into more open, young forest stands. Goshawk populations may be eliminated from the southeast portions of the watershed since there are no large blocks of mature forest.

Great Gray Owl

Historic Condition - Historically, habitat for the great gray owl was more abundant than today. Timber harvest activities have reduced suitable nesting habitat in the lodgepole pine and mixed conifer PAG's. Total available foraging habitat was less than it is currently due to timber harvest activities. Foraging habitat in natural meadows was more abundant, as fires and the natural flow regimes of water kept the meadows more open (the creation of Crane Prairie Reservoir destroyed several thousand acres of meadow habitat). Population densities for this species is unknown.

Current Condition - A historical sighting of a great gray owl was documented in the Benchmark Butte area. Great Gray owls are suspected along the Deschutes River meadow complex above Crane Prairie Reservoir. Nesting habitat is at high risk due to high beetle mortality (high catastrophic fire risk). These stands will continue to provide nesting habitat until they begin to fall apart (5 to 15 years) or until they are salvaged. Foraging habitat is being lost in natural meadows by encroachment in most meadows by lodgepole pine. Foraging areas continue to be created with harvest activities.

Trends - There has been a loss of nesting habitat in the lodgepole pine plant association groups due to beetle killed trees and salvage timber harvest. Meadow foraging habitat is decreasing due to lodgepole pine encroachment.

Flammulated Owl

Historic Condition - Historically, the amount of habitat available for the flammulated owl was greater than it is today. Frequent low intensity fires kept mixed conifer stands more open. The owls were known to exist within the watershed, but population densities are unknown.

Current Condition - Flammulated owls have been heard vocally on many occasions in the past while spotted owl surveys have been conducted. Flammulated owl habitat has been lost by the conversion of uneven-aged, multi-layered forests to even-aged single-layered forests, reduction in size and numbers of mature and old-growth ponderosa pines which are used as nesting sites, and loss of snags (Marshall, 1992). The lack of low

intensity fires due to aggressive fire suppression has reduced most of the suitable habitat for the flammulated owl within the mixed conifer PAG's and has caused the development of a more closed canopy.

Trends - There has been a loss of suitable habitat in the mixed conifer dry plant association group. Ponderosa pine dominated stands are being lost due to fire suppression which has created densely stocked stands, and insects and disease problems.

3. Furbearers

Marten

Historic Condition - Historically, marten were more abundant than today. Many of these furbearing mammals were trapped heavily in the 1920's and 1930's reducing local populations. Habitat was greater due to more contiguous, late-successional coniferous stands and a greater abundance of standing and down snags.

Current Condition - Much is not known about this species within the watershed or within central Oregon. Marten have been sighted several times with the most abundant sightings occurring near Mt. Bachelor during the winter.

Their habitat is well distributed through the mixed conifer and lodgepole pine stands that are in an unmanaged state or have received only light partial cut treatments over the years. Habitat in General Forest areas has been impacted by timber harvest. The mechanism by which martens are impacted are the removal of overhead cover and large diameter coarse woody debris, especially, and in the case of clearcutting, the conversion of mesic sites to xeric sites, with associated changes in prey communities. Extensive loss of this habitat has occurred within the low-mid elevations displacing some of the population once existing population.

Trends - There is high potential for declines in marten populations from habitat loss, fragmentation, and lack of tolerance to human disturbance. Populations may be increasing due to the number of sightings on or near Mt. Bachelor. Some may have become accustomed to human habitation or these are repeat sightings of the same animals.

Fisher

Historic Condition - Historically, fisher were more abundant than today. Many of these furbearing mammals were trapped heavily in the 1920's and 1930's reducing local populations. Habitat was greater with contiguous, late-successional forests and dead and down wood more abundant.

Current Condition - Much is not known about this species within the watershed or within central Oregon. Sightings have occurred along the Deschutes River and near Green Lakes. Corridors occur along drainage and forested saddles between drainages at low to mid-elevation. The Deschutes River may be an important link for fisher movement. Extensive logging in the mid 1900's, along with trapping in the early 1900's, has decimated fisher populations. The problem for fishers is not with forest openings per se. Fishers evolved in forests where windthrow and fire were common. Small patch cuts, group selection cuts, and small clearcuts can superficially resemble both these disturbances. Fishers will experience habitat loss when timber harvest removes overstory canopy from areas larger and more extensive than natural windthrow and fire would (USDA, 1994). Small cuts interspersed with large blocks of habitat probably won't affect fisher populations but large cuts interspersed with numerous small cuts will limit resting and foraging habitat. Habitat has been heavily fragmented due to timber harvest. This fragmentation may result in the isolation of populations. With population densities of fishers being low relative to other mammals, they can undergo fluctuations that are related to their prey. These fluctuations make small or isolated populations particularly prone to extirpation. Declining amounts of mature and overmature timber may be isolating populations that are too small for long-term viability. Extensive fragmentation has probably decreased populations of this species.

Another rising conflict is the increasing winter disturbance from snowmobile users causing the animals to react in adverse terrain conditions (movement through snow). This conflict may reduce foraging areas within heavily recreational travelled areas during the winter months.

Trends - Fisher were historically hunted for their pelts which may have dramatically reduced historic populations. Timber harvest (fragmentation) in the low to mid-elevations, and possibly high recreation use along the Deschutes River, has reduced populations. The establishment of LSR's will likely enhance habitat conditions throughout the range of the animal. Fire suppression within their habitats may have been improved by providing greater cover within those areas but has not created additional amounts of habitat.

MISCELLANEOUS WILDLIFE

A. AVIAN

1. Neotropical Migrants

These migratory landbirds breed mainly in temperate North America and winter primarily south of the United States-Mexico border. Of the 122 neotropical migrant bird species that breed in Oregon, most use more than one habitat type during the breeding season, and

43% are habitat generalists using four or more habitats for nesting and/or feeding during the breeding season. Overall, 34% of the species are habitat specialists depending on only one or two habitats for breeding (Washington Natural Heritage Program, 1994).

56% of the neotropicals are associated with riparian habitats and 75% of these are habitat generalists. Wet and dry coniferous forests, particularly old growth stands, provide important habitat. 37% of the species are associated with old growth coniferous forests. Two of these species are habitat generalists. In the past 200 years, there has been an 83 to 90% loss/conversion of old growth coniferous forests.

Historic Conditions - Historical populations of neotropical migrants was much higher than current populations. Interior forest habitat and undisturbed healthy riparian environments provided the necessary requirements for these bird species. Loss of large amounts of old growth habitat in the mixed conifer forests have reduced those populations of neotropical birds dependent on these forests.

Current Conditions - Table II-16 shows declining species of neotropical migratory birds. None are currently listed as T, E, or S species at the state or federal level although the Williamson's Sapsucker is a state Sensitive. Since the Williamson's Sapsucker is a habitat specialist with a restricted breeding distribution and significant population declines, there is additional cause for concern. From this table, only the olive-sided flycatcher and the barn swallow are declining significantly nationwide, while the Wilson's warbler and western wood-pewee experienced significant declines in some regions (Washington Natural Heritage Program, 1994).

Table II - 16 - Cascade Lakes Watershed - Declining Populations of Neotropical Migratory Birds.

Turkey Vulture	Rock Wren
American Kestrel	Swainson's Thrush
Killdeer	Varied Thrush
Mourning Dove	Wilson's Warbler
Vaux's Swift	Western Tanager
Rufous Hummingbird	Chipping Sparrow
Belted Kingfisher	White-crowned Sparrow
Williamson's Sapsucker	Dark-eyed Junco
Olive-sided Flycatcher	
Western Wood-peewee	
Violet-green Swallow	
Barn Swallow	

The reason for the decline of a majority of these species is the loss of their wintering habitats in Central and South America. Other reasons include eggshell thinning (turkey

vulture), loss of wetland habitat, loss of old growth habitat, degraded riparian habitats, and parisitism. Several of these species, including the olive-sided flycatcher, western tanager, and the dark-eyed junco respond favorily to low intensity fires.

The following species are of concern because of their unknown population trends, restricted breeding distributions, and are habitat specialists (mature coniferous forests): Townsend's Warbler and the Hermit Warbler.

Trends - There has been widespread decline in neotropical migrants from loss of habitat in their breeding and wintering grounds.

2. Waterfowl

Historic Condition - Historically, waterfowl were probably more abundant than today. There was less disturbance occurring and riparian areas were not being impacted by recreationists. There may have been less lake associated waterfowl, as the creation of Crane Prairie Reservoir increased the amount of habitat for these species.

Current Condition - Approximately 35 species of waterfowl are known or suspected to utilize the watershed. 6 of these species are cavity nesters. Other species rely on riparian habitats for nesting.

An abundance of lakes can be found. All of these lakes at some time or another will have various species of waterfowl utilizing the habitats. Most have some form of wetland habitat associated with them. Nesting habitat is available at Crane Prairie (spotty distribution), the Lava Lakes, Hosmer Lake, Muskrat Lake, and Winopee Lake, and also along the Deschutes River. Invertebrates are common in most of the lakes, except for Sparks Lake. Aquatic vegetation isn't very common with the lakes due to the lack of nutrients in the water. Lakes such as Teddy, Muskrat, Winopee, Little Cultus, and Lemish have some emergent vegetation. Snags are abundant due to the insect and disease outbreaks that continue to occur. These snags are beginning to be removed in some areas such as campgrounds because of the hazards they pose.

Over the last 20 years, biologists have installed numerous nesting platforms and nest boxes for ducks and geese, mostly at Crane Prairie Reservoir. Most of these structures have fallen apart from lack of maintenance and old age. Most lakes in the watershed have, at some time in the past, nest boxes set up around the lakes. These nest boxes need to be checked and cleaned out or replaced.

Crane Prairie and the Deschutes River are important waterfowl habitats for nesting as well as stopover areas in spring and fall migration. Crane Prairie supports a high number of nesting waterfowl including: Canada geese, goldeneye, bufflehead, American and hooded merganser, mallards and possibly ring-necked ducks and cinnamon teal. Coots, western,

eared, and pied-billed grebes also occur throughout the open water season. Crane Prairie supports abundant meadows and marshy areas, large numbers of snags with cavities, loafing logs, and shallow productive water providing an abundant forage strata. The Deschutes River provides habitat in its slackwater oxbows and associated meadow riparian zones.

Increased recreation has led to a decrease in effective riparian areas and has also led to disturbance of nesting pairs.

Trends - There is a decline of effective nesting habitat for some waterfowl from increased recreation use in riparian areas (disturbance during critical reproductive periods) and loss of snags adjacent to lakes near recreation sites for hazard removal.

Recreation use of water bodies in combination with trampling of nests and loss of brood cover from grazing as well as residual lead shot in the foraging strata pose the potential for some level of adverse cumulative effects on waterfowl.

3. Other Avian Species of Interest

Osprey

Historic Condition - Osprey were first sighted at Crane Prairie in 1949 (Anderson, 1983), 27 years after the creation of the reservoir. Population densities before this time are unknown. It is likely that osprey still utilized habitats along the Deschutes River and the lakes.

Current Condition - Osprey nesting populations may be declining in the Osprey Management Area. The number of nesting osprey is unknown. Osprey nesting has declined from a peak in the late 70's. It appears to be in another possible decline also due to loss of traditional nest territories on Crane Prairie Reservoir. In recent years, major nesting failures of the population on Crane Prairie have occurred every few years while they appeared to be non-existent during the 70's. Large scale nesting failure occurred in 1991 with only 2 nests on the reservoir fledging young, where traditionally 20+ nesting pairs would successfully rear young. Possible causes range from overall loss of snags over the water, weather, pesticides from their southern wintering grounds, or human recreational increases around the nest sites. Artificial nesting platforms have been placed at Crane Prairie Reservoir periodically since 1973 in an attempt to augment natural nest sites and replace over water snag nests with nest sites along the shoreline of the reservoir. Many of these nesting platforms have been lost. Suitable nest sites are available on a continuing basis, however, long term nest sites may become lacking since much of the young understory is in a very dense condition from overstocking. In addition, this understory is competing with the overstory trees and negatively affecting the current suitable nest trees longevity and growth (Anderson, 1983).

Osprey have adapted to high degrees of human disturbance within their habitat. The most critical time period when nesting failure could occur is during egg laying, incubation and first few weeks after eggs have been hatched and small young are being reared by adults. There is moderate potential for adverse affects to occur as a result of recreational fishing, boating and camping within osprey territories on Crane Prairie Reservoir. Heavy recreational fishing pressure could lead to loss of adequate fish supply to feed the adults and nourish young osprey. This could lead to abandonment of nesting territories from lack of adequate food supply coupled with human harassment (Anderson, 1983).

Adverse cumulative effects of overstocked forest stands in combination with increased human distribution could lead to dramatic losses of suitable nesting habitat. There is a risk of losing many of the overmature and mature large ponderosa pine to beetle kill and other mortality agents from overstocked stressed stands.

Negative cumulative effects may be developing over time for raptor species requiring or favoring mature forest conditions with high canopy closure and trees per acre. Timber harvest in combination with catastrophic wildfire, blowdown, and loss from insect and disease epidemics could lead to major declines of raptor species.

Great Blue Heron

Historic Condition - Historic population densities for this species is unknown.

Current Condition - 2 great blue heron rookeries exist. One is east of Crane Prairie Reservoir. The population began to build at the rookery in the late 70's as herons from rookeries north of Crane Prairie abandoned sites at Deschutes Bridge and Benchmark Butte and consolidated into one rookery at Crane Prairie. This is assumed to be true from reviewing old district notes. Today, one rookery of 3 trees exists with somewhere around 50 nests. Prior to 1990, 6 nest trees were in use. This same year an arson fire destroyed 3 of the large ponderosa rookery trees while 3 other trees survived at the edge of the burn. The population probably has suffered a setback of unknown duration. The road into the rookery areas is currently closed from March 1 to August 8 each year. The other rookery is west of Crane Prairie Reservoir in an engelmann spruce stand. The number of nests at this site are unknown. Crane Prairie, Cultus River, and the Deschutes River down to Wickiup are assumed to be the primary foraging habitat for this heron population.

B. MAMMALS

1. Big Game

Deer and Elk

Deer and elk tend to migrate through the valleys between the buttes to and from summer and winter range. The watershed provides summer and winter range, calving and key elk areas (Crane Prairie and Clover Meadow) for elk and summer range for deer. Deer and elk cross over the Cascades crest from east to west which produces mule and black-tailed deer crosses and Roosevelt and rocky mountain elk crosses. These crosses probably occur north of Charlton Lake and north of Crane Prairie.

Historic Condition - Before human settlement in central Oregon, deer were fairly abundant. A statement from Judge John B. Waldo from his journeys throughout the high Cascades, "The mule deer are about in considerable numbers." This was a statement made about the Crane Prairie area. Deer, along with other game species were plentiful in the early days, but diminished greatly as settlement increased between 1906 to 1912. In 1924, on the Deschutes National Forest, it was estimated that there were 1250 mule deer. With tightened hunting regulations, by 1949 there were an estimated 26,000 mule deer on the forest, with 35,800 by 1968 (Brogan, 1969).

Historically, elk were non-existent or in very small numbers. Roosevelt elk inhabited the Cascades west to the Pacific Ocean. Some of these populations probably drifted into the watershed in the summer months. The Blue and Wallowa Mountains in the northeast corner of Oregon was primary habitat for the rocky mountain elk. These elk probably migrated south and west towards Klamath Falls and north up the east side of the Cascades. In 1924, there were no elk on the forest and by 1949, there were an estimated 300 elk (Brogan, 1969).

Current Condition - Deer and elk populations have increased over time as a result of past timber harvest activities which created forage (harvest units) in close proximity to cover. In addition, there has been an increase in the amount of effective deer and elk cover where fire suppression has resulted in dense understories of white fir. Stands infected with insects have provided additional security habitat in areas of abundant down logs. Increased human use of riparian areas (preferred breeding habitat for deer and elk) has displaced some animals from historic breeding sites. Future land management activities with an emphasis on restoring and conserving late successional forests in the watershed will most likely, within 20 years, reduce the amount of forage for deer and elk. Currently, total deer and elk populations are unknown. An estimated management objective for this watershed is 140 elk, 1650 adult deer, and 860 fawns.

Hiding and thermal cover are abundant. Forage/cover ratios and thermal cover are as follows:

Table II - 17 - Cascade Lakes Watershed - Forage/Cover Ratios by Landscape Area and Thermal Cover % by Key Elk Area.

Forage/Cover (by Landscape Area for Deer)	**Thermal Cover (by Key Elk Area)**
Rec-Alpine/Tephra - 28:72	Charlton Creek (2950 acres) - 24%
Outback - 1:99	(697 acres of thermal cover)
Rec-Riparian - 26:74	Crane Prairie (8830 acres) - 44%
Timber Products - 24:76	(3884 acres of thermal cover)

The Forest Plan recommended levels for thermal cover in Key Elk Areas is 20% of the area. The Charlton Creek Key Elk Area is fairly close to the recommended level of thermal cover. Prior to any type of harvest removal, this area should be analyzed to maintain thermal cover at or above 20%.

The Forest Plan recommended levels for forage/cover are 70:30, with optimal levels at 60:40. The current forage/cover ratios are well above Forest Plan and optimal levels. This is important in the Recreation/Riparian Landscape Area where there is an increase in human disturbance.

Road densities have been broken down by watershed for deer summer range and by Key Elk Areas for elk populations. In deer summer range, recommended levels are 2.5 mi/mi2, and in Key Elk Areas, it is 0.5 to 1.5 mi/mi2 (DLRMP). Road densities are analyzed using all surface type roads at maintenance levels 2 to 5. The results are as follows:

Table II - 18 - Cascade Lakes Watershed - Road Densities by Sub-Watershed and Key Elk Area.

Sub-Watershed		**Key Elk Area**	
Sparks	0.5 mi/mi2	Charlton Creek	1.3mi/mi2
Elk	0.5		
Lava	0.6	Crane Prairie	3.1 mi/mi2
Headwaters	2.5		
Cultus	0.3		
Snow	4.5		
Charlton	2.4		

The Snow subwatershed and the Crane Prairie Key Elk Area contain well over Forest Plan recommended levels and need priority action to close roads to reduce densities and achieve habitat effectiveness. The Headwaters and Charlton subwatersheds and the Charlton Creek Key Elk Area contain high road density levels also (they are at or just below Forest Plan recommended levels), and should have roads closed that are not necessary to keep open.

Some elk are in permanent residence on the east slopes of the Cascades. Others will winter on the west slopes in the Willamette National Forest. During the spring and summer, elk remain in the lower elevations of their range. Several elk areas are protected through a Forest Service wildlife road closure system.

Key Elk Areas - Small elk herds range across the watershed. The west and north portions of Crane Prairie Reservoir compromise important spring through fall range for over 100 elk. This area is important calving habitat with its numerous meadows, water, and excellent cover. Four years of radio telemetry with five collared elk revealed the importance of this area for elk. Anywhere from 5 to 25 elk overwinter in the Cultus River and Deschutes River/Snow Creek area above Crane Prairie. Recreation management is a very important use within Crane Prairie Key Elk Area and is growing at an ever increasing rate. New proposals for recreation opportunities could potentially create future conflicts with maintaining habitat effectiveness for elk if not properly coordinated.

Clover Meadow is another Key Elk Area. The Charlton Creek area appears to be an important summering and calving area for elk.

Poaching has been evident in he past. In a study conducted in the Cascade elk telemetry study (Oregon Cascades form Mt. Hood through South Umpqua) in 1989, 13 of 25 elk mortalities of known cause were illegal kills. On the Deschutes National Forest, 6 of 11 collared elk mortalities of known cause were illegal kills. According to ODFW, this equates to a 52 to 55% mortality from poaching.

Trends - Past timber harvest (patch clearcuts and shelterwood harvests) created an abundance of forage in close proximity to cover. This has created optimal deer and elk habitat, whereby populations of these animals increased over historic levels. The establishment of LSR's and a trend away from patch timber harvesting may reduce the availability of forage in some areas in the future, leaving elk and deer to concentrate foraging in meadow habitat areas. This may cause deer and elk populations to decline slightly. Recreational harassment (mushroom gathers, hunters, and vehicular traffic) can reduce overall fitness of animals, cause abandonment of habitats and create a potential for illegal harvest. Fire suppression has allowed cover (understory vegetation) to build up where historically periodic small ground fires would have "thinned" these understories. In addition, areas of insect killed timber that have not been salvage logged are creating good

hiding cover (down wood) and small amounts of forage for deer and elk. Roads and campgrounds along Crane Prairie may be displacing calving in historic calving habitat. Increasing recreation to and around ponds/lakes and creeks may continue to disturb or displace big game as well as other animals. Vehicular traffic along Cascade Lakes Scenic Byway is increasing with the increased recreation use, thus increasing potential for big game mortality from vehicle hits.

Increased recreational hunting pressure together with continued stand thinning programs and failure to keep roads closed during the hunting season could lead to increased vulnerability of deer and elk to hunting pressure and poaching.

C. AQUATIC SPECIES

Amphibian species that can be found are: the **cascade frog, spotted frog,** long-toed salamander, northwestern salamander, pacific giant salamander, pacific tree frog, tailed frog, red-legged frog, and the western toad.

Historic Condition - No historic documentation of aquatic populations has been identified, however, human impacts have likely reduced the distribution and survival of amphibians in some locations. Given the recent introduction of non-native fish, poisoning of certain lakes, and loss of riparian habitats in localized disturbance areas, it is likely that the cascade and spotted frogs were more widely distributed. The designation of these two species as federal candidate species (Category 2) reflects geographic concerns. Populations of cascade and spotted frogs, along with other amphibian species, are likely to have been more widely distributed.

Current Condition - Amphibian (frogs, salamanders and toads) species likely to be found are highly associated with aquatic and riparian habitats. Although some species may migrate overland, they will usually be associated with water or moist conditions (rainy season, etc.). All species use aquatic habitats for reproduction. Landscape corridors between ponds, lakes and key streams would allow amphibian migration between and within watersheds, thus enhancing gene pool exchange and the potential for recolonization of historic habitats. The corridors would link key aquatic and riparian areas and provide connections between watersheds over the crest of the Cascades which would link suitable habitats on both sides of the crest.

The wilderness area, given its abundance of "potholes", may be a reservoir of native amphibians at endemic levels where recreational use and fish stocking have not disrupted their life history, habitat or predator/prey relationships. This entire area provides a link to the south and west where there are additional pothole lakes. These pothole lakes also provide important linkages to Cultus and Little Cultus lakes, Elk and Hosmer Lakes, and Sparks Lake. Intermittent and perennial streams assist in providing this linkage.

Crane Prairie is the centralized water body that receives flow coming from high to low elevations. All migrational corridors finger off this lake going north, south, and west. The Deschutes River is a major amphibian waterway connecting the Lava Lakes to Crane Prairie. Cultus Creek is the major amphibian waterway connecting Cultus Lake and Crane Prairie, along with Deer Creek connecting with Crane Prairie from Little Cultus Lake. During high water flow, Charlton Creek periodically connects Charlton Lake with Crane Prairie.

Lack of surveys prevent disclosure of the current condition. However, factors that have likely influenced populations have been the introduction of fish stocking to many lakes that historically did not contain fish. Non-native fish are competing for food and cover as well as directly preying upon endemic amphibians. These fish may have reduced or eliminated historic amphibian populations and may continue to act as a block within travel corridors for amphibians. Poisoning to kill fish species within the Lava Lakes and Hosmer Lake would have likely eliminated populations of amphibians within these systems. Slow recovery of amphibians to the riparian system after poisoning is likely due to species dispersal capabilities. Recreational use in riparian areas has likely reduced breeding habitat.

Trends - Stocking of non-native fish are likely competing for food and cover as well as preying upon endemic amphibians. During a local survey of Cultus Lake, a stocked trout had consumed 10 long-toed salamanders. Roland Knapp, a University of California Research Biologist, has documented dramatic declines in amphibian and endemic fauna in historically fishless lakes that have been stocked with non-native fish. In addition, increased recreational use and development along lakes and streams is degrading riparian habitats important to amphibians. It is expected that recreational pressure will continue to center around aquatic areas and continue to degrade adjacent riparian habitats thus reducing amphibian habitats and dispersal capabilities. Drought and possible climatic changes may be affecting the quantity and quality of amphibian habitat, however this change is likely to be within the natural range of variability. Historically, the Lava Lakes and Hosmer Lake were poisoned to try to eradicate the illegally introduced tui chub. Rotenone poisoning likely reduced the number of amphibians as well as their prey base for several years. Documented response or results of this poisoning on amphibians and other aquatic organisms is not known. Traffic along the Cascade Lakes Scenic Byway may pose a migration barrier to amphibians.

Declines in endemic population levels and distribution of amphibians may occur where continued non-native fish stocking occurs and where extensive recreational use adversely affect riparian habitats. This may pose migrational barriers within and between watersheds that may adversely affect gene pool exchange and ability to recolonate depopulated areas. A loss of native amphibian populations are likely to disrupt local food webs, disruption of the aquatic and, to a lesser degree, the terrestrial ecosystems. These systems would not be within their range of natural variability.

RIPARIAN HABITAT

Of the 262 species known or suspected to utilize the watershed during the year, 220 species use the riparian areas as primary habitat for breeding, feeding, resting, and/or dispersal. 159 species will utilize riparian areas as primary or secondary habitat for breeding, feeding, and/or resting. Not only are riparian areas diverse in vegetative species, but they are highly diverse in small mammals, amphibians, reptiles, insects, aquatic insects, and fish. Snags, down logs, large trees, willows, alder, spruce and grass and grass-like species are highly desirable habitat for many species.

Dry lodgepole pine riparian zones are the least diverse of the riparian habitat, showing no dramatic vegetative species change within the riparian zone. These areas are still important for wildlife. Wet lodgepole pine riparian zones demonstrate much more diversity within the riparian area, with influences of white fir, douglas-fir, ponderosa pine, spruce, alder, willow, spirea and many other herbaceous species. Mixed conifer and mountain hemlock riparian areas are also highly diverse.

Streams, wet marshes/bogs, ponds, and lakes play a key role for amphibians, song birds and waterfowl. 23 species, such as the wood duck, barrow's and common goldeneye, downy woodpecker, mountain chickadee, long-eared owl and longed-legged myotis, utilize cavities along riparian areas. Down logs along the riparian zone are utilized by the amphibians, ermine, golden-mantled ground squirrel, long-tailed vole, long-tailed weasel, river otter, Townsend's chipmunk, western jumping mouse, wolverine, and yellow-pine chipmunk. Large trees along or near riparian areas are used by breeding bald eagles, Clark's nutcracker, common raven, Douglas' squirrel, golden eagle, great blue heron, northern flying squirrel, northern saw-whet owl, osprey, red-breasted sapsucker, tree swallow, violet-green swallow and western gray squirrel. The loose bark on ponderosa pine and mixed conifer trees provide nesting habitat for the brown creeper and bats. Willows and alder patches provide nesting and foraging habitat for mourning doves, olive-sided flycatchers, ruffed grouse, white-breasted nuthatches, hummingbirds and warblers.

Riparian vegetation is used as lining material in nests for nesting birds and small mammals. The vegetation provides abundant foliage for hiding, grazing, browsing, and preying on insects, amphibians, and small mammals. Riparian areas also provide a cool microclimate for breeding and resting wildlife. Maintaining a constant body temperature is critical to most wildlife species. If body temperature drops or rises too much, animals have to burn many calories to warm or cool the body. Expenditure to calories reduces the animals reserves to face seasons of low food and harsh weather conditions. Riparian areas and their distribution within the watershed provide logical travel corridors for many species and a central location for mating species.

The following is a list of riparian habitats and the number of species associated with that habitat:

Headwaters (springs, seeps, marshes, swamps and bogs) - 41 species, including the American dipper, belted kingfisher, long-toed salamander, Northwestern salamander, Pacific treefrog, red-winged blackbird, river otter, rough-skinned newt, sharp-shinned hawk, Swainson's thrush, tailed frog, water shrew, and western toad. Tailed frogs focus on cold, fast running water in springs.

Marsh and Bog - 141 species, including the American bittern, American wigeon, common garter snake, evening grosbeak, gadwall, hermit thrush, killdeer, marsh wren, Pacific treefrog, spotted frog, water vole, and yellow-headed blackbird.

Streams (streams and creeks, fast and slow moving) - 112 species, including the American coot, belted kingfisher, Caspian tern, common merganser, Forster's tern, river otter, rough-skinned newt, ruddy duck, and spotted sandpiper. Slow moving only, 16 species, including the bufflehead, common goldeneye, green-winged teal, mallard, marsh wren, Virginia rail, and wood duck. Fast moving only, 3 species, including the American dipper, harlequin duck and the tailed frog.

Lakes (Lakes, ponds, reservoirs) - 147 species, including the American bittern, canvasback, common snipe, gadwall, great blue heron, killdeer, long-toed salamander, long-billed curlew, and sandhill crane.

Mesic/Wet Shrublands - 73 species, including Anna's hummingbird, beaver, brewer's blackbird, broad-footed vole, common nighthawk, long-tailed vole, mountain quail, racer, red-winged blackbird, ruffed grouse, willow flycatcher, and yellow-breasted chat.

Alpine Shrublands - 29 species, including the American robin, barrow's goldeneye, black rosy finch, bobcat, broad-footed mole, Cassin's finch, coast mole, common raven, coyote, downy woodpecker, harlequin duck, heather vole, long-tailed vole, mink, MacGillivray's warbler, merlin, pine siskin, porcupine, red fox, river otter, rufous hummingbird, spotted sandpiper, stellar's jay, Swainson's hawk, water shrew, western jumping mouse, western red-backed vole, western toad, and white-crowned sparrow.

Subalpine/Alpine Meadows - 43 species, including the black rosy finch, cassin's finch, fox sparrow, montane vole, pine siskin, western red-backed vole, and white-crowned sparrow.

Riparian species that demonstrate sensitivity to human activity, tolerate low levels of activity but react to high levels of human activity: American pipit, American white pelican, American wigeon, Arctic loon, bank swallow, Barrow's goldeneye, Bonaparte's gull, bufflehead, Canada goose, canvasback, cinnamon teal, common loon, common

merganser, Franklin's gull, great blue heron, great egret, greater white-footed goose, green-winged teal, harlequin duck, hooded merganser, lesser scaup, long-billed curlew, mallard, northern pintail, northern shoveler, redhead, ring-necked duck, sandhill crane, semipalmated plover, snowy egret, tundra swan, and wood duck. The trumpeter swan demonstrate a high sensitivity to human activity, reacts to low level and high levels of human activity. Crane Prairie, the Lava Lakes, Hosmer Lake, and Sparks Lake are utilized by the above species for feeding and resting on their way north to breeding grounds or south to winter migration areas. With increasing human activity around the lakes, many of these species may be displaced from these stop-over lakes.

Historic Condition

Judge John Breckenridge Waldo: *Diaries and Letters from the High Cascades of Oregon, 1880-1907* (Williams, 1985):

Crane Lake on Crane Prairie, August 24, 1883.

"Our eyes sighted from the overlooking higher ground, a yellow expanse of prairie, that looked like a wheat field of several thousand acres in the waste of sand and pine. It was nearly circular, and about 2 1/2 miles either way - a beautiful spot which answers to Crane Prairie or Lake. It is nearly dry with the exception of the clear streams with white sandy bottoms that meander through it, and meet at the east end and flow out toward the Deschutes River in a very considerable stream."

Deep (Deschutes) River, August 26, 1883.

"Crane Prairie is not easily traversable in any direction, or in a straight line at all. It is traversed by numerous clear canal-like streams - not fordable in the lower part of the prairie where two or more have united. There are numerous swampy spots, beaver land and bogs in the western portion of Crane Prairie (You would appreciate the pertinence of this name if you could hear, as we have, the deep sounding tone of the sandhill cranes, morning and night, and during the day)."

Crane Prairie, August 9, 1886.

"At Crane Prairie once more; quite well, but my fine summer resort has been discovered and turned to base uses - nearly four thousand sheep have disposed us and the deer and bear from a great part of our possessions - driven us into the nooks and corners of its wide expanse, still undisturbed, but with such occupation of a part, the charm of the whole is gone."

Crane Prairie Dam was first built in 1922 to provide irrigation to the Bend area. It was rebuilt in 1939. The uniqueness and beauty of Crane Prairie was lost forever.

Prior to 1912, most of the lakes in the watershed were without fish (Baker, 1949-1950).

The first uses of grazing were on a seasonal basis with no regulations and it was first come first serve. Crane Prairie and the Sparks Lake area were the primary grazing allotments. Crane Prairie was grazed by sheep in the late 1800's until about 1906 when cattle grazing began. The north meadow of Crane Prairie, historically fairly wet, was ditched in several places and had a road built through it sometime in the 30's or 40's. Records indicate sheep were grazing in the Sparks Lake area from the early 20's until the early 40's, when cattle grazing began. Sheepmen were actively diverting Soda Creek for irrigation of the Sparks Lake Meadow as early as 1916. Early restrictions took place as riparian degradation from grazing abuses and recreation began. The Sparks Lake Allotment was also altered by planting vegetation. Intense modification by planting vegetation was done to improve forage productivity. Several species of native and non-native vegetation was planted in the 40's and 60's. Diversion dams, concrete headgates, and water spreading ditches were constructed in 1957. In the 60's, some pastures were deep furrowed, contoured, and seeded with several grass species. Fertilizer was applied to seeded sites and gopher control was undertaken using strychnine. In the late 60's, the flooding of Soda Creek deposited large amounts of sediment and glacial debris in the meadow.

Current Condition

Overall, the riparian habitats are in good condition. A small percentage of localized habitats have been degraded and wildlife species have been displaced. Cattle grazing is becoming a "thing of the past." Crane Prairie was last grazed in 1994, and will probably not be grazed in the future as the use of this allotment is inconsistent with the Northwest Forest Plan. The Sparks Allotment was last grazed in 1990 and will not be grazed until an Environmental Assessment has been conducted. It is likely that this allotment will not be grazed in the future also as it is also inconsistent with the Northwest Forest Plan. Fire suppression, natural succession, and drought are causing many meadows to become encroached with lodgepole pine. This is evident in the Crane Prairie Meadows and several stringer meadows seen from the Cascade Lakes Scenic Byway north between the Lava Lakes and Elk Lake. With increasing use by humans on water bodies and within the riparian areas, habitat effectiveness is being degraded and will continue to degrade. The degradation has not only been the loss of habitat to developed recreational facilities (campsites and trails), undeveloped recreation sites, roads, and winter recreation, but also the increased disturbance to wildlife species, which adds a stress factor. Disturbance that creates a stress factor to wildlife increases the animal's adrenaline, causing them to burn calories that may affect the animal's ability to reproduce, care for young, or survive extreme temperatures if disturbance is continual and/or prolonged.

Several lakes, especially Crane Prairie and Hosmer Lake, provide unique habitats with abundant feeding grounds for some shorebirds and waterfowl. The shallow waters surrounding these lakes provide excellent foraging for egrets, herons, pelicans, ducks, phalaropes, geese, cranes, and shorebirds. Sandhill cranes, osprey, and bald eagles also nest adjacent to the lakes relying on the lake's resources to provide food. Amphibians and reptiles are also closely tied to the lake habitats. Rushes provide a unique habitat for the marsh wren, yellow-headed blackbird, red-winged blackbird, and others. The lava flows at these lakes and others provide safe rearing habitat for otters, yellow-bellied marmots, and pikas.

Trends

Increased recreation in riparian areas has decreased overall effective riparian habitat through habitat loss, disturbance to wildlife, which may be causing stress and possible displacement (waterfowl, big-game, some furbearers), and thus reducing species diversity. There is also a decrease in the natural biological ecosystems process. Fire suppression, natural plant succession, and drought have caused continual encroachment of meadows and shrubby riparian areas. This habitat loss can affect bird species such as the calliope hummingbird, warbling vireo, white-crowned sparrow, and willow flycatcher.

TERRESTRIAL OR AVIAN SPECIES - Associated with the Following Habitats:

Lodgepole Pine (Dry and Wet)-Seral/Structural Stages
Mixed Conifer (Dry and Wet)-Seral/Structural Stages
Mountain Hemlock-Seral/Structural Stages
Meadows (includes Wet Meadows, Moist (hairgrass) Meadows, and Dry Meadows)

See Tables A5-3 - A5-7 in Appendix A-5 for lists of the species associated with the PAG's and the structural stages that they utilize for breeding, foraging, resting, and dispersal.

Historic Condition - Early furtrapping reduced the populations of many species in the mid to late 1800's. The beaver population was significantly impacted while trapping of mink, marten, weasel, ermine, fisher, and wolverine also affected these populations. Hunts to kill large numbers of wolves, grizzly bears, coyotes, mountain lions and other predators were common place in this time period. The gray wolf and grizzly bear are thought to be extirpated from Oregon. Mountain lion and coyote numbers have been reduced from historical numbers. Coyote numbers may be increasing due to reduced hunting and poisoning.

Current Condition - Increased disturbance to wildlife by forest users (mushroom pickers, other forest product gatherers, recreational vehicular traffic, and hunters) affect an animals

fitness, depending on how it responds to human disturbance. Species that demonstrate a sensitivity to human activity that will tolerate low levels of human activity but react to high levels of human activity: bald eagle, boreal owl, Cooper's hawk, elk, golden eagle, marten, merlin, mountain lion, northern goshawk, red-tailed hawk, rough-legged hawk, sharp-shinned hawk, Trowbridge's shrew, and white-winged crossbill. Species that demonstrate a sensitivity to human activity that will react to low and high levels of human activity: big brown bat, California myotis, little brown myotis, long-eared myotis, long-legged myotis, peregrine falcon, silver-haired bat, wolverine, and yuma myotis. Depending upon the extent, frequency and duration of disturbance, it may affect the animals ability to survive during stressful periods, cause abandonment of young and/or abandonment of habitats. Vehicular traffic on roads, whether it be cars, trucks, motorcycles, ATV's, snowmobiles, or mountain bikes all contribute to disturbing wildlife. The road densities in several sub-watersheds are high (see big-game road density analysis, Table II - 18). Many roads are closed but not all closed roads may be effective closure to motorcycles, ATV's, mountain bikes, and snowmobiles. This does not include skid roads created during timber harvest activities or recreationally created (non-forest).

Not only do the roads provide an avenue for disturbance, but they create a fragmented habitat along with timber harvest units. Fragmentation, the breaking up and eliminating of large continuous stands of habitat, is prevalent within the PAG's, except the mountain hemlock PAG. Fragmentation reduces habitat for species that require large home ranges with continuous habitats and species that use interior, non-edge influenced habitats. Some species that are detrimentally affected by fragmentation include: black-backed woodpecker, northern goshawk, spotted owl, Barrow's goldeneye, mountain bluebird, Anna's hummingbird, fisher and marten. However, fragmentation favors edge and contrast species such as elk, deer, European starling, brown-headed cowbird, great horned owl, and red-tailed hawk.

Species that have an extremely low to low/moderate degree of habitat versatility are species which tend to have very specific habitat requirements. These include: American dipper, Anna's hummingbird, ash-throated flycatcher, bald eagle, bank swallow, barn owl, Barrow's goldeneye, belted kingfisher, black rosy finch, black-backed woodpecker, black-chinned hummingbird, bufflehead, cascade frog, Clark's nutcracker, common goldeneye, common merganser, common poorwill, double-crested cormorant, Douglas' squirrel, fisher, flammulated owl, golden eagle, golden-crowned kinglet, golden-crowned sparrow, great blue heron, great gray owl, heather vole, hooded merganser, horned lark, house wren, killdeer, Lewis' woodpecker, long-toed salamander, MacGillivray's warbler, marsh wren, marten, merlin, mountain bluebird, northern goshawk, northern harrier, northern pocket gopher, northern saw-whet owl, northern salamander, osprey, pika, pygmy nuthatch, red-breasted sapsucker, red-winged blackbird, rock wren, rough-skinned newt, rubber boa, ruby-crowned kinglet, sandhill crane, spotted frog, spotted owl, tailed frog, three-toed woodpecker, Townsend's chipmunk, tree swallow, Trowbridge's shrew, Vagrant shrew, varied thrush, water shrew, western flycatcher, western gray squirrel,

western jumping mouse, western kingbird, western pond turtle, western red-backed vole, western toad, white-breasted nuthatch, white-headed woodpecker, white-throated swift, white-winged crossbill, Williamson's sapsucker, winter wren, wolverine, yellow warbler, yellow-bellied marmot, yellow-breasted chat, and yellow-rumped warbler. Because these species have low versatility, they are adversely affected by the removal or degradation of their associated habitat.

The existing habitat fragmentation throughout the lower elevation PAG's has affected the density of species with large territories. Species that have a territory area greater than 100 acres will actively defend the area usually during the breeding season against intruders of its own species. These include: 1) Utilizes two structural stages in close proximity - American kestrel, bald eagle, beaver, bobcat, coyote, elk, great gray owl, long-eared owl, mink, mountain lion, mule deer, peregrine falcon, red-tailed hawk, ring-necked duck, and sharp-shinned hawk; 2) Utilizes two or more structural stages for primary and/or secondary habitat - badger, golden eagle, marten, northern goshawk, pileated woodpecker, porcupine, red fox, spotted owl, and wolverine.

There has been a loss of large trees due to timber harvest and declining forest health. Large trees are an important habitat component for breeding and roosting wildlife. Species such as the brown creeper create nests under the large, loose bark, utilize the large loose bark, while several species of bats (myotis) also utilize this bark for roosting. Bald eagles, golden eagles, osprey and Great blue herons depend on large trees and their large limbs to create nests on. Cavities in large dead or live trees are used by various species such as marten, fisher, bear, and squirrels for denning, nesting or resting.

The loss of large snags to firewood cutting, timber harvest, and safety hazard reduction has eliminated much of the habitat needed by many primary and secondary cavity users. Areas that typically lack snags are recreational use areas adjacent to water bodies and streams in the lodgepole pine forests (firewood collection) and the mixed conifer forests (timber harvest). Many waterfowl species (wood ducks, Barrow's goldeneye, bufflehead, common goldeneye, and common merganser) have shown a decline possibly due to loss of snags and disturbance by recreationist.

Increased numbers of forest users have favored certain wildlife species. Species that show a positive association to human activity include: American crow, barn owl, European starling, golden-mantled ground squirrel, gray jay, Townsend's chipmunk, and yellow-pine chipmunk.

Those species that are known or suspected to occur within the watershed that are on the decline are listed in Table A5-8 (Appendix A-5).

Trends - Wildlife species are affected by continuous disturbance by humans either by recreating throughout all four seasons or by habitat removal. Historically, habitat removal was the primary source affecting wildlife. Today, recreation is also a primary source (hikers, horseback riders, recreational vehicular traffic, etc.). The number of people using the forest and its resources has risen dramatically in past years. This increase has led to disturbances to wildlife and actual displacement in areas where habitat removal or human use has exceeded wildlife tolerance levels. Winter recreation (snowmobiling and cross-country skiers) is probably the most critical disturbance factor for wildlife. Winter time is a critical stress period and disturbance to wildlife at this time period causes the animals to use up much needed energy that is needed to survive this stressful period. Increase use of wilderness areas by backcountry users can displace human sensitive species from their habitat.

Habitat removal and fire suppression has decreased suitable habitat for several species. For example, habitat for some specialized species such as the white-headed woodpecker, black-backed woodpecker, and brown creeper. Fragmentation has led to an increase in the loss of avian eggs and nestlings. Opening up areas by timber harvest invites predation from birds such as the stellar's jay, American crow, and common raven, and nest parasitism by the brown-headed cowbird.

D. NON-NATIVE SPECIES

1. Terrestrial or Avian Species

House Sparrow (Passer domesticus)
Brown-Headed Cowbird (Molothrus ater)
European Starling (Sturnus vulgaris)
Barred Owl (Strix varia)

Historic Condition - The house sparrow was introduced and established in the United States between 1850 and 1867.

The brown-headed cowbird was introduced through cattle drives from the eastern and midwestern states. Artificial green belts along east-west irrigation canals have also aided in the invasion of the cowbird.

The European starling is native to Eurasia and North Africa and it is not known how the bird was established in North America.

Barred owls originally utilized the eastern United States, Canada, and also down to Hondurus. Fragmentation of the Northwest forests have provided suitable habitat for entry of the barred owl from Canada.

Current Condition - The house sparrow aggressively appropriates nests especially those of bluebirds and swallows often destroying eggs and nestlings.

Studies have shown that fragmentation of forested habitats and the creation of edge habitat has contributed to the expanding range of the cowbird. Increased fragmentation increases cowbird parasitism of bird species associated with late-successional habitats. For a list of birds parasitized by cowbirds and declining populations of many bird species, refer to Table A5-9 (Appendix A-5). Of the 44 birds species listed as parasitism hosts, 34 of those species are known or suspected to occur within the watershed.

The European starling can be found mostly in the southern half of the watershed where fragmentation is the heaviest. The starling is an aggressive cavity nesting species which is known to displace native cavity nesting species, especially bluebirds.

To date, there are two records of barred owl sightings. One occurred near Siah Butte which is near the eastern edge of the watershed boundary. The other sighting occurred in July of 1995 on the west side of Cultus Mountain near Deer Lake. Fragmented habitats are desirable habitats for barred owls. They will move into nearby suitable spotted owl habitats and compete for forage and habitat. They are also known to cross-breed with spotted owls.

Trend - Continued decline of native birds from cowbird parasitism, and house sparrow nest predation.

2. Aquatic Species

Bullfrog (Rana catesbiana)

Historic Condition - Bullfrogs are native to the eastern and midwestern United States and southeastern Canada. Due to human introductions, they are now well established throughout most of the western United States and southwestern Canada.

Current Condition - Bullfrogs are currently not known to inhabit the watershed. Bullfrogs are known to be in the Little Deschutes River up as far as Rosland Campground. It is unknown how far up the Deschutes system the frogs may be. Since the Deschutes system runs through the watershed, there is a high potential for invasion.

Trend - Increasing risk of invasion of bullfrogs.

FISHERIES AND AQUATIC RESOURCES

OVERVIEW

Recreational fishing is a very popular activity in the watershed and in the United States. Rainbow trout (Oncorhyncus mykiss), eastern brook trout (Salvelinus fontinalis), cutthroat trout (Oncorhyncus clarki), lake trout (Salvelinus namaycush), atlantic salmon (Salmo salar), kokanee salmon (Nerka kennerlyi), mountain whitefish (Prosopium williamsoni), and largemouth bass (Salmoides micropterus) constitute the game species. Recreational fishing supports many retail businesses and guide services in the Bend/La Pine area. Statewide, the percentage of Oregon's sport fishing population has dropped from 33% to 25% in the last 14 years (Wolf, 1995), but the increase in the overall human population has increased, therefore the number of anglers has probably remained steady. Because of declining salmon and steelhead runs on the Pacific coast and in the Columbia River system, and the subsequent diminishing recreational fishing opportunities, increased fishing pressure is expected in areas such as central Oregon (Marx, personal communication 1995). The intense recreational fishing pressure concentrates use along shorelines and streambanks, leading to resource damage in some areas (compacted soils, trampled riparian vegetation, probable untreated sewage input).

Fish habitat conditions approximate those of historic conditions. Crane Prairie Reservoir and Soda Creek are major exceptions. Streams and lakes are largely unaltered, except for localized areas. Some of the activities in the watershed that have potential to, or have altered the stream or lake environment are grazing, dam construction, riparian vegetation trampling from recreational use, road and trail crossings, stream channelization, stream cleaning of large wood, pollution from motor boats, and inadequate sewage disposal.

The construction of Crane Prairie Reservoir inundated approximately 15 miles of stream environment, and added about 4,500 acres of lake environment when the reservoir is at full pool. The reservoir is the terminus for all surface water flow in the watershed. Discharge leaving the watershed at Crane Prairie Dam is at an elevated temperature (occassionally exceeding 80° Fahrenheit.) from the pooling effect of the reservoir, degrading fish habitat in the Deschutes River downstream to Wickiup Reservoir.

Fish habitat in Soda Creek was affected by 2 flood events in the 1960's and a subsequent channelization effort, and by over 75 years of cattle and sheep grazing. Pool habitat, riparian vegetation, and overhead cover for fish are reduced as a result.

The present fish distribution and species make-up is much different than historic conditions. Many lakes and streams that did not historically contain fish now have populations that are either naturally reproducing or maintained by fish stocking, or a combination of the two. Bull trout are presumed to have been eliminated from the watershed approximately 40 years ago. An active stocking program initiated by state

agencies early this century, along with illegal introductions, have greatly increased the distribution, species composition, and angling opportunity of the fishery. Some of the lakes would experience decreased recreational pressure if fish stocking did not exist. Presently, the state operated stocking program utilizes helicopters and llama pack teams for back country water bodies, and tanker trucks for road accessible water bodies.

Historic Fish Distribution

Historically, the watershed contained abundant populations of native redband trout (Oncorhyncus mykiss), bull trout (Salvelinus confluentus), and mountain whitefish (Prosopium williamsoni). Habitat for sculpin (Cottus sp.) exists, but there is no record of documentation. The distribution of the fish was dependent on connection to the Deschutes River. Mountain whitefish and redband trout resided, reared, or spawned throughout the Deschutes River and its tributaries in the watershed. They were found as far up as Winopee Lake and Lava Lake. Bull trout were documented in the Deschutes River and Little Lava Lake, and are speculated to have resided in Lava Lake. For at least part of their life cycle, bull trout were likely to have used Snow Creek and several of the tributaries to the Deschutes River that are now completely or partially inundated by Crane Prairie Reservoir (Quinn River, Rock Creek, and Cultus River, Fies 1995, personal communication). Historically, adult bull trout resided in the mainstem Deschutes River below the present day Wickiup Reservoir, and then would migrate in the fall into these headwater tributaries to spawn.

Before it was inundated, the Deschutes River within Crane Prairie was regarded as an anglers paradise, abundant with trout (Hatton, 1987).

Background Information on Bull Trout

Bull trout are endemic to the western U.S. and Canada, and inhabit the Deschutes River basin. Like the eastern brook trout and lake trout, it is actually a char. Prior to the 1980's, bull trout were not held in high esteem, and were often discarded as "trash" fish. Even fishery managers of state agencies attempted to eradicate bull trout, mistakenly referred to as Dolly Varden, in favor of more desirable game species. The bull trout has a reputation as a fish eater, and was thought to be limiting the populations of other species through predation.

Bull trout have strict environmental requirements. They require cool water temperatures, generally <14° C. for distribution and <9° C. for spawning activity to initiate (Skeesick, 1989) with optimal egg survival between 2 to 4° C. (Pratt, 1993). Egg survival is greatly increased for salmonids when fine sediments (<1/4" diameter) make up 20% or less of the substrate (Meehan, 1991). Large wood accumulations are important cover for both juvenile and adult bull trout (Skeesick, 1989). The requirements of bull trout make them a valuable indicator of ecosystem health and integrity (Ratliff, et al 1992).

Bull trout have been eliminated or have depressed populations throughout much of its historic range. Because of the decline, the species has been warranted for inclusion by the U.S. Fish and Wildlife Service under the Endangered Species Act. The decision to list it as either a threatened or endangered species has been precluded at the time of this analysis. The bull trout is also on the Region 6 Foresters Sensitive Species List.

The bull trout are presumed to be eliminated from the Deschutes River system upstream of Steelhead Falls near Lake Billy Chinook (over 30 miles downstream of Bend), which still supports a viable population (Ratliff, 1993). The last reported catch of a bull trout in the Cascade Lakes Watershed was in Crane Prairie Reservoir in 1955 (Fies 1995, personal communication). The possible reasons for elimination were one or more of the following:

1. Angling mortality, 2. Competition with other fish species for food, space, and spawning habitat, 3. Hybridization with brook trout, 4. Blockage of historic spawning grounds of fluvial populations with the construction of Crane Prairie dam in 1922 and Wickiup Dam in 1949, 5. Kokanee superimposing redds on the bull trout redds. 6. Eradication by fishery managers.

Creation of Crane Prairie Reservoir eliminated the fluvial bull trout population, isolating the fish upstream of the dam, creating an adfluvial population. The reservoir was closed to fishing from 1925 to 1949 (Brogan, 1969) in an attempt to preserve the population of rainbow, which were an important egg source for the Oregon Game Commission hatchery program (Fies, 1995, personal communication). When fishing was reconvened, it apparently took only about 6 years before the bull trout were gone. Bull trout are very susceptible to angling, and this is most likely the largest factor in the elimination of bull trout from Crane Prairie Reservoir after the fishing ban was lifted.

Background Information on Other Native Fishes

The redband trout is an inland version of the rainbow trout, and are endemic to the western U.S. and Canada. Dr. Robert J. Behnke (fish geneticist) has divided the rainbow into 3 major evolutionary groups (Behnke, 1992). The Deschutes Basin redband belong to the Columbia River Basin group. This group is presently listed by the U.S. Fish and Wildlife Service as a Category 2 sensitive species. It is also on the Region 6 Foresters Sensitive Species List.

The watershed has been planted with rainbow trout of various stocks over the years by ODFW under a Memorandum of Understanding between the ODFW and the Forest Service. Interbreeding may have occurred between the hatchery stocks of rainbow and the native redbands, diluting the genetic purity of the redbands. Genetic sampling has recently been undertaken at three locations in the watershed, but the analysis is incomplete at the time this document was written.

Currently, habitat for redband trout has been altered with the inundation of Crane Prairie, actually increasing by over 4500 acres when the reservoir is at full pool. Some riverine habitat was lost, having been displaced with lake habitat. Redband trout would be able to tolerate the warm summer temperatures of the reservoir (>20° C. at surface) but may concentrate in the old river channels. The existing range and distribution of the redband is unknown until the genetic study is completed. Currently, there is at least some variety of naturally reproducing rainbow throughout the historic range.

Limiting factors for redband trout include, the introduction of various exotic species which compete for food and possibly interbreed, recreational harvest, loss of habitat in the first 1.5 river miles of the Deschutes River above Crane Prairie, and chemical treatment for elimination of the tui chub (Gila bicolor). Kokanee salmon, brook trout, largemouth bass, tui chub, various strains of rainbow, three-spined stickleback (Gasterosteus aculeatus), and lake trout have all been introduced, either legally or illegally. Lava Lake has been treated with rotenone intentionally 3 times, and Little Lava received one accidental partial treatment (Fies, 1995, personal communication). Ceratomyxa shasta, a fatal bacterial fish disease present in Wickiup Reservoir and downstream in the Deschutes River, is not present in the Cascade Lakes Watershed.

The mountain whitefish belongs to the salmonidae family and is abundant and widespread in the watershed where there is or has been a connection to the Deschutes River. It is endemic to the western U.S. and Canada. Currently, it still occupies its historic range. The creation of Crane Prairie Reservoir increased the habitat available to the whitefish. Mountain whitefish were historically a very important food source for bull trout.

Aquatic Invertebrates

Cascades Apatanian Caddisfly:

The Cascades apatanian caddisfly is a Category 2 Sensitive Species on the US F&W register and is also on the Region 6 National Forest Sensitive Species list. Populations have been documented in the Metolius River, and is suspected to be found elsewhere on the Deschutes National Forest. Positive identification is possible only through collection of adult males. Macroinvertebrate sampling within the last 3 years on Soda Creek, Fall Creek, the Deschutes River above Crane Prairie Reservoir, and Cultus River did not locate any Cascades apatanian caddisfly, but the standard technique used collects instream specimens, primarily juveniles, so the samples would not contain adult males of this caddisfly.

The habitat type it has been found in is headwater type streams with good water quality, slow to moderate current, with clean gravels and cobbles. This species is thought to be more abundant than early records indicated (Wisseman, 1992). The most likely habitat

for the Cascades apatanian caddisfly within the Cascade lakes Watershed occurs in the Deschutes River and Snow Creek.

Alsea Ochrotrichian Micro Caddisfly:

This caddisfly is a Category 2 Sensitive Species on the US F&W register and is included on the Region 6 Foresters Sensitive Species list. The species has been documented on the Deschutes River at Tumalo State Park north of Bend, and is suspected to occur in suitable habitat in streams within the Deschutes National Forest. Positive identification is possible only through collection of adult males, therefore the sampling technique used by the Deschutes National Forest would not be adequate.

They are found in a variety of habitats, ranging from small seeps to large rivers, but are most likely to be associated with large cobbles or boulders in moderate current. As with the apatanian caddisfly, this species is thought to be more abundant than the limited sampling records indicate (Wisseman. 1992).

Effects of Stocking Fish on Other Aquatic Life

Stocking of salmonid fish in previously fishless lakes was very common in the watershed, and dates back to about 1912 (Brogan 1969). Previous studies in the Sierra Nevada have shown that fish can eliminate or reduce the abundance of amphibians and zooplankton through predation (Knapp, 1994). Fish are known to feed upon both amphibian larvae and eggs. Dispersal of amphibians may become affected and their habitat may become fragmented from the stocking of fish in lakes. Hatchery fish are also known to carry the fungus Saprolegnia ferax. which can kill amphibian eggs (Knapp, 1994).

The larger zooplankton are more visible to fish and preyed upon more frequently than smaller bodied species. The end result is a community dominated by the smaller bodied species (Knapp, 1994). Many of the lakes sampled on the Deschutes National Forest in recent years show zooplankton communities that have been affected by fish predation (Vogel, 1994).

Fish also prey upon macroinvertebrates (mayflies, caddisflies, midges, damselflies, dragonflies) in the larval form, which may reduce the availability of the adult terrestrial life stage for insectivorous birds to prey upon (Knapp, 1994).

Feasibility of Restoring Bull Trout to the Cascade Lakes Watershed

Research indicates that eastern brook trout have hybridized with bull trout, and the hybrids are nearly completely sterile. Some research has indicated that bull trout are eventually displaced by the brook trout (Leary, et al 1991). Hybridization is a contributing factor to the general decline of bull trout populations in Oregon (Leary,

et al 1991). Eastern brook trout can also out compete bull trout, considering the brook trout can mature at age 2 to 3 years, producing many offspring in a relatively short period, whereas the bull trout do not mature until age 3 to 6 years (Leary, et al 1991). Introductions of rainbow trout and brown trout (Salmo trutta) have also been associated with the decline of bull trout populations (Rieman. et al 1993).

Reintroduction of bull trout to establish a widespread, self-sustaining population in the Cascade Lakes Watershed is probably unrealistic. This would require the eradication of eastern brook trout from any waters associated with the Deschutes River to eliminate potential hybridization with the bull trout, which would be extremely difficult and expensive. Conservative fishing regulations would need to be applied to bull trout harvest if they were to be restored. Enforcement of special regulations would be difficult because of the large number of anglers. Competition with other species would be intense. Suitable spawning habitat is available, but decreased over the historic condition with the inundation of Crane Prairie Reservoir. The bull trout would also have to compete with the eastern brook trout and kokanee for spawning areas.

In some streams, bull trout have remained separated from eastern brook trout because of a tolerance of very cold water temperatures. Considering eastern brook trout are found all the way up to the source of the cold water spring systems in the Cascade Lakes watershed, it is unlikely the two species could remain separated based on temperature alone.

To restore bull trout to a limited portion of its historic range would require selection of a reach of suitable stream habitat, installation of a physical barrier to eastern brook trout, electrofishing out all the eastern brook trout, and introducing bull trout within this habitat.

To restore bull trout to its historic range upstream of Bend would require large scale changes to the impoundment structures. Upstream fish passage would need to be provided at Wickiup and Crane Prairie Reservoirs, and extensive habitat restoration and flow regime changes to mimic natural conditions would be required in the Deschutes River below Wickiup Reservoir. Even then, many miles of historic spawning and rearing habitat would still be inundated by the two reservoirs.

Bull trout could potentially be stocked in a wilderness lake to establish a reserve. Offspring from this reserve could supply a seed source for restocking portions of the bull trouts historic range. Middle and North Green Lakes appear to be candidates for this proposal, which has not been discussed formally with ODFW.

HISTORIC AND CURRENT CONDITIONS BY LANDSCAPE AREA

The Recreation/Alpine Tephra Landscape Area

Historically there were no fish present in this area. Although there was surface water connection to the Deschutes River at one time (approximately 22,000 years ago), intense glacial runoff reduced water quality, likely preventing fish from migrating upstream into this habitat. Later volcanism isolated the waters from connection to the Deschutes River, the source of fish populations in the watershed. Currently, many of the lakes are stocked with salmonids, or have naturally reproducing populations of exotic species.

LAKES

In general, the lakes are popular for a variety of recreational activities, including fishing, canoeing, swimming, camping, wildlife viewing, and wildflower viewing. Water chemistry analysis indicates they are relatively low in major ions and nutrients, and high in clarity. Except for some of the small, shallow, high elevation wilderness lakes, they are capable of supporting fish on a year round basis. The lakes, both wilderness and non-wilderness, receive a large number of recreational visitors, but fishing is not the big draw. People visit this area primarily because of the outstanding scenery.

Sparks Lake

Sparks Lake is popular for non-motorized craft. The lake is about 400 acres with a maximum depth of about 10 feet, but much of the lake is less than 2 feet by late summer. The current lake is a remnant of a much larger and deeper lake (Johnson, et al 1985). The lake is stocked annually by the ODFW with 30,000 to 40,000 eastern brook trout fingerlings which grow to a legal size in one year. There is also natural reproduction in the tributary streams. Although there is potential for rainbow trout to emigrate to Sparks Lake from Middle Green Lake via Fall Creek, fish sampling conducted by the ODFW in Sparks Lake indicates an eastern brook trout population only. Flyfishing only regulations apply. There is poor angler success and subsequent low fishing pressure. Fish grow to sizes approaching 17 inches in length. The lake has poor hiding cover, and the mergansers are thought to take substantial numbers of young fish. Some of the rearing habitat in the tributaries has been degraded from grazing activity.

Historically, beavers were more numerous and their dams maintained a higher water level in the upper portion of the lake, providing good rearing habitat for fish (Fies, personal communication 1995). The beavers disappeared in the late 1960's, possibly trapped out (Fies, 1995, personal communication). There have been reintroduction efforts since, but a community has yet to be established.

Other factors that have affected the fishery are the two floods in the 1960's that impacted fish rearing in Soda Creek and added tons of sediment to the lake. Drought conditions, the Crater Creek diversion, and the many leaks in the substrate have all contributed to a reduced water volume, and a probable increase in the temperature of the lake. Construction of a berm near the boat ramp over 50 years ago prevented water from reaching an area known to leak a large volume of water, which partially offset the drawdown effects of the previously mentioned factors. Additional plugging efforts included pouring concrete into known leaks. There is interest from the ODFW to plug additional leaks in the substrate to retard water loss. Habitat projects were undertaken in the early 1990's to introduce hiding cover to the lake. Several small tree bundles were sunk to the bottom, and whole trees were felled from the shoreline. Monitoring results are inconclusive on the benefit the habitat projects provided.

Todd Lake

Todd Lake, formerly known as Lost Lake, is a popular day use fishing destination. Fishing for eastern brook trout (the only fish species) is good in the 29 acre lake, which is stocked annually by the ODFW with 2,000 brook trout fingerling. There is natural reproduction in the small springs and streams that feed the lake (Fies, 1995, personal communication). The maximum depth of the lake is 60 feet. The lake is illegally commercially harvested for dragonfly nymphs, a popular fishing bait. The populations of dragonflies may be depressed, and some species may be eliminated as a result of this practice.

Green Lakes

North, Middle, and South Green lakes are 8, 8.5, and 6 acres, respectively. The stocking history includes introductions of both eastern brook trout and rainbow trout. The rainbow were apparently stocked as early as 1920. There is presently natural reproducing populations of both species in the tributaries of Middle and North Green Lakes, which are no longer stocked. South Green Lake is stocked biennially with 300 eastern brook trout. At times, there is surface water runoff from South lake down to Middle lake, so there is potential for fish to migrate between the lakes. Natural reproduction is also possible in the outlet.

Devils Lake

This small (19 acres) and shallow (8 feet) roadside lake is primarily a "put and take" fishery for rainbow trout. ODFW stocks the lake with 5,000 legal size trout annually, spread out over several stockings during the season. Eastern brook trout have been stocked in the past, and there is natural reproduction within the tributary streams, Tyee Creek and Hell Creek. Natural reproduction of rainbow trout is possible, but undocumented. Most of the rainbow trout are caught by anglers before the onset of

winter. Overwinter survival of stocked fish is rare, if existent at all (Marx, 1995, personal communication). The probable causes of winterkill are lack of oxygen and food supply.

Other Lakes

Bare, Corral, Moraine, Sisters Mirror, Camelot, and an unnamed lake on Broken Top are all small wilderness lakes that are presently fishless, but attempted stockings may have occurred in the past.

Junco Lake is a small, isolated wilderness lake that is stocked biennially with eastern brook trout fry. There are no inlet or outlet streams, so natural reproduction is unlikely. There is little recreational use of Junco Lake.

STREAMS

The channel morphology and riparian zone conditions of the streams are relatively undisturbed from historic conditions, except for road and trail crossings, and the Sparks Meadow. The streams are characterized by moderate to high gradients in the wilderness, and low gradient as they enter the valley bottom that Century Drive follows. Much of the streamflow is attributed to springs. Since there has been no large scale timber harvest in the Recreation/Alpine Tephra zone, the riparian zones have not been affected from timber harvest. Stream shade and instream large wood component are close to historic conditions for most stream reaches.

The best fish habitat, and the resulting highest fish populations, are found in the low gradient stream reaches in the valley bottom. As with the lakes, fishing pressure is light.

Fall Creek

Fall Creek plunges 1,000 feet in elevation over 4.5 miles as it leaves Middle Green Lake and flows toward Sparks Meadow. The stream has two distinct reaches, and is characterized by numerous falls that are migrational barriers to fish inhabiting Sparks Lake. Most of the stream habitat is dominated by riffle, with occasional plunge pools and pocket water. Some fish may reside in this reach year round, and others may migrate out of the lake. Rainbow and brook trout leaving Middle Green Lake could potentially end up in Sparks Lake. Recent gillnetting in Sparks Lake has not found any rainbow trout. There is little recreational fishing pressure in this reach.

The character of the stream changes as it leaves the mountains and meanders for nearly a mile through the meadow before emptying into the lake. The habitat is predominantly glide (66%) and lateral scour pool (27%). There are 7.4 pools/mile. There is no large woody material present. Fish hiding cover is provided by undercut banks, which are vegetated with sedges, grasses, and some willow. This portion contains some legal size

brook trout, but is primarily spawning and rearing habitat for fish of Sparks Lake. ODFW regulations restrict angling to flyfishing only on all Sparks Lake tributaries up to the Cascade Lakes Highway.

Soda Creek

Soda Creek is similar to Fall Creek in that there are two distinct reaches based on gradient and valley type. The origins of Soda Creek is near Broken Top, where snowmelt and springs unite. The upper reach is characterized by falls and predominant habitat type is riffle (67% of surface area). Pools make up only 18% of the habitat (14.6 pools/mile). Substrate types are cobble, gravel, and boulder. Some large wood is present, and pools have formed at some of the accumulations. There is a waterfall near Century Drive that is a migrational barrier. Eastern brook trout of various age classes are present above the falls, and their distribution is assumed to be up to near the headwaters.

The character of the stream changes as it enters the low gradient meadow section. Glides are the prevalent habitat (44%), followed by an even mix of pools (18%, and 27.5 pools/mile) and riffles (16%). Side channels are abundant (19%). The substrate type is cobble, gravel, and sand. Past livestock grazing, recent floods, and mechanical channelization have contributed to a decrease in the quality of fish habitat in this reach.

Undercut banks, which are the primary fish hiding cover element in this reach, are in a degraded condition. Eastern brook trout of various age classes inhabit this reach, and are especially numerous in side channels and backwater areas. As with Fall Creek, Soda Creek is primarily spawning and rearing habitat for fish of Sparks Lake.

The diversion of water into the Crater Creek ditch high in the basin diminishes the flow in Soda Creek during the summer months, resulting in less available aquatic habitat and increased water temperatures because of the reduced water volume. The water temperatures occasionally exceed 70° Fahrenheit, above the desired conditions for trout and some species of invertebrates.

Other small streams inhabited by eastern brook trout are Goose Creek, Satan Creek, Tyee Creek, Hell Creek, Todd Creek, Sink Creek, Crater Creek, and Crater Creek Ditch. Generally, these streams are used as rearing grounds for eastern brook trout, and do not experience much angling pressure.

The Recreation/Riparian Landscape Area

Most of the streams and water bodies in this area historically had all 3 species of fish native to the Cascade Lakes watershed (bull trout, redband trout, and mountain whitefish). Elk Lake, Hosmer Lake, Sink Creek, and Quinn Creek are the exception, as they were fishless prior to stocking efforts. Through various activities of human influence in the last

100 years, the fishery today is much different. As mentioned previously, bull trout are no longer present, the genetic status of the redband is unknown, and various exotic fish species have been introduced to water's that contained native fish, and to some that were previously fishless.

Exotic fish species that were either introduced by fisheries managers or by illegal means that are currently present in this landscape area are largemouth bass, tui chub, eastern brook trout, kokanee salmon, Atlantic salmon, three-spined stickleback, lake trout, cutthroat trout, and various stocks of rainbow trout.

LAKES

Most of the lakes and reservoirs in this area are productive fisheries and attract large numbers of anglers. Fishing is the main attraction to many of the visitors to this landscape area. They are all reached easily by road, and all have developed campgrounds except Deer Lake. The lakes vary widely in physical make-up, from shallow, eutrophic, macrophyte-laden Crane Prairie Reservoir, to deep, ultra-oligotrophic, transparent Cultus Lake. There are a variety of fish species sought after by anglers.

Elk Lake

Elk Lake is 405 acres and has a maximum depth of 62 feet, and is considered oligotrophic. The lake is popular for windsurfing, sailboating, swimming, fishing, and canoeing. Approximately 20,000 eastern brook trout fingerlings are stocked annually. Kokanee were introduced to the lake years ago and have established a self-sustaining population. Generally, they do not attain a large size and are not highly sought by anglers. There may be some natural reproduction of the eastern brook trout also. Many years ago, eastern brook trout eggs were collected at Elk Lake and delivered to the Bonneville Fish Hatchery on the Columbia River (Johnson, et al, 1985).

Hosmer Lake

The lake is mesotrophic, and is progressing toward becoming a meadow. Angling is restricted to flyfishing with barbless hooks. Fish species inhabiting the lake are Atlantic Salmon, which must be released unharmed, and eastern brook trout, for which there is a restricted catch limit. Annually, 2,000 Atlantic Salmon fingerlings are stocked. The brook trout are a self-sustaining population, utilizing the inlet Quinn Creek for spawning.

Prior to 1957, Hosmer Lake contained non-game fish including carp, and was known as Mud Lake, due to the constant stirring of lake bottom sediments. The lake was treated with rotenone in 1957 to eradicate the non-game fish, and was stocked with Atlantic Salmon for the first time in 1958. The lake was renamed to Hosmer Lake in 1962 in honor of naturalist Paul Hosmer.

Lava Lake

Lava Lake is a very popular fishery. The lake is stocked with 100,000 rainbow trout and 20,000 brook trout fingerling annually, which grow to 10 to 12 inches in length by fall (Marx, 1995 personal communication). Tui chub were illegally introduced several years ago, providing intense competition to the game fish species. The lake has been treated with rotenone 3 times (1949, 1963, 1980) to control the tui chub populations, which quickly rebound within a few years after treatment. There is currently an active program of net trapping and spot rotenone treatment to control the chub population.

Little Lava Lake

Little Lava Lake, considered the headwaters of the Deschutes River, is 138 acres with a maximum depth of 18 feet. This lake also has an elevated phosphorus content, again probably a result of springs on the lake bottom. Approximately 15,000 fingerling rainbow trout are stocked annually. There are also eastern brook trout and mountain whitefish that move into the lake from the river.

Cultus Lake

This ultra-oligotrophic, deep, cold lake has populations of lake trout, mountain whitefish, eastern brook trout, and rainbow trout. The rainbow trout in Winopee Creek, a tributary to the lake, are currently being analyzed as possible redband trout. The status is unknown at this time. The only stocking undertaken at this time is 6,000 legal-sized rainbow trout annually. The other species are self-sustaining. Spawning habitat for lake trout, a shoal spawner, is poor, probably resulting in low recruitment. The lake was originally stocked with lake trout in 1957, and successive stockings ceased in the 1960's.

The lake is very popular for water skiing, windsurfing, and jet skiing. The intense recreational activities do not appear to be adversely affecting water quality. The large volume, the short growing season, and the presence of inlets and an outlet that replace the water every 4 years are probable causes for maintenance of excellent water quality.

Little Cultus Lake

The lake has been stocked annually with 10,000 eastern brook trout fingerling in the recent past but this figure will be reduced in the future in an attempt to increase growth rates. The rainbow are self-sustaining and are being analyzed for redband status. The status is not known at this time. There is natural reproduction of the eastern brook trout as well.

Deer Lake

The only fish species inhabiting the lake is cutthroat trout, whose population is sustained with the stocking of 2,000 fingerling annually. Although the lake is road accessible, there is little development and fishing is one of the primary uses.

Crane Prairie Reservoir

Crane Prairie Reservoir was constructed for irrigation water storage but now is renowned for its fishing. The extensive littoral zone, nutrient input from the tributaries, and the abundant large woody material contribute to the biological richness. Much of the timber was left standing after inundation, providing habitat for aquatic invertebrates, fish, and wildlife. The trophic status is eutrophic. The fluctuating water levels, especially during recent drought years, is a limiting factor to the fishery. A history of rainbow trout redd counts in the tributary streams collected by ODFW suggest a positive correlation between the number of redds and the elevation of the reservoir the previous year. If the pool elevation is high in the spring, then the redd counts will be high the following spring (Marx, 1995, personal communication).

The reservoir fishery consists of rainbow trout, mountain whitefish, kokanee salmon, eastern brook trout, largemouth bass, tui chub, and three-spined stickleback. ODFW stocks 200,000 rainbow fingerling annually, and 20,000 kokanee fingerling on an intermittent basis. The other species are self-sustaining. The bass, chubs, and stickleback were all illegal introductions. There has been much concern about the effect on trout from the bass, which are thought to have been introduced in the early 1980's. A recently completed study by ODFW showed some predation on trout by bass, but they generally preferred other food items. There was minimal interspecific competition for food (Shrader et al, 1995).

The chubs, which were used as live bait, were introduced illegally by sport fishermen in 1950, at the resuming of the angling in the reservoir. Chubs were also introduced to Hosmer Lake, Lava Lake, and Little Lava Lake. The chubs have the ability to out compete other fish species, diminishing the angling opportunity for the more desirable species. For unknown reasons, the chub population has decreased tremendously over the last 5 years (Marx, 1995, personal communication).

Sprague Pond

Sprague Pond lies in an inactive gravel quarry near the Deschutes River, and is about 5 acres. ODFW stocks 1,000 catchable rainbow trout each spring. The fish are either caught or die of winter kill.

Century Pond

Century Pond, approximately 3 surface acres and located near Cultus Creek, is another gravel quarry pond that is stocked with 1,000 catchable rainbow trout annually. Again, the fish are either caught or die of winterkill.

STREAMS

Excluding the construction of Crane Prairie Reservoir, which inundated approximately 15 river miles, the streams have been spared major habitat modifications from other land uses, although there are some problem areas. Generally speaking, shade, instream LWM, channel morphology, and streambank stability have been protected. There has been some grazing, riparian vegetation trampling, LWM removal, and road crossings that have had negative effects to the stream and floodplain function. Timber harvest has been of minor disturbance.

Deschutes River

The Deschutes River above Crane Prairie Reservoir has natural flow and is a popular stream with anglers who seek rainbow and eastern brook trout and to a lesser degree, mountain whitefish. This is the largest stream in the Cascade Lakes Watershed, initiating at Little Lava Lake and flowing into Crane Prairie Reservoir, a distance of approximately 8.5 river miles. The river actually becomes a small lake at 3 locations in this reach.

The stream is currently managed as a wild fishery. The stocking of rainbow ceased in the late 1980's. The riparian zone conditions are in good shape overall, with a few problem areas. There is some trampling of riparian vegetation from the intensive recreational use.

Cattle grazing in the first 1.5 miles above the reservoir has resulted in some streambank damage, estimated at 30 to 50% in some areas (Berscheid, 1995). The allotment was abolished in July 1995. Activities in the past cleared some of the large woody material (LWM) from the stream near the mouth.

The stream is approximately 35% pool and glide, with the majority of these units occurring in the first 4 river miles. There are 16.7 pools/mile in this lower section, but only 1.6 pools/mile in the upper section, not including the 3 small lakes. Undercut streambanks and LWM are fairly abundant and provide good hiding cover for fish. The abundant gravels and cobbles provide good spawning areas and habitat for macroinvertebrates. The Deschutes River is the most important spawning and rearing tributary for the fishery of Crane Prairie Reservoir.

Snow Creek

Snow Creek is an important tributary to the Deschutes River. From its headwater springs, it flows through a lodgepole pine and engelmann spruce forest for over 5 miles before joining the Deschutes River near Cow Camp Campground. The habitat is primarily glide, dissected with extensive large woody material and concomitant vegetation that provides excellent hiding cover for fish. Resident fish are present but are generally of small size and are not highly sought after by fishermen. The very cool water temperatures and the sand dominated substrate are likely limiting factors to the fishery. Snow Creek is used by mountain whitefish, rainbow trout, eastern brook trout, and kokanee salmon for spawning and rearing.

Cultus River

Cultus River is a spring-fed system characterized by cool temperatures, wide, shallow glides, gravel/sand substrate, and abundant LWM along the perimeter, although most of the wood (81% from 1989 stream survey) is less than 12 inches in diameter. This size of wood can provide hiding cover for juvenile fish, but does not form pool habitat as sufficiently as larger diameter size classes. Pool habitat is limited to 6 pools constructed during a habitat enhancement project accomplished jointly between the Deschutes National Forest and ODFW in 1992. This tributary to Crane Prairie Reservoir is a very important spawning and rearing resource for kokanee salmon, mountain whitefish, eastern brook trout, and rainbow trout. Resident mature fish are nearly non-existent. The limiting factors to a resident fishery are the lack of pool habitat and the lack of quality substrate to support macroinvertebrates.

Cultus Creek

Cultus Creek originates at the outlet of Big Cultus Lake and drains into Crane Prairie Reservoir 2.6 miles downstream. The stream is characterized by very abundant LWM and shade, numerous side channels, and a fair amount of pool habitat (22% surface area and 25.4 pools/mile). The primary limiting factor is the natural diminished flow in late summer and fall. Some rainbow trout do spawn in the lower section in the spring. Rainbow trout, mountain whitefish, and eastern brook trout emigrate from Cultus Lake and reside in the stream during the summer months.

Deer Creek

Deer Creek is the outlet for Little Cultus Lake and enters Crane Prairie Reservoir 2.7 miles downstream. Deer Creek is very similar to Cultus Creek in habitat conditions, fisheries, and flow regime.

Quinn River

This small spring-fed system is nearly entirely inundated when Crane Prairie Reservoir is at full pool, only approximately 100 yards remains at natural flow. Past surveys indicate that there is very limited spawning by rainbow trout, eastern brook trout, and kokanee salmon. The substrate is dominated by sand, and there is very little pool habitat or hiding cover.

Quinn Creek

Quinn Creek is a small spring-driven system that is a tributary to Hosmer Lake, and is approximately 2 miles long. The first 0.5 mile is an important spawning and rearing area for eastern brook trout. A migrational barrier (falls) at river mile 0.5 prevents access to upstream reaches for Hosmer Lake fish. Although there is some fair habitat above the falls, the fish population appears to be sparse, based on a limited electrofishing survey.

Sink Creek

This small stream originates from several springs and enters Quinn Creek approximately 3 miles downstream. During late summer, surface flow may be limited to the upper reaches. A recent stream survey did not locate any fish, but there is potential for eastern brook trout to emigrate from Quinn Creek. There is a migrational barrier at river mile 0.7.

Rock Creek

Rock Creek is completely inundated by Crane Prairie Reservoir nearly at all times, and emits approximately 16 cfs.

The Outback Landscape Area

Most of the water bodies in the Outback Landscape Area did not contain historic native fish populations. Winopee Creek, Winopee Lake, and Muskrat Lake are the exceptions - redband trout and whitefish historically occupied these waters. Fish populations now exist in many of the lakes.

LAKES

Presently, many of these lakes are stocked by ODFW on a regular basis primarily with eastern brook trout. Most of the lakes do not have naturally reproducing fish populations (Fies, 1995, personal communication). Stocking or choosing not to stock these lakes can be used as a management tool which may influence the number of recreational visits to these lakes. Fishing is a popular activity for visitors to these lakes.

Charlton Lake

This road accessible lake is the largest and deepest lake in the Outback Landscape Area at 156 acres and 95 feet deep. The trophic status is ultraoligotrohic, with low concentrations of nutrients available. Approximately 3,000 eastern brook trout fingerling are stocked annually. The travel distance and the rough nature of the road probably limit the number of visitors from the east. A paved road accesses the lake from the west.

Irish Lake and Taylor Lakes

These lakes are 28 and 34 surface acres, with maximum depths of 16 and 11 feet. They have extensive shoal areas. Approximately 3,000 brook trout fingerling are stocked annually in each lake, but occassionally 1,000 cutthroat are substituted. The rough road limits the amount of visitors.

Other Lakes

Most of the other lakes in the Outback Landscape Area are small, wilderness lakes, that are stocked with brook trout fingerling biennially if they are capable of sustaining populations over the winter. This usually requires a maximum depth of 8 feet or greater. There are numerous small lakes that are not stocked, particularly in the Many Lakes Basin. These small lakes provide a refugia for amphibians and invertebrates from trout predation.

STREAMS

The stream channels are predominantly fishless except for some seasonal spawning or outmigrants from lakes when water levels allow discharge into outlets.

The Timber/Forest Products Landscape Area

There are few stream channels and only one lake (unnamed and fishless) within this landscape area. Past timber sale activity along and within Charlton Creek created disturbance to the stream over a 2 mile reach, affecting the large wood component and shade. The stream has an intermittent flow regime. Eastern brook trout may occasionally migrate out of Charlton Lake into Charlton Creek, or fish in Crane Prairie may occasionally migrate upstream during the spring snow melt.

TRENDS

Trends Common to Recreation/Alpine Tephra, Recreation/Riparian, and Outback Landscape Areas:

Although there is natural reproduction of fish in many lakes and streams, populations continue to be supplemented by stockings made by ODFW. Many lakes that lack natural reproduction continue to be maintained by stockings made by ODFW.

Trends Specific to the Recreation/Alpine Tephra Landscape Area:

There is a probable trend of declining abundance and diversity of aquatic invertebrates and amphibians in lakes and streams stocked with fish. The water bodies historically did not contain any fish. Fish prey upon invertebrates and amphibians.

Fish habitat continues to be decreased in Soda Creek due to reduced flow, channelization, and degraded streambanks. Streambank stability is improving within the meadow since cattle grazing was ceased in 1990. Within Sparks Lake, rearing habitat for juvenile fish in the upper lake continues to be diminished from conditions observed until the 1960's, at which time the beaver community was extirpated. The beaver dam maintained a greater volume of water in the upper lake than present conditions.

Trends Specific to the Recreation-Riparian Landscape Area:

The trend continues of loss of native fish species with the elimination of bull trout, and possibly of redband trout. If redband are still present, competition from non-native fish species continues.

There is a trend of increased large wood recruitment into the Deschutes River upstream of the Road 40 crossing as a result of the beetle epidemic. As the trees along the river fall, there will be a temporary (30 to 50 years) loss of shade until regrowth occurs.

Trends Specific to the Outback Landscape Area:

No other trends known.

Trends Specific to the Timber/Forest Products Landscape Area:

See Water Resources Trends Section.

SOCIAL DOMAIN

RECREATION AND SCENIC RESOURCES

OVERVIEW

Located in the center of the state at the crest of the Cascade Range, the Cascade Lakes Watershed is an area full of many features attractive to increasing numbers of recreation visitors throughout the Pacific Northwest and western region. Scenic alpine lakes, clearflowing streams, rivers surrounded by snow-capped volcanic peaks, forests, and meadows work well together to provide a dramatic and appealing setting to those seeking refreshment and peace of mind.

The summer and fall months are full of activities such as fishing, camping, boating, hiking, hunting and sightseeing along the Cascade Lakes Scenic Byway. The road is usually clear of snow by Memorial Day weekend and closed as early as mid-November. The winter and spring months are full of skiers and snowmobilers attracted to the Mt. Bachelor ski area as well as to many of the sno-parks and groomed trails for both cross-country skiing and snowmobiling activities.

With tourism ranking as the third largest industry in Oregon, Deschutes County has experienced a dramatic increase over the past 5 years in its population and travel and tourism activities. This area is one of Oregon's most important recreation centers for both winter and summer seasons. The 1995 population for Deschutes County is 92,245 with projected growth at 106,671 in the year 2000 and 117,887 in the year 2005. The 1995 population for the City of Bend is 40,000 with increases at 44,000 in the year 2000 and 49,500 in the year 2005.

Deschutes County:	**Bend:**
1995.....92,245	1995.....40,000
2000....106,671	2000.....44,000
2005....117,887	2005.....49,500

In central Oregon for the year 2000, demand for recreational activities is projected to grow 145% for nature and wildlife observation, 114% for on-road bicycle riding, 94% for hiking trails, 86% for non-motorized boating on lakes, and 85% for sailing. Other increases are sailing, non-motorized boating, off-road motorcycle use, and on-road bicycle riding. Other less significant increases worth noting are more camping with recreation vehicles, horseback camping without packstock, freshwater fishing from boats, and overnight hiking on trails. Throughout the state, demand for recreational activities is projected to grow the most for sightseeing and picnicking, hiking, camping, fishing, hunting, nature study/food gathering, on-road bicycle riding, water activities, off-road motorized activities, and snow activities. (Source: 1991 Oregon State Comprehensive Outdoor Recreation Plan, Oregon State Parks and Recreation Department).

A large portion of outdoor recreation in the U.S. occurs on public lands. Recreation use on public lands has seen an increase of approximately 125% from 1984 to 1991. A larger percentage of the activities occurring are people taking walks, the study of nature, camping in developed sites, and day hiking on trails. There are also many people attracted to camping in primitive sites. Nationally, the projected trends for the years 2000 to 2040 are for increases of 193% for day hiking, 155% for backpacking, 155% for rafting/tubing, and 122% for bicycling.

The most noticeable trend with lasting impacts on the recreation experience and sustainability of the ecosystems within the watershed is the increased demand for recreation in developed, undeveloped, and wilderness settings within and adjacent to riparian zones. The quality of the recreation experience can be affected by the appearance and condition of the natural resources, the appearance and condition of the developed facilities and access for convenience, personal safety, and sanitation, the occurrence of human encounters, the knowledge of what is special about a place, and an attitude of stewardship through outdoor education and interpretive programs.

The increased demand for recreation in this area has also been a result of the trend of marketing the wildness of the outoors as a commodity to be bought and sold rather than as a personal interaction or challenge. The impacts on the natural resources and recreation sites seem to escalate as the technology of recreation equipment, vehicles, and the desires to go higher, faster, and farther also escalate. The quests for solitude are more difficult to achieve with the increasing numbers of visitors lured to the area due to fishing expectations through fish stocking, the promises of discovery and freedom by being able to drive anywhere as promoted by automobile advertisements world-wide, and the idea of having access to a "wilderness" experience by merely pulling into a parking space or on to a riparian area next to the water.

There are increasing conflicts between the diverse types of recreation visitors who want to come to this area to use the trails and bodies of water. There is also a growing desire to camp in undeveloped areas in a location chosen individually because it is close to water and wildlife instead of being confined to crowded developed campgrounds. The lack of controls, direction, and regulation allows existing damage to continue to occur and to spread to larger areas. The vegetation has less of a chance to recover with the increasing impacts due to the short growing season found at the higher elevations.

HISTORIC CONDITION

Recreation and Scenic Resources

In the past, there were fewer developed recreation sites and access to the Cascade Lakes was by either horseback or hiking prior to construction of the the main road in the 1920's. Primitive camping with limited facilities (also know as "dispersed recreation") dominated the landscape. Although fishing was good along the Deschutes River, the lakes were devoid of populations until stocking began in 1912 with heavier stocking occurring between the 1920's and 1960's.

Summer homes were established in the 1920's and the ski area at Mt. Bachelor was developed in 1958. Since World War II, Century Drive (including Road 42) now known as the Cascade Lakes Scenic Byway was the main access. Road 40 was partially constructed in the 1950's and then completed in the 1960's. There was also a road to Broken Top as well as other existing historic trails.

Some of the more popular activities during the historic era were trapping, fishing (in the Deschutes River up to Lava Lakes), hunting (for food and outdoor experience), mountain climbing (a much more intense experience with longer trips), and horseback riding (as the main means of transportation). There was opportunity for solitude, less structured and more individualized activities, and the availability of a true wilderness experience in more isolated and primitive settings. Recreation sites that did exist were used for camping or picnicking where families or large groups had traditionally gathered for many years or generations. The summer homes are also a traditional use over a long period of time through a special use permit.

The special places in the watershed are those which allow physical or visual access to water. Some of these places have immense natural scenic beauty and if found in areas which are unroaded, wilderness, or at higher elevations, it is possible to seek and find isolation from crowded areas and other people. These are the places that have always given us opportunities for solitude, reflection, challenge, and wonder. Preserving, restoring, and protecting the elements which combine to create these unique gems in the landscape has been long recognized as our most critical and top priority. The integrity of these landscapes must be maintained at the highest levels in order to continue to provide the quality experience people have traditionally found and come to expect when visiting here.

Prehistory and History

In general, the prehistoric occupation of the area appears to have post-dated the eruption of Mt. Mazama to the south approximately 7000 years before present (and creating Crater Lake). All known archaeological sites to date do not contain pre-Mazama components. Most sites occur near permanent water (lakes, streams and springs) and indicate seasonal occupation for the purpose of harvesting floral and faunal resources. Access to the area may have either followed up the Deschutes River from the south or up the Tumalo drainage from the east and into the watershed. There are sites of rock art indicating a potential spiritual significance to portions of the watershed in prehistory, as mentioned above. It is likely the peaks, lakes, rivers and other "special areas" held spiritual meaning for different cultural groups at different times in prehistory.

While it is likely that bands of Columbia Plateau, Klamath and Northern Paiute utilized the resources of this watershed at both different times in prehistory and in some cases concurrently, it is not fully understood which cultural groups actually occupied this area. This watershed was not any group's territory exclusively, nor was it occupied year round. There is unrealized

research potential in many of the sites in the area. A few of the sites around lakes in the watershed have the potential for underwater archaeology studies as well.

Access to the area prehistorically followed watercourses and game trails. Once use became more or less established over time, the trails developed into well established and shared routes. These trails provided the first hunters, trappers and stockmen of Euro-american extraction access to the watershed, and in no small way established the pattern for future access in historic and modern times.

Much of the watershed, including the high Cascades, had been subjected to grazing of both cattle and sheep prior to the creation of the Cascade Forest Reserve in 1893. Some limited recreation use also occured predominantly from upper class citizens of the Willamette Valley, such as Judge J.B. Waldo. In fact, it was through his and lobbying efforts by others that set the stage for the creation of the Cascade Forest Reserve by presidential proclamation. Pioneer settlers, stockmen and trappers were present in the earlier part of the century and loggers began to appear as early as 1915. The area became more attractive to fishermen after Crane Prairie Reservoir was built in 1922 and then enlarged in 1940. Tourists began to visit the area more frequently through the construction of the road in the 1920's and also when the ski area was developed in 1958. High elevation places may have had spiritual importance or of special significance, mountain climbing groups such as the Mazamas were already "bagging" peaks, early in the 20th Century. Trapping for subsistence, traveling from hunting area to hunting area, and grazing were activities that happened more in the past than today.

These past activities left their marks on the landscape. The following discussion presents the types of evidence reflected on the landscape today offered in the form of historic and archaeological sites. Early Native Americans may have left evidence of "teepee (wickiup) rings" at their seasonal and temporary campsites, but these require studies for verification and this has not been possible to date. Caves and lava tubes were also sites of acitivity, but these are in need of cave inventories for proper protection and management. By far, the most premdominate site type, lithic scatters, are found throughout the watershed area. The Devils Flow has been a source for the cultural uses of obsidian. Finally, rock art is found in the area, though is not numerous, with only one site recorded within the watershed boundary. Several similar sites are present in adjacent areas such as the Tumalo drainage.

Both current trails and campsites reflect the historic pattern of use in the area, stockmen and trappers have left old blaze markings on trees as trail markers in and around the wilderness areas as well. The remains of old cabins, lean-to's, fencelines, corrals and roads are reminders of those historic activities. The advent of Forest Service custodial stewardship in the early 1900's on through the pre-World War II period left many a mark on the landscape including improved trails and roads, Forest Guard Stations, campsites, picnic areas and designated "Primitive Areas". In addition, the resorts and summer homes on area lakes, such as Elk Lake, reflect a pattern of recreation use that became popular during the 1920's and remains so today for certain segments of the recreating public.

Land Ownership and Administration

The Deschutes National Forest was originally established in 1893 as the Cascade Forest Reserves. Upon presidential proclamation as public domain, Sections 16 and 36 were reserved as state lands for the purpose of funding county schools. All such sections have acquired by the Forest Service, in some cases, the state retains water and subsurface mineral rights on those parcels. Some lands around Crane Prairie Reservoir are administered by the USDI Bureau of Reclamation, but these parcels only amount to a few acres in size. By far permits for grazing, summer homes and resorts were an early way of providing facilities for people to use the area.

Commodities and Utilities

Past commercial uses within the watershed include timber harvest, mining, grazing, trapping, fishing (with licenses), water skiing at Cultus Lake, boating, geothermal applications (non-active leases), recreation, resorts (1920's), and horse pack trips. Crane Prairie Reservoir has been a source for irrigation water and its fluctuating water levels has resulted in significant changes throughout the Deschutes River corridor. Drinking water has been available at the resorts.

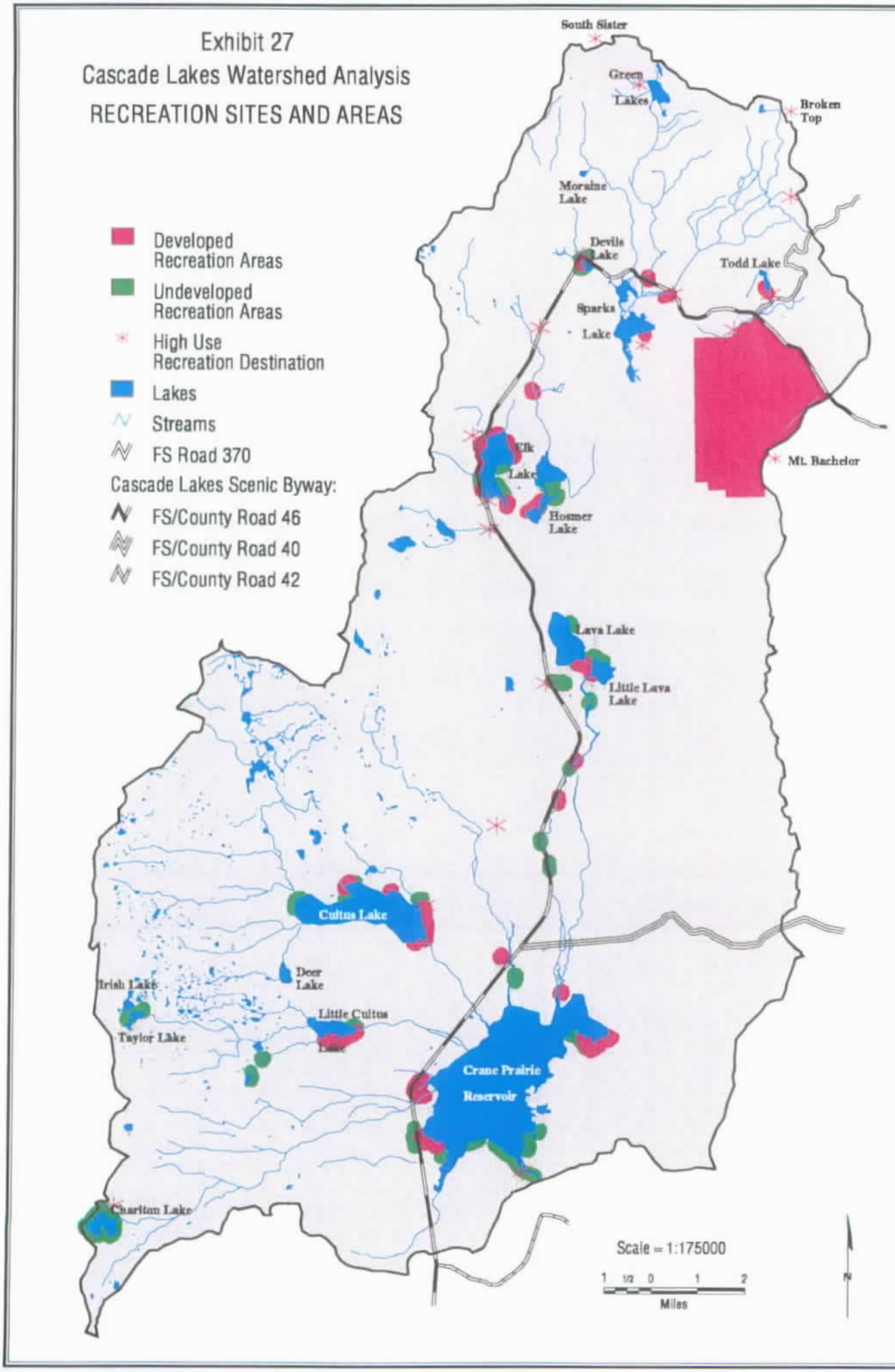
CURRENT CONDITION

Important places today that have a strong attraction for people from places outside of the state or within the state are the Mt. Bachelor Ski and Summer Resort, the wilderness areas, and the Cascade Lakes. Besides the winter skiing activities offered in the area, the summer activities are supported by many picnic sites, developed campgounds, horse camps, trails for hiking, mountain biking, and horseback riding, and viewpoints with interpretive features. The campgrounds also feature campfire programs, knowledgeable campground hosts, and interpretive programs. Special use recreation activities include outfitter guides, windsurfing lessons on Elk Lake, as well as fishing and boating supplies and rentals and restaurants at several of the lakeside resorts (See Exhibit 27, Recreation Sites and Areas).

In addition to the more developed recreation sites, people are also very attracted to the undeveloped sites in more primitive settings where fees are not required, camping sites are not designated, vegetation and wildlife are present, access to water is easy, and there are fewer encounters with other people. These are the places raising the highest concerns for sustaining healthy ecosystems and continuing to provide quality recreation experiences in the watershed. (See Appendix A-6, Current Conditions for Developed Recreation Sites by Landscape Area).

Existing access for most of the visitors is from the Cascade Lakes Scenic Byway with additional traffic coming in from Roads 40 and 42 from Highway 97, Sunriver, and LaPine. These roads seem to adequately meet the demands of the recreation users. Road 46 is also the primary access from the west and from Oakridge. Road 4290 is the secondary access from Waldo Lake.

Exhibit 27
Cascade Lakes Watershed Analysis
RECREATION SITES AND AREAS



Currently, prehistoric and historic sites are not being actively managed due to a lack of funding. They are subjected to preservation treatment on a project-by-project basis. Of historic value to the public in this area are Devil's Lake Pictographs, general prehistoric chronology and Native American culture history, Muskrat Cabin (vintage 1934), Crane Prairie Reservoir and its construction chronology, and the histories of the settlers, trappers, and livestock grazers.

The Forest is in the process of developing a Heritage Preservation Plan that will prioritize preservation treatment and management of classes and specific types of archaeological sites. Data from all sites that have been recorded are stored in computer databases and locations stored in the Forest G.I.S. There will likely be future inventory, monitoring, archaeological testing and data analysis on sites within this watershed. Sensitive sites, such as Devil's Lake Pictographs, will reguire the establishment of protection measures to prevent vandalism and to interpret the feature to the public. There is also an interest in the restoration and interpretation of the Elk Lake and Deschutes guard stations.

The Recreation/Alpine Tephra Landscape Area

Winter recreation activities are alpine and nordic skiing, snowshoeing, snowmobiling, and dog sledding. Summer recreation activities are hiking, camping, biking, boating, fishing, horseback riding, hunting, ATV use, wildlife viewing, sailing, canoeing, photography, sailboarding, and kayaking. There are outfitter guides and special athletic events such as the Pole Pedal Paddle competition. The media constantly promotes the recreation opportunities available at Mt. Bachelor and the Cascade Lakes area.

The unique features attract many people to the riparian and fragile soils areas. Many of the trails to the wilderness have crowded and eroded conditions. Use is often concentrated along any sources of water such as creeks, springs, and lakes. Heavy use also affects the developed facilities to the wilderness areas (parking, trailheads, toilets, roads, trails, day use sites).

The Three Sisters Wilderness is where people anticipate non-motorized activities and the opportunity for solitude in more primitive and isolated settings. Recent changes have been made to deal with heavy use and site damage to riparian areas by limiting use and restricting camping to designated sites only. Within the main travel corridor of the Cascade Lakes Scenic Byway, there is access to Todd Lake for day use and camping, Broken Top via Road 370, Sparks Lake, Devils Lake, and to the Green Lakes and Wickiup Plain trailheads which access the Three Sisters Wilderness.

The grander scale of the entire watershed is realized when viewed from the main mountain peaks and from certain viewpoints along the Cascade Lakes Scenic Byway. On a more intimate scale, there are detailed views of nature at work along creeks, streams, or enclosed meadows. People visiting here often express a strong desire to be close to water and to see the surrounding area from the highest point possible. There are many signs of human use and development. The Crater Creek Ditch to the west of Todd Lake is used by the Tumalo

Irrigation District. Mt. Bachelor Ski & Summer Resort operates under a special use permit with the Forest Service and its runs are enjoyed by thousands of visitors each winter. Its development is visible from different locations throughout the watershed area. The Sparks Lake Meadow area has a grazing allotment which may be terminated in the near future. The Three Sisters Wilderness area is managed jointly between the Deschutes and the Willamette National Forests. The Cascade Lakes Scenic Byway is under county administration and is designated as a national scenic byway and a state scenic tour route. Barrier-free access, outdoor education, and interpretive programs are beginning to occur in this landscape area. Mt. Bachelor provides barrier-free access to its facilities and provides both summer and winter interpretive programs. The Ray Atkeson Memorial at Sparks Lake has a barrier-free viewpoint and interpretive trail.

The Recreation/Riparian Landscape Area

Most of the recreation use occurs at the lakes. Elk Lake is very popular for sailing, windsurfing, camping, and boating. The resort has plans to upgrade. There are several day use sites, developed campgrounds, and summer homes located here. Hosmer Lake is more low key with fishing and boating activities. It has a couple of developed campgrounds. Lava Lake and Little Lava Lake have campgrounds and a resort for fishing and boating activities.

The Deschutes River is where many people fish, hike, wander, explore, photograph and view wildlife and wildflowers, and seek the "pristine" experience. Cultus Lake has a resort with cabins, developed campgrounds and facilities for boating, sailing, and fishing, and access to many of the wilderness trails. Little Cultus Lake has a campground and is more low key for canoeing activities.

Crane Prairie Reservoir is where most of the fishing in the watershed area occurs as well as boating and camping. Crane Prairie is a fairly new campground designed to accommodate large numbers of people. The recent fire to the area opens once protected meadows to the threat of vehicular damage. The construction of the Crane Prairie Reservoir has submerged creeks and portions of the Deschutes River and it has also provided opportunities for fishing and boating that did not occur in the past. There are more motorized recreation activities occurring on both land and water.

Horseback riding activities and access to trails are accommodated by the Quinn Meadow and the Cultus Corral Horse Camps. Mountain biking and hiking are accessed from several trailheads scattered throughout this watershed area. Winter activities include snowmobile activities accessed by the Cascade Lakes Scenic Byway to some of the resorts open year-round.

Facilities with barrier-free access are beginning to be developed. There is a new canoe launch at Hosmer Lake built by volunteers. The campground at Crane Prairie has barrier-free camping sites and toilets. Cultus Lake has a new bridge and toilet and long-range plans for

barrier-free camping sites and a trail. Barrier-free toilets have also been installed at Quinn River Campground, Quinn Meadow Horse Camp, Cultus Corral Horse Camp, and Little Fawn Group Camp.

There are very few interpretive viewpoints or trails along the Cascade Lakes Scenic Byway through here. The only views to water are along a portion of Elk Lake which is partially screened by trees, the Upper Deschutes River as it runs parallel to the road, several rivers or creeks crossed by the road, and a glimpse of a finger of Crane Prairie during a high water year.

Due to an outbreak of mountain pine beetle in the southern postions particularly around Cultus Lake and towards the Lava Lakes area, potentially hazardous conditions exist for fire. Scenic quality has been greatly diminished. Developed recreation sites also are affected by this condition due to the potential hazard of falling trees.

The Outback Landscape Area

Traffic flows into mostly from the west side of the Cascades in both winter and summer from the Waldo Lake area on the Willamette National Forest to the Charlton Lake area. There are joint marketing and advertising for the Cascade Lakes and Three Sisters Wilderness. The area to the west of Mt. Bachelor is unroaded. There are mountain bike and horseback riding trails going through this area to other locations. There are very few interpretive features or programs provided.

The wilderness areas seem to receive less heavy use than the Recreation/Alpine Tephra Landscape Area although the kinds of damage are erosion of trails, lack of vegetation along water, and sanitation problems. There are fewer regulations or enforcement of controls occurring. There are several areas outside the wilderness boundary between the Many Lakes area and Charlton Lake that are largely unroaded with more dispersed use and a quasi-wilderness feel.

The Timber/Forest Products Landscape Area

Timber harvest activites have resulted in the heavily roaded character. Many of these roads provide recreation opportunities for access to views from the buttes to the surrounding areas. Sheridan Mountain, Lookout Mountain, Round Mountain, Browns Mountain, Benchmark Butte, Ketchketch Butte, and Wuksi Butte are landmarks which add interest to the area's topography because they are highly visible from the Cascade Lakes Scenic Byway as well as from several of the surrounding water bodies. There are also views to the lakes from the buttes. Caves located in this area are a protected resource with most of the protection and inventory provided by the caving community and monitoring of bat habitats provided by the wildlife biologists.

SOCIAL TRENDS

The social trends continuing to occur are primarily an increased demand for recreation in developed, undeveloped, and wilderness settings and a growing number of visitors seeking high quality recreation experiences in the form of diverse activities ranging from large groups and motorized vehicles to more isolated situations away from noise, development, and other people. There is a high demand to enhance and maintain the scenic resources which provide a dramatic setting for the recreation activities associated with water and a volcanic landscape. The Cascade Lakes Scenic Byway will continue to attract people who will travel through the watershed and have the desire to stop at points of interest along the route in order to learn and discover more about the area's natural and cultural history.

The Recreation/Alpine Tephra Landscape Area

The Recreation/Alpine Tephra Landscape Area has a continuing trend of increasing numbers of recreation users attracted to the wilderness setting. There is also a strong attraction to the water features and high volcanic peaks. The Cascade Lakes Scenic Byway provides the opportunity for tremendous views to the Sisters, Broken Top, and Mt. Bachelor as well as outstanding views of Devils Lake and across Sparks Meadow to Sparks Lake. Many creeks visibly flow throughout the area. Access to Green Lakes and Moraine Lake is along drainages with clear fast flowing creeks. The riparian vegetation and peaceful setting of the basin surrounding Todd Lake continues to attract many people.

Many of the shoreline areas of riparian vegetation along the lakes and creeks have been trampled and destroyed by visitors seeking access to the water and to the outstanding views. The damage continues to spread out and affect more and more of the riparian vegetation. There is a trend for the damage to be irreversible due to the short growing season, soil compaction from vehicles and foot traffic, the sensitive nature of the native riparian vegetation, and continuing heavy use. Promoting day use activities while limiting and designating overnight camping sites will continue to be a way to preserve opportunities for solitude, to protect wildlife refugia, and to rehabilitate riparian vegetation areas.

Winter recreation activities occuring in the areas of Mt. Bachelor, Dutchman Flat, Todd Lake, and Tumalo Mountain are experiencing heavy and increasing use. With the growing numbers of users, there is a trend of increasing conflicts occurring between motorized and non-motorized uses. The winter recreation experience changes according to numbers of people, noise, visible signs of activities, and feelings of comfort and safety. Access to the winter recreation areas is dependent on availability of parking and cleared roads. There are opportunities to control the level of impact to the area by limiting access, scheduling uses, or improving the layout of existing facilities.

The scenic quality is known throughout the region and is the major attraction for visitors coming to central Oregon. The views along the Cascade Lakes Scenic Byway are inviting and

present many opportunities for outdoor education and information interpreting the natural and cultural history of the area. The restoration and protection of sites damaged by heavy recreation use will be highly successful through the use of Human Resource programs which depend upon volunteers and youth work crews, a greater Forest Service presence, and accompanying programs educating users on how to lessen impacts to sensitive and fragile areas. The promotion of environmental education and interpretive programs will be a way to teach land ethics to the public and to convey the geologic, hydrologic, scenic, riparian, and wildlife values, the essence of the watershed.

The Recreation/Riparian Landscape Area

The Recreation/Riparian Landscape Area has a continuing trend of increasing numbers of recreation users attracted by the easy access of the Cascade Lakes Scenic Byway and the many recreation activities associated with water. Conflicting uses will continue to occur due to the demand for a diverse range of recreational activities. There is also a continuing trend of deteriorating recreation facilities and natural resource amenities. More crime and vandalism are occurring, especially because of overcrowded conditions in developed campgrounds and the desire to camp in non-fee undeveloped sites close to water and wildlife areas.

The recreation sites associated with water include Quinn Meadow Horse Camp, Elk Lake, Hosmer Lake, Little Lava and Lava Lake, Blue Lagoon, Crane Prairie, Cultus Lake, Little Cultus Lake, Deer Lake, the Upper Deschutes River, Snow Creek, and numerous other creeks and springs. Along with 4 lakeside resorts, summer homes, and the Cascade Lakes Scenic Byway, there is a major economic draw to the area for tourism. The large numbers of users for the major activities of boating, camping, fishing, hunting, sightseeing, biking, and hiking continue to visit this area filling the facilities to overflowing during peak holiday weekends.

Increased crime in the recreation sites appears to be due to population growth and an increasing diversity of user groups. Increasing conflicts, more use, and the lack of agency presence make it dificult to enforce regulations and as a result, the quality levels of the resource and of the experience traditionally expected are not realized. The public continues to express anger over additional fee campgrounds, overcrowded conditions, and deteriorating facilities.

Scenic views have an opportunity to be improved along the Cascade Lakes Scenic Byway with additional viewpoints and interpretive sites. There are also opportunities to use silvicultural treatments to protect or improve scenic views affected by insect and disease attack. The most highly regarded views are the ones looking out over the water to a background of volcanic peaks and forested slopes. This setting continues to be a source of enjoyment for both those new to the area and to those who traditionally vacation in their favorite sites in the watershed.

The Outback Landscape Area

In the Outback Landscape Area, there has been a trend of increasing numbers of recreation users attracted to the wilderness setting of the area. The features have an appeal to those seeking to be away from crowded areas or away from trails which have several types of user groups. The wilderness lakes are receiving more and more use. Due to the lack of regulations and controls, there have been sanitation problems and increasing impacts to the riparian vegetation by trampling from camping, foot traffic, and vehicular traffic.

The Many Lakes area, Irish and Taylor Lakes, Charlton Lake, and several of the other lakes scattered throughout the area are easily accessed by road or relatively short trails. These areas are becoming more and more impacted by increased uses such as camping, hiking, biking, and off-highway motorized vehicles. The areas receiving damage have difficulty recovering on their own and damage continues to spread as use increases.

The scenic quality is especially important on the west slopes of Mt. Bachelor. There is high visibility from several important recreation sites such as Hosmer Lake, Sparks Lake, Little Lava Lake, Lava Lake, and viewpoints along the Cascade Lakes Scenic Byway.

The Timber/Forest Products Landscape Area

There will continue to be an increasing demand for undeveloped camping sites with no fees. The diversification of high-tech recreation equipment such as off-highway vehicles and mountain bikes is resulting in an increasing need to regulated trail use to avoid conflicts and to prevent resource damage. There are also opportunities to enhance the scenic quality through the perpetuation of large ponderosa pine and douglas fir forests.

The Cascade Lakes Scenic Byway

The Cascade Lakes Scenic Byway is the primary access through the watershed. An interpretive plan for the byway was recently completed by the Bend/Ft. Rock District which outlines its management goals and objectives, identifies themes and sub-themes for possible interpretive sites and opportunities, prioritizes key interpretive opportunities, and describes potential partnerships which would allow some of these projects to happen. The scenic resources of the watershed are enjoyed via the byway. Since many of the other resources are impacted, the byway presents many opportunities such as outdoor education for lighter impacts to the heavily used and damaged areas. The Scenic Byway is to be managed through the Cascade Lakes Watershed Analysis. It is an integral part of the watershed with the potential of attracting even higher use to the area. To qualify as a scenic byway, a route must posess at least one of six "intrinsic qualities". In addition to scenic qualities, the byway must also have historic, natural, cultural, recreational, and archaeological qualities. The Cascade Lakes Scenic Byway was recently selected by Scenic America as one of the top ten scenic byways in the United States.

Chapter III
Synthesis of Trends

CHAPTER III
SYNTHESIS OF TRENDS

This phase of the Cascade Lakes Watershed Analysis takes the trends identified by primary resource affected and presents a synthesis of their physical, biological, and social components, associated causes, and assessment of the relative ecosystem risk. These trends are examined by geographic locations in terms of the four landscape areas identified within the watershed. The trends are then rated ecologically and prioritized based upon relative risk and whether or not an urgency for restoration exists. The resulting management goals and opportunities for future watershed restoration are presented in Chapter IV.

Trends → Causes/Resource Effects → Ecological Risk → Goals & Opportunities

CURRENT WATERSHED TRENDS

A trend is a result of factors which over time influence change on a given element of the ecosystem. In this section, the discussion of trends examines current patterns of change that are seen consistently over broad areas of the watershed that may or may not depart from past patterns. In most cases, the trends are expected to continue into the future unless significant changes occur in social uses, management, or physical and biological processes. The team's analysis includes the discussion and display of future trend development as a method to assess ecosystem risk.

The team identified eighteen landscape level trends in the Cascade Lakes Watershed. The trends are closely allied with the key issues and questions described in Chapter I. The highest geographic correlation of trends was found within the Recreation/Riparian Landscape Area. All trends are highly or moderately correlated to this landscape. The high recreational demand, current forest health deterioration, fire hazard, Northwest Forest Plan land allocations, riparian health, and wildlife habitat needs in this landscape will require challenging management changes in order to implement the recommended goals and opportunities for restoration.

Listed below are the watershed trends identified by the team and described in terms of the causes and effects upon ecological processes and related resources. These are also shown in Appendix A-7 and are located by landscape area.

Physical Domain Trends

P1. Trend: Throughout the watershed, soil quality is decreasing in riparian areas and adjacent upland areas through loss of surface organics and increase in soil compaction. **Location:** Recreation/Alpine Tephra and Recreation/Riparian Landscape Areas

P2. Trend: Decline in soil productivity in timber harvest areas. **Location:** Timber/Forest Products and Recreation/Riparian Landscape Areas

P3. Trend: Decline in water quantity and quality in select water bodies (particularly Soda Creek, Sparks Lake, Green Lakes, Todd Lake, Elk Lake, Cultus Lake, Crane Prairie and outflow to the Deschutes River, and high use Outback Lakes). Water quality changes are primarily increase in water temperature and accelerated euthrophication. **Location:** Recreation/Riparian, Recreation/Alpine Tephra, and Outback Landscape Areas

P4. Trend: Soil quality increasing in areas of organic matter build-up (fine litter, duff, and coarse wood). **Location:** Outback, Recreation/Alpine Tephra, and portions of the Recreation/Riparian and Timber/Forest Products Landscape Areas

Biological Domain Trends

B1. Trend: Increase in insect activity and insect induced mortality in lodgepole pine of the lodgepole pine and portions of the dry mixed conifer plant association groups. **Location:** Recreation/Riparian and Timber/Forest Products Landscape Areas

B2. Trend: The dry mixed conifer plant association group is outside the historic range of variability for large diameter, ponderosa pine and douglas fir structure, increasing densities of white fir, canopy cover for white fir, and patch size and patch area (fragmentation). **Location:** Timber/Forest Products and Recreation/Riparian Landscape Areas

B3. Trend: Mountain hemlock plant association group is moving towards late-successional seral stage which provides unfragmented forest matrix, dense canopy cover, unroaded refugia for wildlife. **Location:** Recreation/Alpine Tephra and Outback Landscape Areas

B4. Trend: Meadows and riparian streamsides are moving towards late seral stage with associated reduction in grass/forbs/shrubs and increase in conifer species. **Location:** Recreation/Riparian, Recreation/Alpine Tephra and Outback Landscape Areas

B5. Trend: Decline in amphibians (spotted frog, cascade frog) and native fish (red band, bull trout) populations. **Location:** Recreation/Riparian, Recreation/Alpine Tephra and Outback Landscape Areas

B6. Trend: Decline in available habitat for Jepson's Monkeyflower in lodgepole pine and wet mixed conifer plant association groups. **Location:** Recreation/Riparian and Timber/Forest Products Landscape Areas

B7. Trend: Increasing weed populations within the road prisms of major road corridors of the watershed. **Location:** Recreation/Riparian, Recreation/Alpine Tephra, and Timber/Forest Products Landscape Areas

B8. Trend: Loss of habitat connectivity between Late-Successional Reserves and associated available late-successional habitat in Adminstratively Withdrawn and Matrix areas. **Location:** Recreation/Riparian, Timber/Forest Products Landscape Areas

Social Domain Trends

S1. Trend: Increased demands for diversified recreation experiences in developed, undeveloped, and wilderness settings within and adjacent to riparian zones and increasing conflicts between recreation wildlife, fisheries, and irrigation needs. **Location:** Recreation/Riparian and Recreation/Alpine Tephra Landscape Areas

S2. Trend: Deterioration of recreation facilities and natural resource amenities. **Location:** Recreation/Riparian and Recreation/Alpine Tephra Landscape Areas

S3. Trend: Increased fire hazard along with increased demand for protection and immediate suppression. **Location:** Recreation/Riparian Landscape Area.

S4. Trend: Trend towards more crime including violent, city-type crime moving from urban to rural forest settings (use of weapons and domestic conflicts). **Location:** Recreation/Riparian Landscape Area

S5. Trend: User maintenance of existing high road densities. **Location:** Recreation/Riparian and Timber/Forest Products Landscape Areas

S6. Trend: Decrease in size class and amount of forest products extracted from the General Forest Management Area. **Location:** Timber/Forest Product and Recreation/Riparian Landscape Areas

Ecological Risk and Trend Rating

The relative importance of watershed trends is rated using three ecological concepts together. These are **susceptibility** (ability to resist change), **resiliency** (ability to return to current, historic or desired state) and **risk** (degree of probability of irreversible loss of an

element or species, and/or large geographic extent) to an ecosystem. Human or social elements are assumed to be part of the ecosystem. Recreation experience or mill closures are considered elements along with soil quality or rare plant species.

Table III-1 displays the ecological risk and resultant trend rating for all trends in the Cascade Lakes Watershed. Each trend receives a color rating; **Red Flag** (few to several ecosystem elements at high risk for catastrophic loss over large geographic areas), **Orange Flag** (one to two ecosystem elements at high risk for loss), **Yellow Flag** (moderate risk of loss of ecosystem element), and **Green Flag** (low to moderate risk of loss of an ecosystem element).

At highest risk within the watershed are riparian soil quality and associated elements (plant and animal diversity, recreation experience, hydrologic function), the current structure and closed canopy cover matrix of the lodgepole pine and dry mixed conifer plant association groups and associated connective habitat between Late-Successional Reserves, the integrated social, physical, and biological quality of the water bodies of Green and Moraine Lakes, Hosmer Lake, Irish and Taylor Lakes, and Charlton Lake, and the safety of recreation visitors in regards to fire hazard.

Detailed rationale for ecological risk and trend ratings are found in Appendix A-8.

Table III-1 - Cascade Lakes Watershed - Ecological Risk and Trend Rating

Trends	Landscape Areas	Susceptibility	Resiliency	Risk to Ecosystem	Trend Rating
P1 - Decreasing soil quality in riparian and adjacent upland areas.	Common to All	High/Moderate	Low/Moderate	High	Red Flag
P2 - Decline in soil quality in timber harvest areas.	Timber/Forest Rec/Riparian	Moderate	Low/Moderate	Moderate/High	Orange Flag
P3 - Decline in water quality and quantity.	Alpine Tephra Rec/Riparian Outback	See **Social Trend S1** Water bodies are rated separately.			
P4 - Increase in soil quality in areas of high organic litter.	Common to All, Primarily Outback	Moderate	High	Moderate	Green Flag
B1 - Insect/disease induced mortality in LP PAG and Dry MC PAG.	Rec/Riparian	High	Moderate	High	Red Flag
B2 - Loss of large diameter PP and DF components of Dry MC PAG.	Timber/Forest Rec/Riparian	High	Low	High	Red Flag
B3 - Trend to late seral stage of MH PAG.	Outback Alpine Tephra	Moderate	Moderate	Moderate	Yellow Flag
B4 - Trend to late seral stage of meadows and riparian streamsides.	Rec/Riparian Alpine Tephra Outback	Moderate	Moderate	Moderate	Yellow Flag
B5 - Decline in amphibians and native fish stocks.	Outback Rec/Riparian Alpine Tephra	High	Moderate	High	Yellow Flag
B6 - Decline in Jepson's monkey-flower habitat.	Rec/Riparian Timber/Forest	High	High	Moderate	Yellow Flag
B7 - Increase in Noxious weeds on major roads.	Rec/Riparian Timber/Forest	High	Moderate	Moderate	Yellow Flag
B8 - Loss of connective habitat between LSR's.	Rec/Riparian Timber/Forest	High	Low	High	Red Flag

Table III-1. Ecological Risk and Trend Rating.- Continued

Trends	Landscape Areas	Susceptibility	Resiliency	Risk to Ecosystem	Trend Rating
S1 - Increased recreation demand in developed, undeveloped, and wilderness settings.	Alpine Tephra Rec/Riparian Outback				
Green, Moraine, Todd, Hosmer, Irish/Taylor and Charlton Lakes.	Alpine Tephra Rec/Riaprian Outback	High	Low/Moderate	Moderate/High	Red Flag
Lava and Little Lava, Cultus Lakes, Upper Deschutes River, Crane Prairie.	Rec/Riparian	Moderate/High	Moderate/High	Moderate	Orange Flag
Sparks, Devils, Elk, Little Cultus, Deer, and several wilderness lakes.	Rec/Riparian Alpine Tephra Outback	Moderate/High	Low/Moderate	Moderate	Yellow Flag
S2 - Deterioration of recreation facilities and natural resource amenities.	Rec/Riparian Alpine Tephra	High	Moderate	Moderate	Orange Flag
S3 - Increased fire hazard and increased demand for protection.	Rec/Riparian	High	Low	High	Red Flag
S4 - Increased crime moving from urban to rural environments.	Rec/Riparian	High	Moderate	Moderate	Yellow Flag
S5 - User maintenance high density road system.	Rec/Riparian Timber/Forest	Moderate	Moderate	Moderate	Yellow Flag
S6 - Decrease in size class and amount of forest products extracted.	Timber/Forest Rec/Riparian	Moderate	Low	Moderate	Yellow Flag

Chapter IV
Management Goals & Opportunities

CHAPTER IV
MANAGEMENT GOALS AND OPPORTUNITIES

Management goals and opportunities were developed to meet needs identified in the trends analysis to protect soils, restore riparian function and forest health, return resilience to ponderosa pine stands, maintain the quality of scenic resources and recreation experiences, and promote environmental and interpretive programs that feature the watershed's outstanding geological, hydrological, scenic, riparian, and wildlife values. These goals and opportunities were developed by landscape area and are recommended by the team as a way to restore natural processes and to enhance human interactions with the watershed ecosystems.

MANAGEMENT GOALS

The Recreation/Riparian Landscape Area

1. Promote and direct diverse recreational uses to lessen visitor impacts on the landscape to maintain or enhance water quality, aquatic resources, scenic quality, critical wildlife habitat and corridors, riparian integrity, heritage resources, and special uses (resorts, summer homes, utilities, concessionaires, travel routes).

2. Manage vegetative component in order to provide for sustainable forest and meadow ecosystems with an emphasis on connectivity among later seral stages and to maintain and enhance the scenic quality of the area.

The Recreation/Alpine Tephra Landscape Area

1. Maintain the outstanding scenic quality of the area.

2. Promote the recreational day use opportunities that pose no threats or disturbances to wildlife refugia and human solitude.

3. Promote environmental education and interpretive programs featuring the outstanding geologic, hydrologic, scenic, riparian, and wildlife values.

4. Restore riparian function to areas impacted by human use.

The Timber/Forest Products Landscape Area

In order to provide sustainable commercial forest products:

1. Restore forest resiliency to insect, disease, and fire disturbances to enhance a mosaic of forest structural diversity, species composition, and wildlife habitat.

2. Respond aggressively to the effects of high forest density and species composition changes, soil compaction, and fragmentation to promote long-term site productivity and forest health.

3. Manage vegetative component in order to provide for sustainable forest and meadow ecosystems with an emphasis on connectivity among later seral stages and maintaining and enhancing the scenic quality of the area.

The Outback Landscape Area:

1. Emphasize environmental awareness to maintain the pristine character of the area in relation to wildlife habitat, scenic quality, and a primitive recreational experience.

2. Emphasize and enhance habitat for native species.

3. Allow natural processes, including fire, to shape the landscape.

4. Maintain the unroaded character of the area.

OPPORTUNITIES

The Cascade Lakes Watershed is one of the crown jewels of the Deschutes National Forest. Scenery, water quality, recreation, forest beauty and health, and wildlife values are very high. The community of Bend and the surrounding counties depend upon the watershed for water supply, recreation, and economic stability. In view of the high risk trends and current conditions present in the watershed, the team recommends swift management changes and restoration in the following categories:

***Forest Health and Scenic Quality:** Vegetation treatment to reduce stand densities and wildfire risk, and retain the remaining large trees and forest cover so valued by the public and so important to wildlife.

***A Sense of Forest Service Stewardship:** An aggressive shift in recreation promotion of the watershed from overhight use to day use. Heavy emphasis on providing interpretive and outdoor educational programs, utilizing Human Resource programs, and a greater Forest Service presence.

***Recreation and Wildlife Habitat Quality:** Relocation and restoration of camping sites in undeveloped areas critical to wildlife, riparian health, and high water quality.

***Facility Maintenance:** Riparian campground facility restoration to prevent further degradation of fragile lake chemistry (clear water), provide a quality recreation experience, and improve site damage caused by camping sites in undeveloped areas.

***Soil Quality:** Restoration of riparian and upland soils to promote long-term productivity, vegetation diversity, and forest health.

Listed below are the restoration and management opportunities for each landscape area. These are specific to certain areas, plant association groups, or water bodies. High priority and critical restoration opportunities are listed in the Executive Summary.

The Recreation/Riparian Landscape Area

1. Promote day use activities throughout this landscape area with a recreational opportunity guide which gives visitors information on what to see, where to visit and a description of the special features to be viewed. Close overnight use in all areas along the Upper Deschutes River with the exception of Mile Camp and Deschutes Bridge.

2. Promote camping in developed sites by restoring vegetation groundcover, providing screening, improving pedestrian and vehicular circulation, and installing sanitary toilets designed for barrier-free access.

3. Develop barrier-free facilities for parking, trail access, and access to the water where feasible and appropriate.

4. Classify campgrounds by describing the allowed use in terms of appropriate vehicle type and size (motorhomes), walk-in tent camping, or car camping. An excellent example is Quinn Meadow Horse Camp.

5. Designate undeveloped camping sites in appropriate areas where conflict with other resource values is absent and increasing use can be sustained over time. Use the Green Team program and other volunteer groups to restore and maintain undeveloped camping areas.

6. Close and restore undeveloped camping sites in areas that currently pose a significant threat to physical, biological, and social values and cannot sustain increasing use over time.

7. Close roads which provide unnecessary access to Riparian Reserves and to undesignated camping sites which have been restored.

8. Provide environmental education and interpretive programs at recreation sites which describe the roles played by the riparian ecosystem.

9. Provide an information guide for off-highway vehicles traffic describing opportunities and closures so that unnecessary roads and closed roads do not become reopened.

10. Use alternative methods for logging such as helicopter, horse logging, winter logging, or helicopter in sub-irrigated or riparian forests (lodgepole pine and mixed conifer).

11. Restore the natural flow of water to areas where surface or groundwater flow has been disruped from channelization, ditching, or improperly functioning culverts.

12. Monitor water quality adhering to USFS Region 6 lake survey protocol every three to five years on the following water bodies: Elk, Cultus, Todd, Charlton, Irish, Taylor, and Green Lakes. If water quality decreases, diagnose and remedy the water pollution source.

13. Improve forest health conditions which would enhance and support the optimal forage, long-term cover, and calving habitat required in key elk areas and support the large tree component within one mile of lakes for bald eagle and osprey.

14. Design vegetation management treatments that restore resilience to the lodgepole pine dry plant association group and the dry mixed conifer plant association group and maintains or promotes connectivity for late-successional species between the Cultus LSR and the Sheridan LSR.

15. Design and implement vegetation management treatments which enhance scenic views and improve the recreation experience. Integrate treatments with roadside pullouts and interpretive information featuring riparian ecology, late-successional species and habitats, wildflower indentification, noxious weeds identification, forest management practices and natural ecosystem processes such as the role of fire, insect and disease outbreaks.

Quinn Meadow Horse Camp - Specific Opportunities:

1. Restore/improve stream fords/watering hole at Quinn Meadow.

Hosmer Lake - Specific Opportunities:

1. Close camping on islands and designate undeveloped camping areas.

2. Create a fee permit system for overnight parking for designated camping areas that is run by concessionaires or a campground host.

3. Develop an educational/interpretive display about Hosmer Lake's wetlands, the importance to wildlife and waterfowl, and the senstitive, fragile nature of this unusual resource in the Cascade Lakes Watershed.

Crane Prairie - Specific Opportunities:

1. Designate and provide non-fee undeveloped camping sites. Close and restore other dispersed use areas, particularly the northwest shoreline (See Aquatic Conservation Strategy), and the upper and lower arms.

2. Redesign the interpretive trail and kiosk at QuinnRiver/Osprey Point to meet barrier-free access requirements, improve the boat ramp, redesign circulation and parking patterns, amd restore damaged riparian areas.

3. Reconstruct Rock Creek boat ramp, improve campground with barrier-free access requirements, and replace toilet (CIP proposal submitted for boat ramp. There is potential to use Granger-Thye funds for toilet replacement).

4. Implement a tree replacement planting and watering program at developed sites that is integrated with thinning, hazard tree removal, cavity nesting bird box and/or bat roost boxes, and traffic control plantings or trail designation.

5. Increase parking capacity at Browns Mountain and the number of pullouts along the road between the boat ramp and Road 42.

6. Provide parking for four to five vehicles on the blocked road north of Rock Creek where float tubers hike down to the river. Parking area should be similar to the one being constructed at Blue Lagoon.

7. Promote use of designated boat ramps. Provide interpretive signs on fragile lakeshores (wet meadows, coarse erosive soils) to discourage boat launch or mooring.

8. Rehabilitate the meadow north of Crane Prairie Reservoir. Obliterate the road that crosses the meadow, and restore the natural flow of water.

9. Maintain Crane Prairie Reservoir volume above 11,000 ft/acre to enhance fishing experience for visitors and reduce conflicts over the fishery between humans, osprey, bald eagles and cormorants (intense competition in concentrated fishing holes discourages use by osprey and eagles).

10. Enforce closure of dispersed camping on the northeast shoreline within the BEMA and OMA designations. Additional road closures will be necessary.

Elk Lake - Specific Opportunities:

1. Replace leaking sewage systems in summer homes that fail to meet EPA water quality guidelines.

2. Create day use access to lakeshore adjacent to Cascade Lakes Scenic Byway. Integrate with improvement of scenic views, safe pullout area, and forest health treatment.

3. Fill and restore the ditch in the meadow south of Elk Lake.

Lava Lake - Specific Opportunities:

1. Thin insect infested lodgepole pine. Integrate with the established tree planting and thinning program. Use Green Team Program for watering new trees.

Little Lava Lake - Specific Opportunities:

1. Redesign and restore the campground at Little Lava Lake (implement fifty foot setback from water and riparian areas with designated sites).

2. Develop an nterpretive trail from Little Lava Lake to Blue Lagoon.

Upper Deschutes River and Snow Creek - Specific Opportunities:

1. Promote and enforce recreation day use only in the area from Little Lava Lake south to Crane Prairie, east to Snow Creek, and west to Cascade Lakes Scenic Byway.

2. Design and construct interpretive features for short viewing stops along the highway where the river is visible. Integrate highway safety with forest health treatments, restoration of trampled day use sites, short access trails to river, and scenic quality enhancements.

3. Retain Mile Camp as a non-fee camping area which functions as an overflow area during high use holidays and weekends. Restore forest health, scenic quality, and retain primitive character. Include toilet maintenance under the concessionaire permit. Close unnecessary roads.

4. Promote Deschutes Bridge as a centrally located campground in the Cascade Lakes area with access to the Deschutes River.

5. Restore and protect riparian areas damaged by camping. Close road access to restored areas. Enforce closures.

Cultus Lake - Specific Opportunities:

1. Design and implement forest health treatment to reduce mountain pine beetle fire hazard in the dead and dying lodgepole pine and to retain the old growth character of the dry mixed conifer plant association group. Enhance scenic quality values and promote public safety needs.

2. Restore and protect lakeshore boat in sites.

3. Prevent erosion and improve the visual quality of the jetty through vegetative and structural improvements.

4. Monitor road closure (close on the south shore) up to Cultus Mountain.

5. Designate additional boat-in sites on the north shore of Cultus Lake.

6. Eliminate fires in non-fee sites.

7. Close south shore of Cultus Lake to camping in undeveloped or undesignated areas.

Deer Lake - Specific Opportunities:

1. Monitor road closure and ensure enforcement. Improve the barriers.

Little Cultus Lake - Specific Opportunities:

1. Designate camp sites fifty feet back from lakeshore, restore soils and vegetation where possible, redirect foot traffic with vegetation screening and path designation. Protect and restore lakeshore from wave action. Maintain primitive character of site.

The Recreation/Alpine Tephra Landscape Area

1. Promote day use activities with a recreational opportunity guide which gives visitors information on what to see, where to visit, and a description of the special features to be viewed.

Green Lake and Moraine Lake - Specific Opportunities:

1. Limit overnight and day use by implementing a permit system in the future.

2. Relocate Fall Creek trail away from areas of user impact on the streambank.

3. Reassess need and viability of restoring areas closed to camping.

4. Improve use of the area through outdoor educational and interpretive opportunities such as brochures and trailhead information.

Todd Lake - Specific Opportunities:

1. Replace barriers along Todd Creek meadow.

2. Redirect a main entry trail to the lake and obliterate all other shortcut and user created trails to Todd Lake.

3. Relocate, define and improve trail around the lake (boardwalk across meadow). Create an interpretive brochure for wildflower identification.

4. Control overnight camping numbers and protect riparian areas by designating tent sites with posts and/or fire rings.

5. Provide firewood for campers so the down woody debris component of this old growth mountain hemlock stand can begin to restore itself in the Riparian Reserves.

6. Plant young mountain hemlock in natural openings of heavily used areas. Integrate with other native plantings, screening, soil amelioration, and campsite and trail designation.

7. Provide a camp host to better serve the public. A new toilet has been installed and some restoration efforts have begun.

8. Several closure opportunities exist for Road 370: close from the trailhead prior to Big Meadow to the west of Bottle Creek in order to keep vehicles out of the

meadows and to prevent erosion, gate Road 378, gate Road 380 and create a parking area/trailhead, or close Road 370 from the 370-380 junction to the 370-4601 junction. There is also an opportunity to use seasonal closures. Restrict access to off road areas from Road 370 by using barriers.

Bachelor /Dutchman - Specific Opportunities:

1. Incorporate a summer interpretive site with the proposed Dutchman parking lot expansion.

2. Assess resource impacts from trail system and relocate if necessary (hiking, cross-country, snowmobile, and mountain biking).

3. Continue education/interpretation at the top of Bachelor Butte.

Sparks Lake and Devils Lake - Specific Opportunities:

1. Restore the natural meander and width in the channelized section of Soda Creek.

2. Fill in the old irrigation ditches that currently drain Soda Creek, and use the gravel pile material.

3. Plant willows along Soda Creek.

4. Convert Soda Creek Campground to a day use picnic site and interpretive area.

5. Restore the closed road bed along Sparks Meadow back to meadow.

6. Remove livestock fencing from Sparks Meadow, maintain corral, and develop interpretive viewpoint. Prevent vehicular access to the meadow.

7. Control access to riparian areas and designate camping sites at Satan Creek.

8. Add interpretive signs and constuct a viewing platform at the Ray Atkeson Memorial Wayside overlooking Mt. Bachelor and Sparks Meadow.

9. Assess viability of interpretive site at Devils Hill domes and pictograph site.

10. Stabilize Fall Creek streambank at Green Lakes trailhead.

The Timber/Forest Products Landscape Area

1. Restore forest resiliency to disturbances by fire, insects and disease.

2. Respond aggressively to the effects of high forest density and species composition changes, soil compaction, and fragmentation.

3. Perpetuate the large ponderosa pine and douglas fir tree component for scenic and wildlife values.

Lodgepole Pine Wet and Dry Plant Association Groups - Specific Opportunities:

1. Remove dead trees except as needed for wildlife habitat, long-term site productivity, and riparian woody structure within two years.

2. Commercially thin green trees to promote healthy stands and provide wildlife habitat within two years.

3. Pre-commercially hand thin at heights of four to five feet to promote healthy stands and wildlife habitat. Promote continous canopy closure while retaining health of stands for the long-term.

4. Restore compacted soils and close roads.

5. Use horse logging, helicopter, and/or winter logging in sub-irrigated or riparian forest plant association groups (lodgepole pine and mixed conifer).

6. Provide vegetation for wildlife habitat to maintain connectivity between the Sheridan and Cultus Late-Successional Reserves.

7. Promote healthy stands by commercially thinning green stands, precommercial hand thinning, and promote continuous canopy closure while retaining longer term health of stands.

Mixed Conifer Dry Plant Association Group - Specific Opportunities:

1. Treat large acreages over a one to two year period to reduce the number of entries and alleviate impacts to soils and resources.

2. Implement broadscale treatments (commercial thin, selective harvest) to maintain large tree structure, reduce stocking densities to promote forest health, and provide future large tree replacements. Integrate treatments to create small (1/4 to 2 acre) openings and enhance species diversity. Integrate understory

treatments to mantain wildlife habitat, snags, and down woody debris. Treat stumps with borax to prevent spread of annosus root disease. Plant ponderosa pine, white pine, and douglas fir to improve species composition, increase resistance to disease, and reduce fragmentation. Introduce prescribed fire, where feasible to promote ponderosa pine and douglas fir, and to reduce brush and competition to seedlings.

2. Design long-term logging systems dedicating areas for landings and skid trails. Use helicopter, horse, and winter logging in sensitive areas.

3. Reduce road densities by installing barriers, obliteration, and rehabilitation of compacted areas. Consider a green dot road system for use during hunting season.

4. Enhance and improve scenic views from the Cascade Lakes Scenic Byway and water bodies, and to and from landmarks such as buttes and mountains.

5. Implement a mistletoe removal project between Roads 40, 4270, 4242, and 42. Conduct intensive survey of old seed tree, shelterwood and plantations due to overstory of mistletoe. Reduce mistletoe infected overstory and adjacent stands on edge of plantations. Design timber sale with objective of pruning and/or removing mistletoe infected trees except those needed for wildlife habitat, snags, and future down woody material.

6. Provide vegetation for wildlife habitat to maintain connectivity between the Sheridan and Cultus Late-Successional Reserves.

7. Promote healthy stands by commercially thinning green trees, precommercial hand thinning, and promote continous canopy closure while retaining longer term health of stands.

The Outback Landscape Area

1. Identify riparian corridors for amphibian movements north/south and east/west along the Cascade Range. Identify lakes critical for amphibians and their movements. Decide if these areas should continiue to be stocked with non-native fish species by the Oregon Department of Fish and Wildlife.

2. Develop a prescribed natural fire plan for the wilderness.

3. Establish a maximum capacity for camping in undeveloped areas at Irish, Taylor, and Charlton Lakes (and other hike-in lakes as necessary) by designating camping sites. Restore damaged shoreline areas and undesignated sites. Install

toilet facilities at Charlton Lake that can be maintained and administered by the Willamette National Forest.

4. Allow natural disturbances such as insects, disease, and fire to shape the landscape.

5. Provide corridors for amphibian migration, primarily to the Willamette National Forest, which may require the cessation of fish stocking of some lakes (Many Lakes Basin does however have many small fishless ponds).

6. Maintain unroaded and semi-untrailed nature of the south side of Mt. Bachelor.

7. Designate camping sites at the heavily used lakes (Irish, Taylor, Charlton, and others). Provide environmental and outdoor educational signing.

8. Assess where camping in undesignated sites is not appropriate. Relocate, restore, and close inappropriate sites. Monitor use.

9. Maintain the primitive driving experience to reach Irish and Taylor Lakes. Improve the road only where necessary to protect resources.

AQUATIC CONSERVATION STRATEGY

INTRODUCTION

The Northwest Forest Plan developed a strategy for the protection and restoration of aquatic/riparian ecosystems for Forest Service administered lands within the range of the Northern Spotted Owl. It also identified several objectives for the Aquatic Conservation Strategy. These objectives can be summarized as follows: ensure protection of aquatic systems, maintain connectivity, maintain water quality, maintain water and sediment storage and transport regimes, maintain and restore fish, wildlife, and plant populations and diversity. There are four components of the strategy: Riparian Reserves, Key Watersheds, Watershed Analysis, and Watershed Restoration. Of importance to note is that within the Cascade Lakes Watershed Analysis area, the Cultus subwatershed was identified as a Tier 2 Key Watershed.

Watershed Analysis is a planning tool which ensures the above objectives are considered and incorporated in all management decisions. Implementation would occur through watershed restoration and the following special standards, guidelines, and recommended Riparian Reserves. The interim Riparian Reserves as defined in the Northwest Forest Plan are shown in Exhibit 11.

RIPARIAN RESERVES

RESOURCE CONSIDERATIONS FOR SETTING RIPARIAN RESERVES

Processes which drive the dynamics of the floodplain and channel are paramount considerations for setting Riparian Reserve widths and conditions. The width of the channel and floodplain and flow regime characteristics dictate the minimum size of the trees needed to provide effective, instream wood. The presence of large woody material (LWM) within a stream channel is critical to maintaining the integrity of the system. In fact, there cannot be an overabundance of LWM. This wood plays an active role in the storage of sediment in the channel. The general rule is, the larger the tree, the more stable it will be in the floodplain, and the more stream shade it will provide while it is alive. Natural sediment storage in the uplands results from woody material that accumulates on the forest floor and impedes its movement downslope.

The floodplain vegetation is important in resisting the erosive forces of flood events. These zones are very important filters of sediment and nutrients; the thick vegetation creates an extreme roughness which inhibits water movement through and over it.

Under the Aquatic Conservation Strategy, Riparian Reserves are also used to provide habitat benefits to riparian-dependent and associated species other than fish, enhance habitat conservation for species dependent on the riparian transition zone, improve travel

and dispersal corridors for terrestrial animals and plants, and serve as connectivity corridors between Late-Successional Reserves. Riparian areas provide a moist zone within which amphibians and other wildlife species travel and reside. Ungulates use the riparian areas disproportionately more than terrestrial areas for fawning and calving. Lactating females take advantage of the improved cover and succulent vegetation. Nearly 80% of the terrestrial wildlife species are either directly or indirectly dependent upon riparian areas for meeting their habitat needs.

In the Riparian Reserves (particularly in the lodgepole pine and the mixed conifer wet plant association groups), it is desirable to maintain healthy forest stands over the long-term, while maintaining high snag densities and green tree replacements. Wildlife habitat requirements, water quality, and long-term stand health should dictate vegetation treatment needs within the Riparian Reserves. These Reserves constitute an area where higher risks are taken (including reduced fire suppression efforts) in order to allow natural processes to occur and continue without excessive human intervention.

RIPARIAN RESERVE WIDTHS AND MANAGEMENT REQUIREMENTS

The Riparian Reserves, as described in the Northwest Forest Plan and Record of Decision (ROD) have been adapted (USDA, USDI, 1994) for the Cascade Lakes Watershed. These Riparian Reserves will be managed as special management areas, utilizing the sideboards listed below in addition to the Standards and Guidelines in the ROD. Site specific conditions and mitigation will be developed in project Environmental Assessments (EA).

Vegetation

East of the Cascades, fire plays an important role in shaping vegetation patterns across the landscape. A combination of salvage, thinnings, and fire can be used as tools to create small openings in the riparian zone. No large trees with the potential of providing shade (within the distance equal to the height of two site-potential trees) or LWM to the creek will be disturbed. Wildlife habitat needs will dictate the remaining condition of the patches to be created. Fuel loading in the Riparian Reserves will be greater than that in the surrounding uplands except within established facilities (campgrounds, summer home tracts, etc).

Roads, Grazing and Minerals Management

As per the ROD, site specific conditions and mitigation will be developed in project EA's. No net increase in roads will occur.

Recreation Management

New campgrounds will not be developed within the distance equal to the height of 2 site-potential trees of any water body. At existing campgrounds with sites closer than 50 feet to the water (fire ring or picnic bench), redesignation of sites falling within this setback zone will be necessary. Dispersed campgrounds will also need to conform to the setback through site designation with a limit to the numbers of camp sites allowed. Vegetative buffers will be used to contain any sediment in the wash into the waterbody. Avoid development or traffic in any areas lacking coarse soils.

Day use picnic sites will need to be designated with picnic table locations especially away from areas where the riparian vegetation is damaged or removed. Circulation patterns and access will need to be redirected through trail realignment or trailhead relocation, the use of different surface materials such as wood boardwalks, wood viewing platforms or hard surfaces, trail borders or boundaries using natural elements such as the surrounding fallen woody material, semi-buried stones, or native shrubs or groundcovers. Native plant species are to be 12 to 18 inches minimum height where appropriate to prevent foot traffic. Mixed tree sizes and spacing will be planted to ensure future generations of tree growth in areas of predominantly large trees. Native plant species are to be approved per site by the District Ecologist/Botanist or the Forest Botanist.

Scenic views will be strongly considered when relocating camping sites, day use picnic sites, trails, and viewpoints. Opening views, providing more sun exposure and light, and replanting damaged riparian vegetation areas will improve not only the overall scenic quality but also the recreation experience.

Fire/Fuels Management

Develop a fire management strategy for the Riparian Reserves within 5 years that will allow for fire by prescription (both natural and human caused ignitions). The intent is to have heavy loading of down fuels in the Reserves to result however, some openings can be created in order to provide a diversity of habitats and to reduce encroachment of conifers in the wetlands.

The fire management strategy should allow fire to burn to and through the water influence zone. No firelines constructed with mechanized equipment should be allowed within or across riparian areas. It should also be commensurate with the surrounding vegetation zone, providing for structural diversity and where appropriate, include the three C's--confine, contain, and control.

Lands, General Riparian Area Management, Watershed and Habitat Restoration, Fish and Wildlife Management and Research

As per the ROD, site specific conditions and mitigation will be developed in project EA's.

RIPARIAN RESERVES WITHIN THE LANDSCAPE AREAS

The designated riparian widths are designed to be wide enough to maintain floodplain integrity and water quality. These widths ensure that when floods occur, there is enough room for the anticipatesd water to pass and to allow for sediment deposition to occur, and that there is adequate vegetation to provide long-term large woody material recruitment. Corridors for wildlife are needed which extend beyond the readily recognizable riparian/wetland vegetation.

The Recreation/Alpine Tephra Landscape Area

Mountain hemlock and lodgepole pine are the dominant species within this landscape area. Mountain hemlock occupies north slopes and higher elevations while lodgepole pine tends to occur at lower elevations. In spite of the porous volcanic soils, many spring and lake fed perennial streams occur in this area in addition to many intermittent channels fed by snow melt. This landscape area is about 60% wilderness with the rest being only lightly roaded (main road through area is the Cascade Lakes Scenic Byway) Natural processes have prevailed across much of this landscape and vegetative manipulations have been minimal in the rest of the area.

The lands within this landscape area are identified in the Northwest Forest Plan as Congressionally Withdrawn (wilderness) and Administratively Withdrawn. Late structural stages of vegetation are emphasized however, a diversity of vegetative structure is desired. Few vegetative treatments will occur since the emphasis is to allow for natural processes and for fire and hydrologic events to continue to design the vegetative patterns on the landscape. When vegetative manipulation does take place in riparian areas, management flexibility is needed in order to maintain or achieve healthy stands.

Along many of the streams in the Recreation/Alpine Tephra Landscape Area, there is a narrow floodplain/water influence zone and the outer terrace defining the vegetation break is very close to the edge of the active channel. Channels are perennial to ephemeral in nature. Some of the channels in the wilderness area contain flowing water for only a few days each year, while others are spring fed and flow year round. There are wide zones of riparian vegetation around portions of some of the lakes (such as Sparks and Todd).

Recommended Riparian Reserve Widths

With the exception of the Todd Lake area, the recommended Riparian Reserve widths to be used in this portion of the watershed are equivalent to the greatest distance reported in the Northwest Forest Plan (minimum slope distances being: 300 feet from lakes and fish-bearing streams; 150 feet from permanently flowing nonfish-bearing streams or edge of riparian vegetation on wetlands greater than 1 acre; 100 feet from intermittent streams or wetlands less than 1 acre). Water quality, wildlife corridors, and vegetative integrity are

key components controlling the management needs for these Riparian Reserves. All management activities are commensurate with riparian goals for existing facilities and complimentary to riparian goals in the undeveloped areas.

At the west end of Todd Lake, the Todd Riparian Reserve (Figure 1) has been established to protect the steep slopes above the many springs which define the upper limits of the extensive wetlands around the western end of the lake. This Riparian Reserve extends upslope to the drainage divide surrounding the west end of the lake. Around the remainder of the lake and along Todd Creek, the standard reserve widths of the Northwest Forest Plan apply with one exception. The exception is along the section of Todd Creek between crossings of Cascade Lakes Scenic Byway and Forest Service Road 4600-370 where the western boundary of the Riparian Reserve extends to the base of the steep slope west of Forest Service Road 4600-370.

The Recreation/Riparian Landscape Area

Lodgepole pine is the dominant species here along with areas of mixed conifer. This landscape contains a series of large lakes with high recreational use. The Cascade Lakes Scenic Byway crosses the length of area and the relatively high road density allows access to many riparian areas.

The lands within this landscape area are identified in the Northwest Forest Plan as Late-Successional Reserve, Administratively Withdrawn, and Matrix. Late structural stages of vegetation are emphasized although a diversity of vegetative structure is desired. Vegetative treatments will occur due to the high mortality in the lodgepole stands and the risk of catastrophic fire. When vegetative manipulation does take place in riparian areas, management flexibility is needed in order to maintain or achieve healthy stands.

Along many of the streams in the Recreation/Riparian Landscape Area, there is a narrow floodplain/water influence zone and the outer terrace defining the vegetation break is very close to the edge of the active channel. Due to the many springs and large lakes in this landscape area there are a large number of perennial channels. Some intermittent channels contain flowing water for only a few days each year, while others may flow well into the summer months. There are wide zones of riparian vegetation around portions of some of the lakes (such as Hosmer, Lava, and Crane Prairie Reservoir).

Recommended Riparian Reserve Widths

With the exception of the Crane Prairie area, the recommended Riparian Reserve widths to be used in this portion of the watershed are equivalent to the greatest distance reported in the Northwest Forest Plan (minimum slope distances being: 300 feet from lakes and fish-bearing streams; 150 feet from permanently flowing nonfish-bearing streams or edge of riparian vegetation on wetlands greater than 1 acre; 100 feet from intermittent streams

or wetlands less than 1 acre). Water quality, wildlife corridors, and vegetative integrity are key components controlling the management needs for these Riparian Reserves. All management activities are commensurate with riparian goals for existing facilities and complimentary to riparian goals in the undeveloped areas.

In the Crane Prairie area, the Riparian Reserve has been expanded around the reservoir to provide dispersal and travel corridors for terrestrial animals and plants adjacent to riparian areas and areas with relatively shallow ground water levels and to serve as a connectivity corridor between the Cultus LSR and the Sheridan LSR. Around the reservoir, the Riparian Reserve boundary has been extended to 300 feet beyond the maximum pool elevation. North of the reservoir, the Crane Riparian Reserve (Figure 2) has been established beginning with the meadows along the northeast arm of the reservoir. The expanded Riparian Reserve boundary is located 300 feet (east) beyond the edge of riparian vegetation and/or Snow Creek until Forest Service Road 4270 is reached. The boundary then goes west along Forest Service Road 4270 to the Cascade Lakes Scenic Byway at Deschutes Bridge on the Deschutes River. The boundary then follows the Cascade Lakes Highway south (or is 300 feet west of the Deschutes River, whichever is greater) until the highway and river separate in Section 16. It then goes south 300 feet west of the Deschutes River to Forest Service Road 4000-990 and then again south along Forest Service Roads 4000-990 and 4000-970 and then west along Forest Service Roads 4600-620, 4600-622, 4600-626, 4635, and 4630 to Deer Creek. The boundary then returns to Crane Prairie along a line 300 feet south of Deer Creek.

The Outback Landscape Area

Mountain hemlock and lodgepole pine are the dominant species within most of this landscape area. Mountain hemlock tends to occur at higher elevations with lodgepole pine at lower elevations and within old burns in the mountain hemlock. Due to the porous volcanic soils, there is only one perennial stream. In addition, there are many small lakes and intermittent channels fed by snow melt. This landscape area is about 55% wilderness with less than 10 miles of low standard roads in the remainder of the area. Natural processes have prevailed across this landscape.

The lands within this landscape area are identified in the Northwest Forest Plan as Congressionally Withdrawn (wilderness) and Administratively Withdrawn. Late structural stages of vegetation are emphasized however, a diversity of vegetative structure is desired. Few vegetative treatments will occur since the emphasis is to allow for natural processes and for fire and hydrologic events to continue to design the vegetative patterns on the landscape. When vegetative manipulation does take place in riparian areas, management flexibility is needed in order to maintain or achieve healthy stands.

Along most of the streams in the Outback Landscape Area, there is a narrow floodplain/water influence zone and the outer terrace defining the vegetation break is very

close to the edge of the active channel. With one exception, all stream channels are intermittent in nature. Some of the channels in the area contain flowing water for only a few days each year, while others may flow well into the summer months.

Recommended Riparian Reserve Widths

With the exception of the Many Lakes area, the recommended Riparian Reserve widths to be used in this portion of the watershed are equivalent to the greatest distance reported in the Northwest Forest Plan (minimum slope distances being: 300 feet from lakes and fish-bearing streams; 150 feet from permanently flowing nonfish-bearing streams or edge of riparian vegetation on wetlands greater than 1 acre; 100 feet from intermittent streams or wetlands less than 1 acre). Water quality, wildlife corridors, and vegetative integrity are key components controlling the management needs for these Riparian Reserves. All management activities are commensurate with riparian goals for existing facilities and complimentary to riparian goals in the undeveloped areas.

The Many Lakes area is a region of numerous lakes, meadows, and intermittent stream channels with a unique geologic history of volcanic and glacial interaction. Much of the area is wilderness and a part of it has been proposed as a Research Natural Area. Because of the abundance of riparian features within this area, the Many Lakes Riparian Reserve (Figure 3) was established. In general, the area lies west of Little Cultus and Deer Lakes, north of the intermittent drainage between Taylor and Little Cultus Lakes, east of the Pacific Crest Trail and south of a line between Brahma and Deer Lakes.

The Timber/Forest Products Landscape Area

Mixed conifer stands dominate much of this landscape area but areas of mountain hemlock occur at higher elevations with lodgepole pine at lower elevations. Due to the porous volcanic soils and lavas, there are no perennial streams and limited numbers of intermittent and ephemeral channels.

The lands within this landscape area are identified in the Northwest Forest Plan as mainly Matrix and Late-Successional Reserve with smaller areas of Administratively Withdrawn. Late structural stages of vegetation are emphasized however, a diversity of vegetative structure is desired. When vegetative manipulation does take place in riparian areas management flexibility is needed in order to maintain or achieve healthy stands.

Along the few stream channels in the Timber/Forest Products Landscape Area, there is a narrow floodplain/water influence zone and the outer terrace defining the vegetation break is very close to the edge of the active channel, which are all intermittent and ephemeral in nature. Most channels are intermittent or ephemeral in nature, with running water rarely occurring on the

of the LWM. Fortunately, sediment movement and accelerated erosion have not detrimentally affected the integrity of the channel.

Recommended Riparian Reserve Widths

The recommended Riparian Reserve widths to be used in this portion of the watershed are all equivalent to the greatest distance reported in Northwest Forest Plan (minimum slope distances being: 300 feet from fish-bearing streams; 150 feet from the edge of riparian vegetation on wetlands greater than 1 acre; 100 feet from intermittent streams or wetlands less than 1 acre). Water quality, wildlife corridors, and vegetative integrity are key components controlling the management needs for these Riparian Reserves. Management activities occurring in this landscape area will be complimentary to riparian goals.

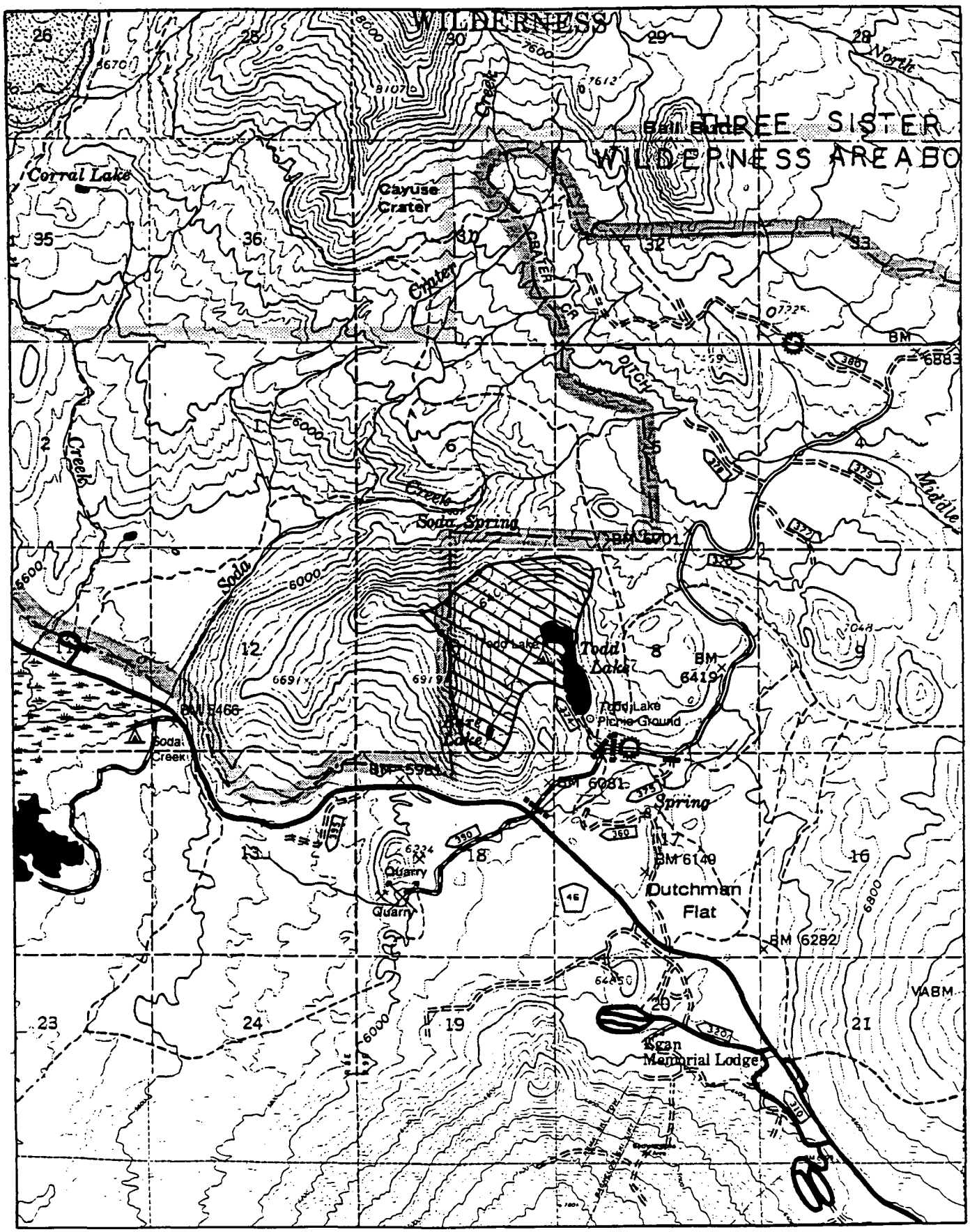


Figure 1 - Cascade Lakes Watershed Analysis - Todd Riparian Reserve

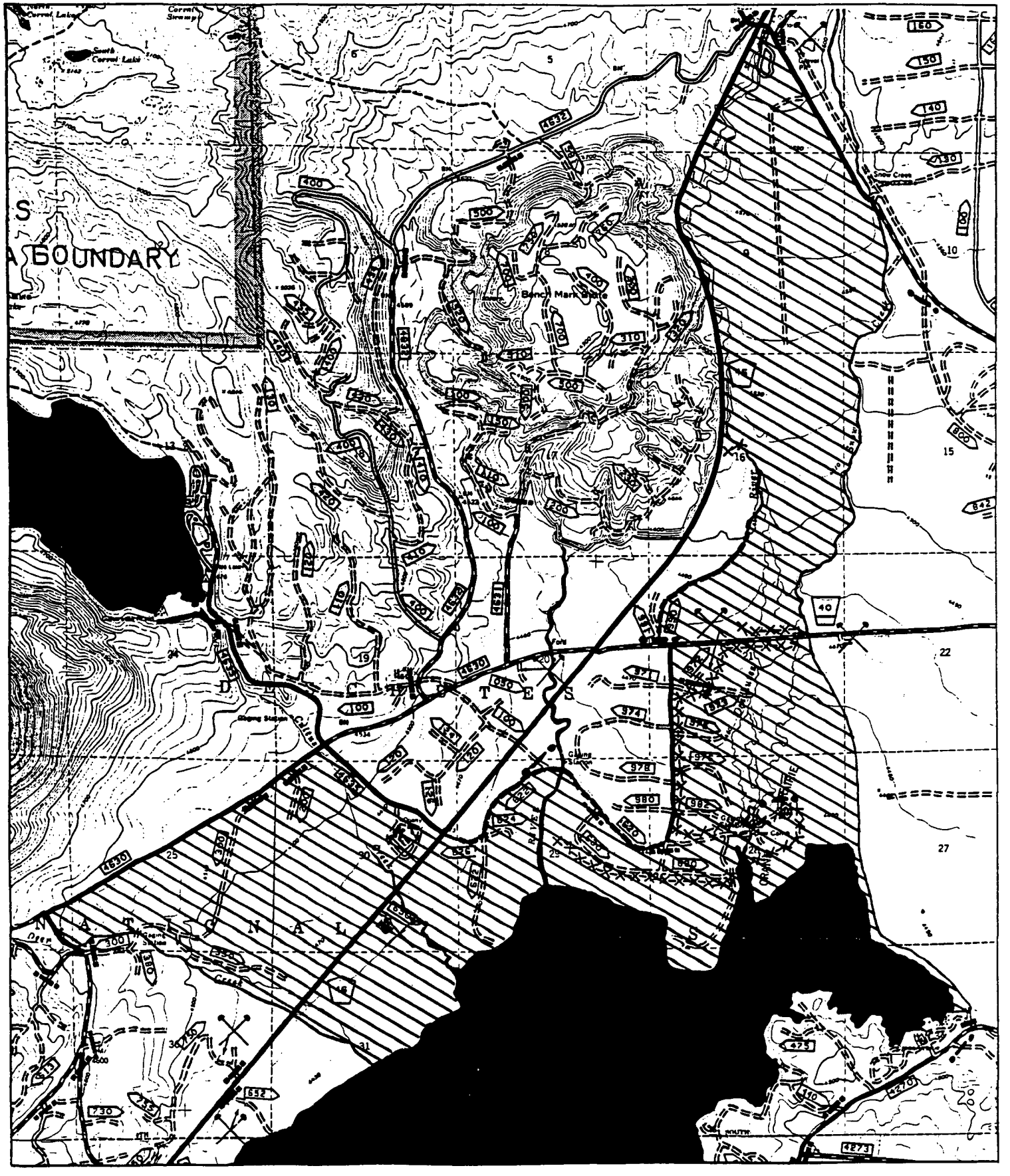


Figure 2 - Cascade Lakes Watershed Analysis - Crane Riparian Reserve

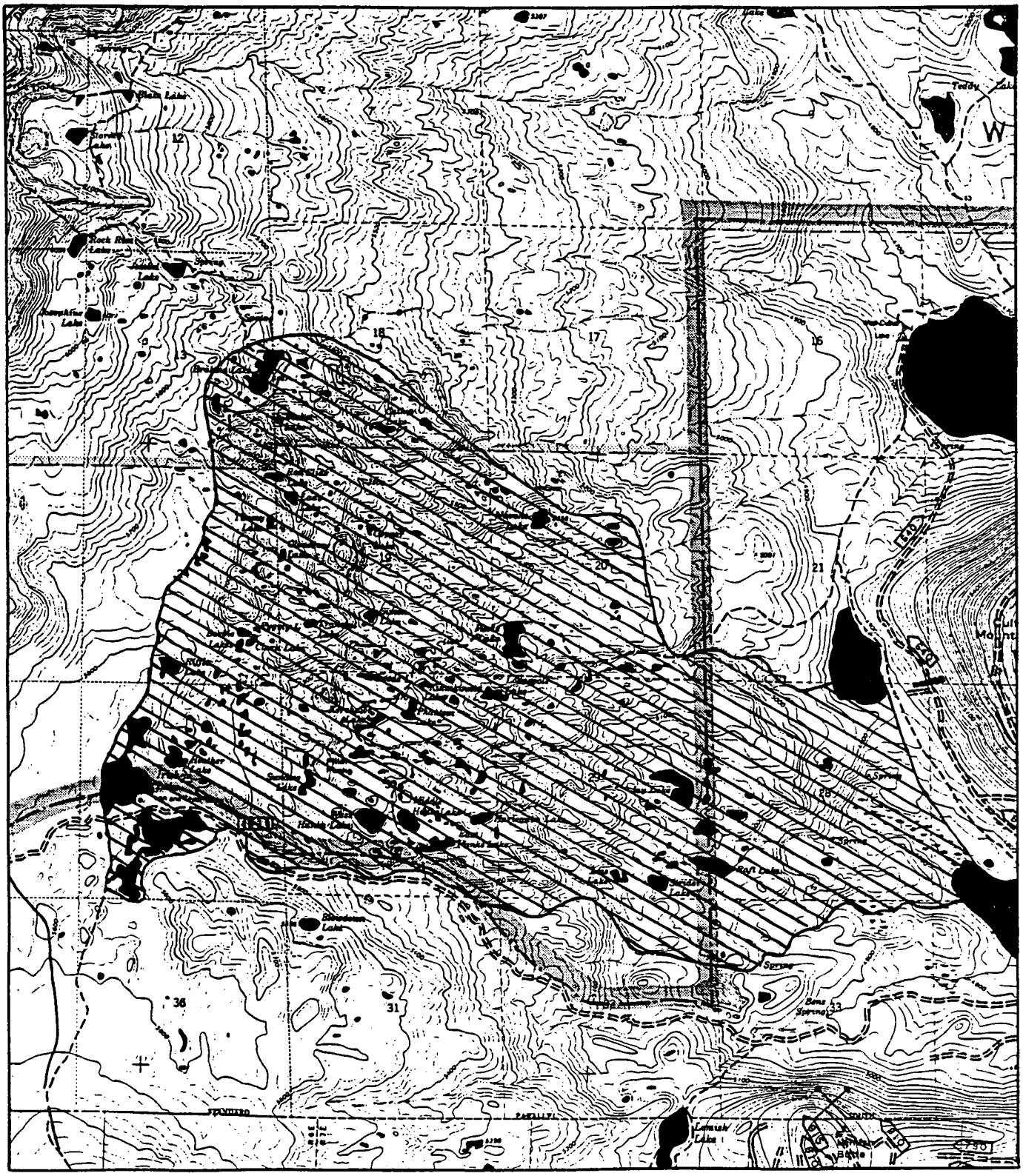


Figure 3 - Cascade Lakes Watershed Analysis - Many Lakes Riparian Reserve

DATA GAPS AND MONITORING

DATA GAPS

1. Direct measures of silvicultural stand densities (stand exams) in the Cascade Watershed Analysis area were not available. Integrated Satellite Imagery (ISAT), field reconnaissance, and aerial photo interpretation were used to estimate stand density. This method was suitable for broad scale analysis but for project level analysis, more site specific information is needed.

2. Data identifying forested areas of insect and disease activities in the Cascade Lakes Watershed Analysis area was very limited. Field reconnaissance, FPM aerial survey, and aerial photo interpretation were used to estimate insect and disease activities. For project level analysis, more site specific information is needed.

3. Patch pattern analysis was accomplished using aerial photo interpretation at a coarse, gross scale. "Fragstats" or other comprehensive analysis methods were not used. General trends were summarized for wildlife habitat analysis. More comprehensive modeling for wildlife habitat needs are needed for project level vegetation management treatments.

4. We assumed the Historic Range of Variability (HRV) was an indicator of healthy and viable vegetation patterns. Patterns that fall outside of this HRV do not meet this definition. This may not be a completely valid assumption. There may be other patterns outside HRV that are healthy and will sustain a viable ecosystem.

5. Analysis of fragmentation in the forested areas in the Cascade Lakes Watershed Analysis area was not completed.

6. Data to estimate quantities of snags/down wood in forested areas was not available.

7. Genetic status of the redband trout is currently unknown. The Deschutes National Forest and the Oregon Department of Fish and Wildlife (ODFW) are in a Challenge Cost Share partnership program, investigating the genetic identity of the rainbow trout in the Watershed.

8. Not all lakes within the Cascade Lakes Watershed Analysis area have been recently surveyed (within the last ten years). Lake Surveys are intended to be repeated on each lake on the Forest at least once every ten years. More recent lake survey data would provide additional current data to facilitate a more thorough analysis.

9. Data identifying bacterial contamination on water bodies in the Cascade Lakes Watershed is incomplete. Testing for fecal coliform in water bodies near high recreational use areas is a way to further identify failing or insufficient septic systems or vaulted toilets.

10. Population data on amphibians and aquatic invertebrates is incomplete in the analysis area. The effects that introduced fish has on these populations in lakes lacking a natural historical presence of fish populations is not fully understood.

MONITORING

1. Monitor success of forest health treatments to restore resilience to insect, disease, and wildfire.

2. Monitor water quality in all other water bodies every ten years at a minimum adhering to USFS Region 6 lake survey protocol.

3. Monitor the black-backed woodpecker in the dry and wet lodgepole pine plant association groups as an indication of vegetation treatment effectiveness for the maintenance and enhancement of late-successional habitat.

4. Continue northern spotted owl monitoring once every three years to maintain records of nesting pairs and resident singles.

5. Consult existing monitoring data for neo-tropical birds collected annually at Elk Lake (BBS breeding bird survey route). Monitor trends.

6. Consult Oregon Eagle Foundation Report for annual monitoring of bald eagles in the Central Oregon Recovery Zone. Monitor trends.

7. Monitor osprey nest sites associated with the watershed in calendar year 1996 and then annually once every three years for fledgling success.

8. Monitor effectiveness of road closures in bald eagle, osprey, and sandhill crane habitats of the Crane Prairie Reservoir annually.

9. Conduct initial surveys to determine the presence/absence and extent of non-native wildlife species within the watershed. Conduct three to five years of survey to obtain baseline data, then every ten years conduct two years of surveys to determine the trend or invasion potential.