

ODELL WATERSHED ANALYSIS

OCTOBER 1999

DESCHUTES NATIONAL FOREST
CRESCENT RANGER DISTRICT

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**Crescent Ranger District
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INTRODUCTION

Watershed Analysis

The Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl was signed in April, 1994. Also known as The Northwest Forest Plan, it requires that watershed analysis be completed in Key Watersheds prior to the occurrence of new management activities. Odell subwatershed is considered a Tier 1 Key Watershed, and along with fourteen other watersheds was selected for conducting pilot watershed analyses. Through the pilot watershed analyses, the process of watershed analysis was defined. Watershed analysis is an iterative process and the reports are intended to be updated and revised if and when substantial new issues come forth, when important new information becomes available, or when significant changes in watershed conditions occur. During the pilot project, the WEAVE process was used (Watershed Evaluation and Analysis for Viable Ecosystems, Deschutes NF). At the time, it was consistent with the Federal Guide for Pilot Watershed Analysis. Since that time, the Federal Guide for watershed analysis has been updated (Ecosystem Analysis at the Watershed Scale, version 2.2, 1995). Therefore, this document is an update to the 1994 Odell Pilot Watershed Analysis and follows the six-step process outlined in the new federal guide.

The intent of watershed analysis is to develop and document a scientifically-based understanding of the ecological processes and conditions occurring within a watershed. This understanding—which focuses on specific issues, values, and uses within the watershed—is essential for making sound management decisions. Protecting beneficial uses is a fundamental motivation for watershed analysis.

Watershed analysis is not a decision-making process like the National Environmental Policy Act (NEPA process). Rather, it is an analytical process. It serves as a foundation for future project-level analysis and decision-making for a wide range of potential management activities. Project level recommendations for federal lands must be further analyzed according to the National Environmental Policy Act (NEPA) process.

Odell Watershed Analysis Area

The Odell Watershed Analysis Area extends from Diamond Peak north to Davis Lake, and from Davis Lake west to the crest of the Cascade Mountains. The analysis area covers roughly 75,000 acres and consists of three subwatersheds: Odell Lake, Moore, and Odell. The analysis area is part of the Middle Deschutes Watershed which is comprised of a total of five subwatersheds, three of which are listed above and included in this analysis (Figure 2). The lava flow which created Davis Lake prevents surface water exchange with the two remaining subwatersheds of the Middle Deschutes Watershed, which results in a closed system for surface water, nutrient cycling, and fish populations within the analysis area. The Browns and Wickiup subwatersheds were part

of a watershed analysis conducted by staff of the Bend/Ft. Rock Ranger District (Deschutes National Forest, 1997)

Distinguishing Features

Key Watershed

In the Northwest Forest Plan *Key Watersheds* were identified. These watersheds provide high quality habitat for at-risk stocks of resident fish species. They are to serve as refugia for maintaining and recovering habitat for these at-risk species. These refugia include areas of high quality habitat as well as areas of degraded habitat. Odell subwatershed contains a stream with high quality habitat conditions which serves as an anchor for the potential recovery of depressed fish populations. Odell subwatershed is designated as a Tier 1 (Aquatic Conservation Emphasis) Key Watershed which contributes directly to the conservation of the threatened bull trout and resident fish populations. This subwatershed is part of a network of 143 Tier 1 watersheds which are designated to ensure that refugia are widely distributed across the landscape.

Davis Lake

This unique lake was formed when a lava flow dammed Odell Creek about 5,600 years ago. The lake is shallow in nature, and its outflow is controlled by "leaks" in the lava along the northeast shoreline and bottom of the lake. The water level fluctuates dramatically, in fact, the lake can vary in size from 40 to 3,000 acres. Davis Lake is extremely important to migrating waterfowl. Tens of thousands of migrating birds make an annual stop to rest and forage in the waters of the lake and along the shoreline. Bald eagles and osprey nest and rear their young at both Davis and Odell Lakes. When the water level is high, Davis Lake also supports an excellent fishery.

Odell Lake and Bull Trout

This lake is 3,600 surface acres in size and is recognized as one of the largest lakes in the Oregon Cascades. The water in the lake remains very cold due to its depth and elevation. Odell Lake contains the only remaining natural adfluvial population of bull trout in Oregon. In 1998, the bull trout was listed as a Threatened species. Odell Lake is a popular fishing and boating lake and has been a major recreational draw for nearly three quarters of a century.

Developed and Dispersed Recreation

Trails, campgrounds, resorts and wilderness provide diverse experiences for recreationists such as hiking, camping, boating and fishing, sno-mobiling and cross-country skiing. Recreation opportunities continue year-round.

Late Successional Reserve

Approximately 48% percent of the Odell Watershed Analysis area is within the Davis Late Successional Reserve (LSR). An LSR Assessment was completed in 1995 and gives specific management strategies for areas within the LSR. The primary intent of the LSR is to protect and enhance habitat for late-successional and old-growth related species.

Land Allocations

The management of this watershed is directed by the Deschutes Land and Resource Management Plan (1990) as amended by the Standards and Guidelines for the Management of Habitat for Late Successional and Old-Growth Related Species within the Range of the Northern Spotted Owl (1994), or Northwest Forest Plan. The following tables illustrate the land allocations within the analysis area. See Figures 3 and 4 for a map of management allocations.

Table 1. Land Allocations as described by the Northwest Forest Plan (NWFP) for the Odell Watershed Analysis area.

Allocation	Acres	% of Watershed
Congressionally Withdrawn	12,331	16%
Administratively Withdrawn	19,639	26%
Late Successional Reserve	36,261	48%
Matrix	6,599	9%

Table 2. Land Allocations as described by the Deschutes National Forest Land and Resource Management Plan (LRMP) for the Odell Watershed Analysis area.

Allocation	Acres	% of Watershed
Dispersed Recreation	18,113	24%
Bald Eagle	4,886	7%
General Forest	11,740	16%
Intensive Recreation	5,934	8%
Old Growth	2,308	3%
Special Interest Area	4,222	6%
Scenic Views 1	928	1%
Scenic Views 3	320	<1%
Scenic Views 4	13,091	18%
Scenic Views X	937	1%
Wilderness	12,236	16%

What's New Since 1994

Changes in the listing of some wildlife species have occurred in the past several years. Canada Lynx has been proposed listing under the Endangered Species Act. The bald eagle has been proposed for de-listing. And the peregrine falcon is no longer listed as an endangered species. These and other species are discussed in the Biological Domain section.

In July of 1998, the US Fish and Wildlife Service (USFWS) placed the bull trout on the Federal list of threatened species. Odell Lake is home to an adfluvial population of bull trout, and during programmatic consultation, USFWS identified conditions at Trapper

Creek as posing a high risk to the lake population. This issue is discussed further in the Biological Domain section.

In 1996, the Oregon Department of Environmental Quality (DEQ) placed Odell Lake on their list of water quality impaired waterbodies (the 303d list). Water quality is discussed in the Physical Domain section.

Changes have been made in the way that vegetative conditions are analyzed. In the Biological Domain section, the more recent methods for analyzing vegetative conditions are discussed.

Participation with Others

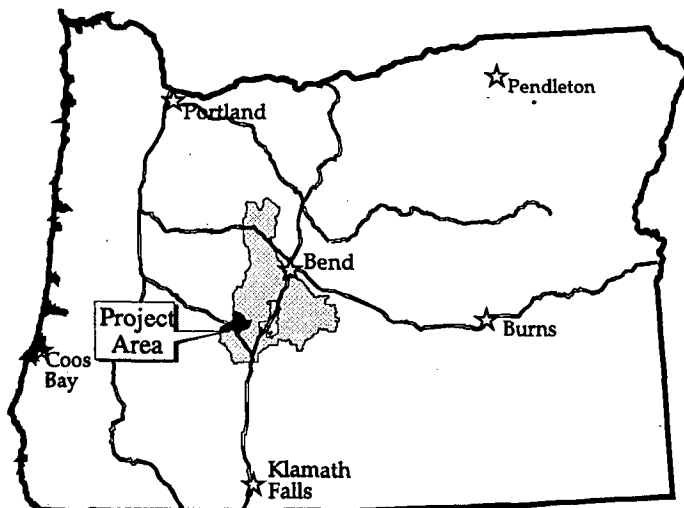
Public participation during the Pilot Watershed analysis in 1994 included several public meetings and presentations, as well as meetings with other agencies. This involvement helped to identify key issues and provide important information regarding current conditions of resources as well as important social aspects of the watershed analysis.

During the second iteration, the original plan to increase the amount of public involvement was modified because of the ultimate lack of change in the issues and because most of the changes consisted of matters of technical analysis, not policy. Finally, the social domain information was found to be complete enough for this iteration.

For example, “wildlife habitat” remained a key issue. Substantive changes were made within the description of this issue because some species were removed from the federal list of threatened species while others were added; yet the concern remained prominent in the analysis.

Similarly, changes made to data analysis regarding vegetation condition and trends served to refine the location of the at-risk vegetation, but this new analysis methodology did not alter the basic premise of the key issue.

This updated analysis document will be made available to the public.



Deschutes National Forest Crescent Ranger District

Odell Watershed Analysis Area

Figure 1

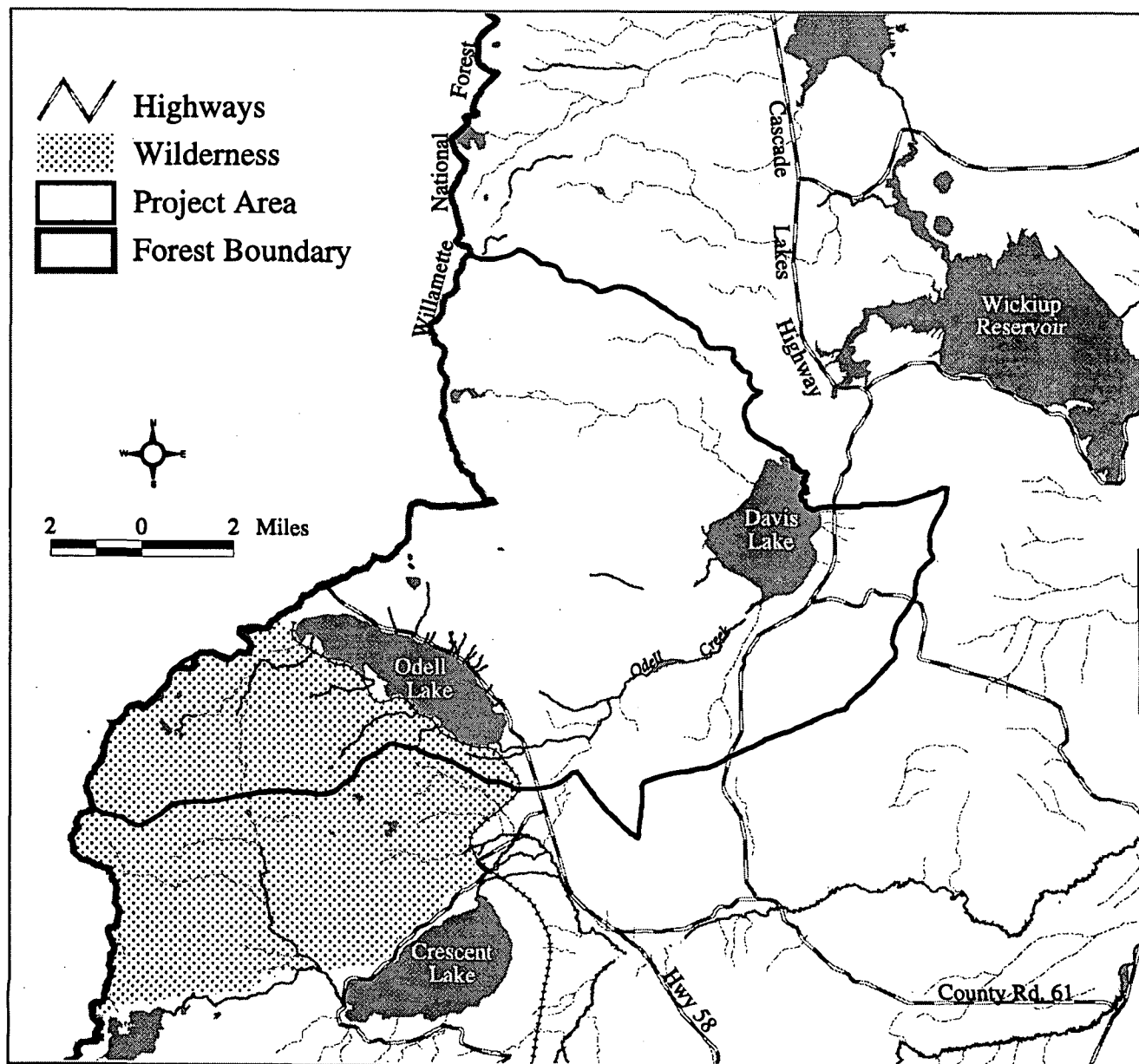
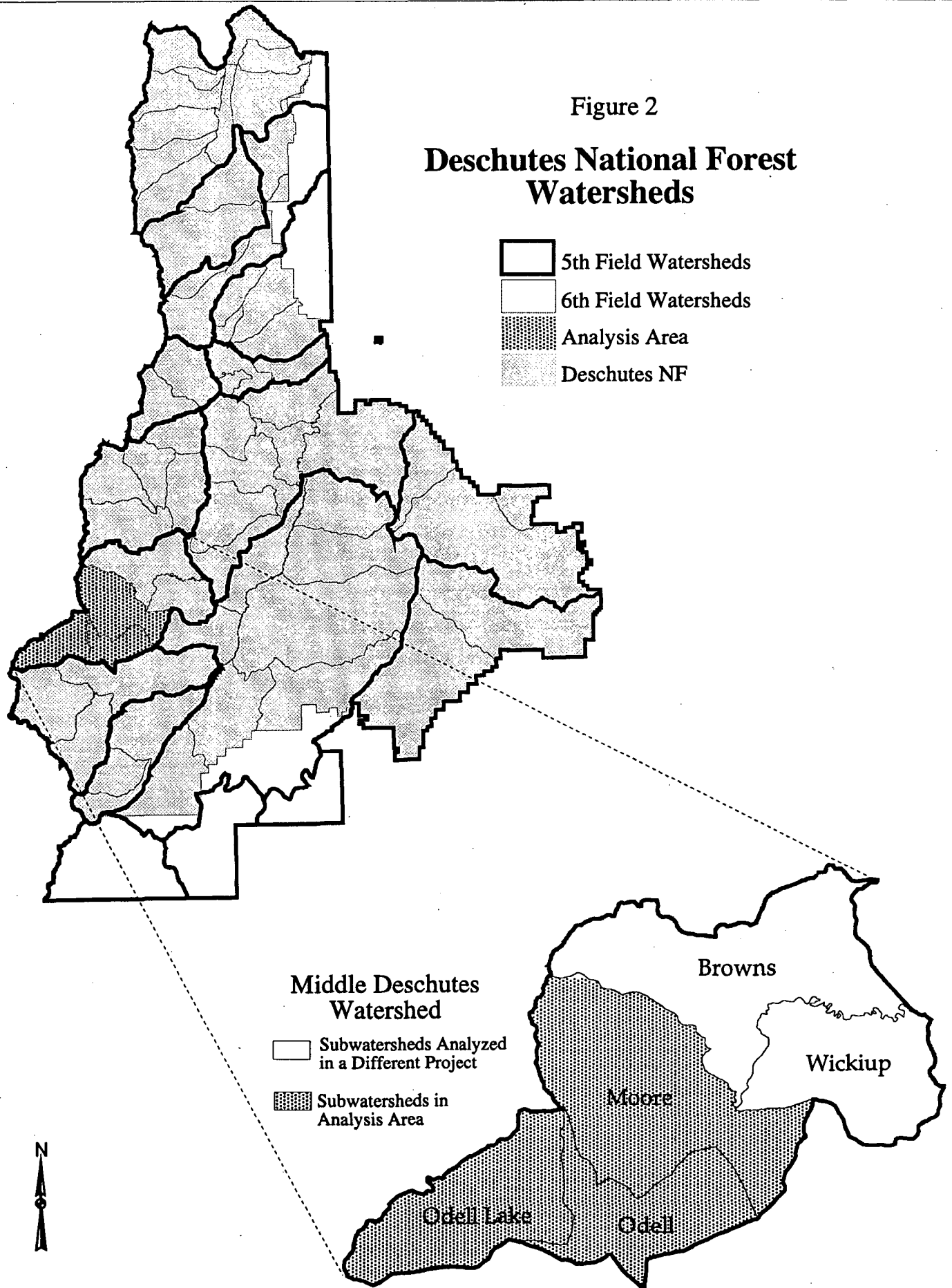


Figure 2

Deschutes National Forest Watersheds

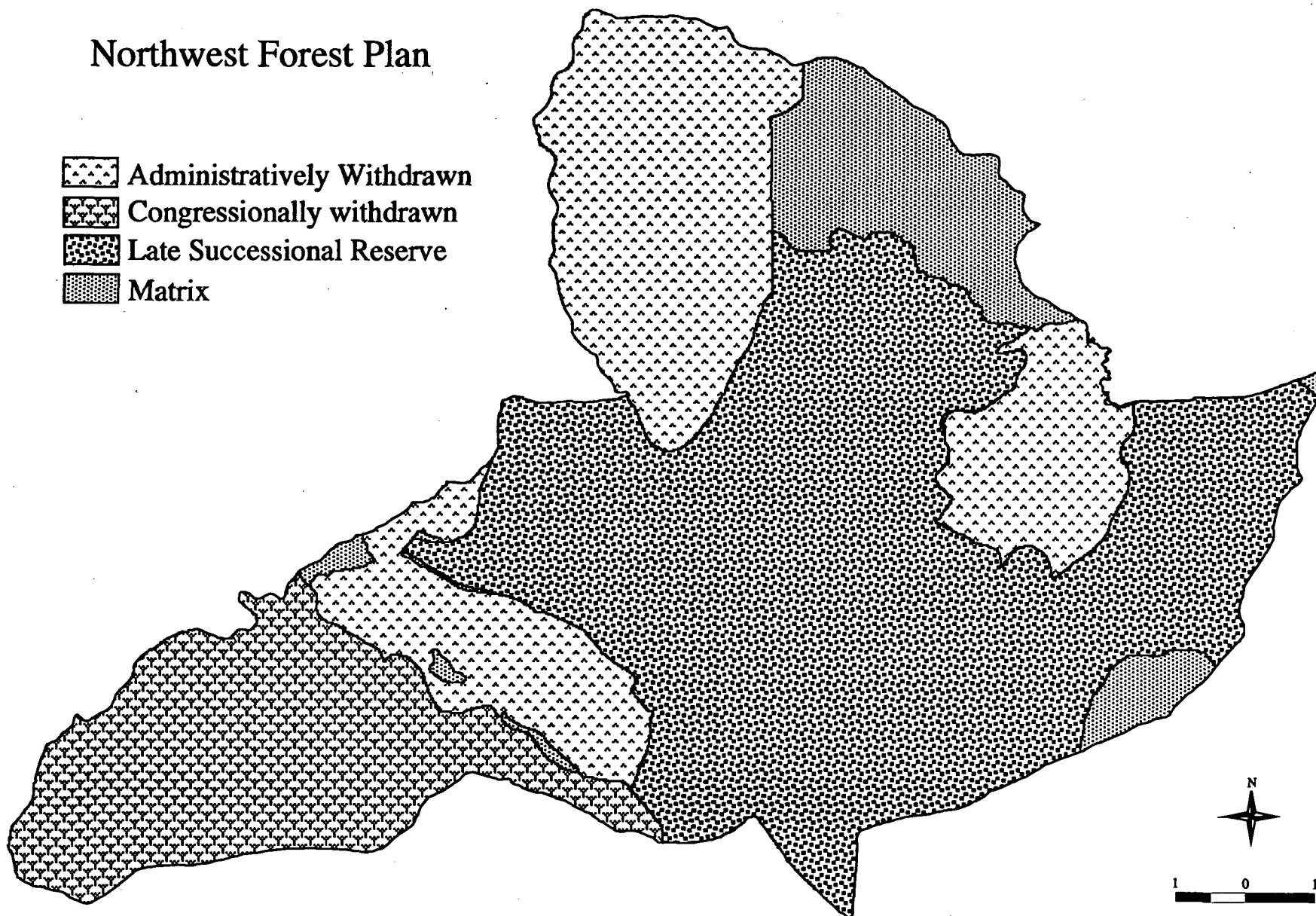


Odell Watershed Analysis Area

Figure 3

Northwest Forest Plan

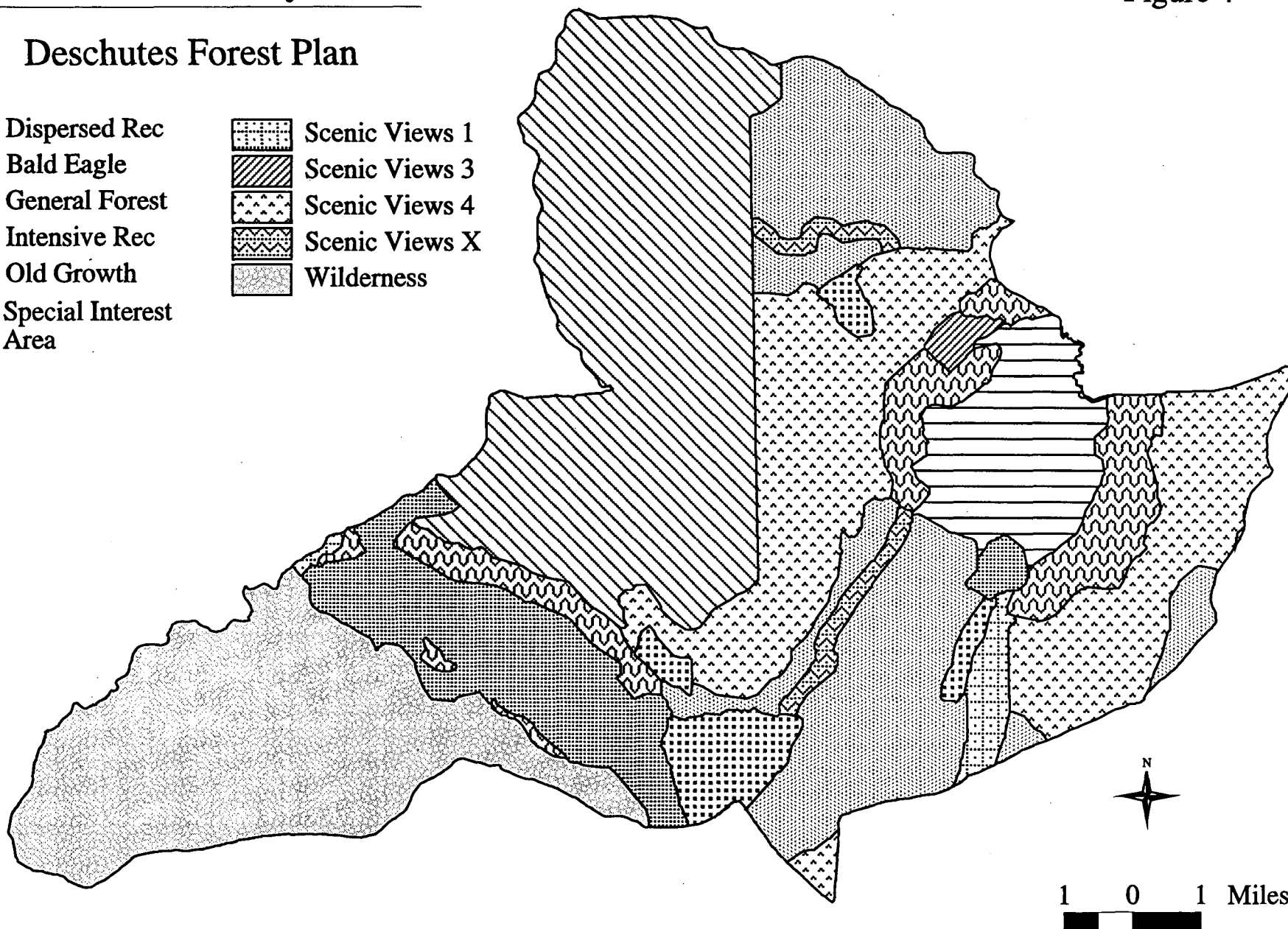
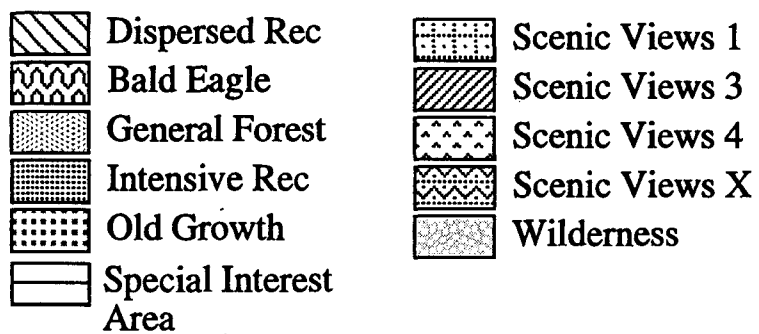
-  Administratively Withdrawn
-  Congressionally withdrawn
-  Late Successional Reserve
-  Matrix



Odell Watershed Analysis Area

Figure 4

Deschutes Forest Plan



ISSUES AND KEY QUESTIONS

The Federal Guide for Watershed Analysis, Version 2.2, outlines a six-step process for conducting watershed analysis. Step number two involves identifying issues and key questions for the watershed. By identifying issues, the analysis can be focused on the most important elements in the watershed. During this analysis the issues developed in 1994 were still considered to be relevant to the watershed. Discussions pertaining to the issues are within the three domain sections, e.g. the information regarding road density as it relates to the soils issue is within the Physical Domain section (p. 23).

The Federal Guide also provides core questions to help focus analysis on the following topics: Erosion processes, Hydrology, Vegetation, Stream channel, Water quality, Species and habitats, and Human uses. Through review of the issues, the interdisciplinary team determines the applicability of the core questions, and to what detail they need to be answered. Additional questions may also be formulated, depending on the issues involved. The questions used for focusing this analysis are included in each domain section, and under Synthesis and Interpretation.

Issues

Physical Domain

Soil Quality	
	Road Density
	Compaction and erosion in recreation areas
	Compaction from mechanized equipment
	Sensitive and low-quality soils
	Loss of organic material from skidding, piling, and machine planting
Water Quality	
	Effects of recreation and facilities
	Effects of increased burning program
	Odell Lake pH level

Biological Domain

Indigenous Fish	
	Viability of Populations
	Competition
	Habitat
Wildlife Habitat	

	Decline in Effectiveness
	Fragmentation
	Increase in human activity
Vegetation	
	Impacts of landscape disturbance events
	Processes of vegetative succession
	Fragmentation
	Retention of large-diameter trees
	Scenic quality
Noxious Weeds	
	Loss of diversity
	Competition

Social Domain

Special Forest Product Collection	
	Unknown impacts to biodiversity, TES species and Survey and Manage species.
Recreation Use and Experience	
	Easy access to wilderness and increasing use
	User group conflicts
	Increased pressure for commercial use
	Impacts caused by resource protection measures (i.e. displacement)
	Impacts to cultural resources

Physical Domain

The Odell Watershed analysis area extends from Diamond Peak north to Davis Lake and from Davis Lake west to the crest of the Cascade Mountains. The watershed covers roughly 75,000 acres and consists of three subwatersheds, Odell Lake Moore Creek (including the Davis Lake area) and Odell Creek which is designated as a Key Watershed. Refer to Figure 1 for the general location of the Odell watershed analysis area and Figure 6 for the water features.

Five subwatersheds comprise the Middle Deschutes Watershed: Odell, Odell Lake, Moore, Browns, and Wickiup. Only Odell, Odell Lake, and Moore subwatersheds are addressed in this analysis due to their unique hydrologic character, i.e. the lava flow which created Davis Lake prevents surface water exchange with the two remaining subwatersheds of the Middle Deschutes Watershed. There is some ground water correlation between the two portions of the Middle Deschutes Watershed, but it was decided that from a landscape analysis perspective (physical, biological, and social), the two areas were distinct enough that they could stand on their own for watershed analysis.

In the Northwest Forest Plan, Key Watersheds were selected which provide high quality habitat for at-risk stocks of resident fish species. They are to serve as refugia for maintaining and recovering habitat for these at-risk species. These refugia include areas of high quality habitat as well as areas of degraded habitat.

Climate and Weather

What are the dominant characteristics of climate and weather that influence hydrology, erosion processes and other components of the watershed?

The character of the Odell Basin has been influenced by changes in climate. Climate has changed from cold air masses that supported the formation of glaciers to more temperate, dry air masses. The changes in climate can be attributed to changes in temperature, the amount of precipitation, or, most likely, a combination of both.

Most of the precipitation results from low-pressure systems that approach from the Pacific Ocean on the dominant westerly winds. A large amount of moisture is accumulated by air masses as they pass over the Pacific Ocean. Before reaching the Odell Basin, the air masses must cross two mountain ranges, and in doing so, lose much of their accumulated moisture as precipitation. Thus, air reaching the basin is much drier than the original marine air. The drier air results in a modified continental-type climate.

A winter precipitation regime occurs within the Odell watershed analysis area. Based on data gathered from weather stations located in the analysis area approximately 55 to 65 percent of the total annual precipitation occurs between November and March, while only 8 to 12 percent occurs between June and August. Yearly totals rise sharply as elevation increases and decline dramatically with increased distance east of the Cascade Crest. For example, average annual precipitation totals range from 60 to 80 inches on the upper slopes of Diamond Peak to 22 to 26

inches on the surface of Davis Lake (a distance of less than 6 air miles east of the Cascade Crest). Snowfall generally amounts to 120 to 150 inches per year on the upper slopes of the basin and approximately 30 inches annually at the lower elevations. Normal weather patterns consist of wet and dry cycles. As an example, the Fremont station a few miles southeast of Crescent, has a mean annual precipitation of 10.50 inches (n=66) with a standard deviation of 3.46 inches. The maximum recorded annual precipitation which occurred in 1956 was 22 inches; the minimum recorded annual precipitation which occurred in 1955 was 4 inches.

There is cloud cover in the Odell Basin approximately 50 percent of the time. Since the clouds are generally patchy, sunshine is provided on most days. Temperatures are characterized by moderate days and cool nights. Elevation has a primary effect on local climate. Precipitation and snowfall increase and temperatures decrease rapidly as elevation increases on the mountainous areas (Franklin and Dyrness 1973). Summers are characterized by high-pressure systems which bring fair, dry weather for extended periods of time. Daytime temperatures rarely exceed 90° F in summer and typically do not drop below -20° F in winter. Daytime humidity levels in the summer average between 30 to 40 percent, although it is not unusual to have humidity levels of 10 and 20 percent during the day. Estimated lake evaporation ranges between 28 to 34 inches per year, and potential evapotranspiration varies from 20 to 30 inches. Winds are common on Odell Lake, since it is located adjacent to a low pass in the Cascade Mountains.

Air Quality

The air quality within the basin is excellent, since there are no major source polluters in the area, and the population base is small. The chemical composition of wilderness and backcountry lakes has been monitored, and no indicators of declining air quality have been found.

Many lichen species are considered to be sensitive air quality receptors. Lichen and moss communities can be found throughout the entire watershed in some form or another. These communities can be found in each of the plant association groups (PAGs), with significant overlap occurring between the PAGs. The presence of lichens and mosses is more a function of moisture and other environmental conditions than a function of vegetation types. Mosses appear to be limited in extent on the east side of the Cascades due to lack of moisture.

Baseline information has been collected on the lichen population within the Odell Basin. Through surveys and population monitoring it has been shown that a diverse lichen population exists within the watershed (18 species). Numerous lichen species are present that are considered to be sensitive air quality receptors. No moss surveys have been completed.

The lichen and moss communities in the watershed are believed to be comparable to what they were prior to the 1850s. Changes in population numbers and species diversity may have occurred in areas where fire historically played an active role in creating open patches in the landscape, which resulted in a greater percentage of vegetation in early structural stages. Lichen population density and diversity increase in later structural stages of vegetative development, since they tend to be slow growing. Due to fire suppression, lichen and moss abundance may have increased in late successional areas. Land management designations and continued fire suppression which

favor late structural stages of vegetation will allow for a high level of lichen and moss community habitat in those areas.

The primary threats to air quality within the watershed are from smoke (primarily from wood heat at summer homes and lodges) and vehicle emissions (primarily from vehicles on Highway 58). There is also the risk of smoke resulting from catastrophic wildfire which would affect air quality.

Air quality trends indicate that due to continued population growth in and around the area and increased traffic on all roads, air quality will slightly deteriorate over time. The primary cause will be from accelerated population growth. As Crescent Lake Junction and Oakridge continue to grow, more locally generated and imported pollutants are anticipated to reach the Odell Basin. The net effect may be a slight decrease in both diversity and abundance of lichens and mosses. The areas within the watershed managed for later structural stages of vegetation will provide improved habitat for these species, but may not be able to counteract fully the impacts of air pollution within the next century.

Geology

What are the dominant characteristics of geology that influence hydrology, erosion processes and other components of the watershed?

The Odell analysis area is part of three ecoregions at the subsection scale (1:250,000; see ecological unit classification April 1994). These ecosubregions are the Upper Cascades, Stratovolcanoes, and LaPine Basin (Figure 5).

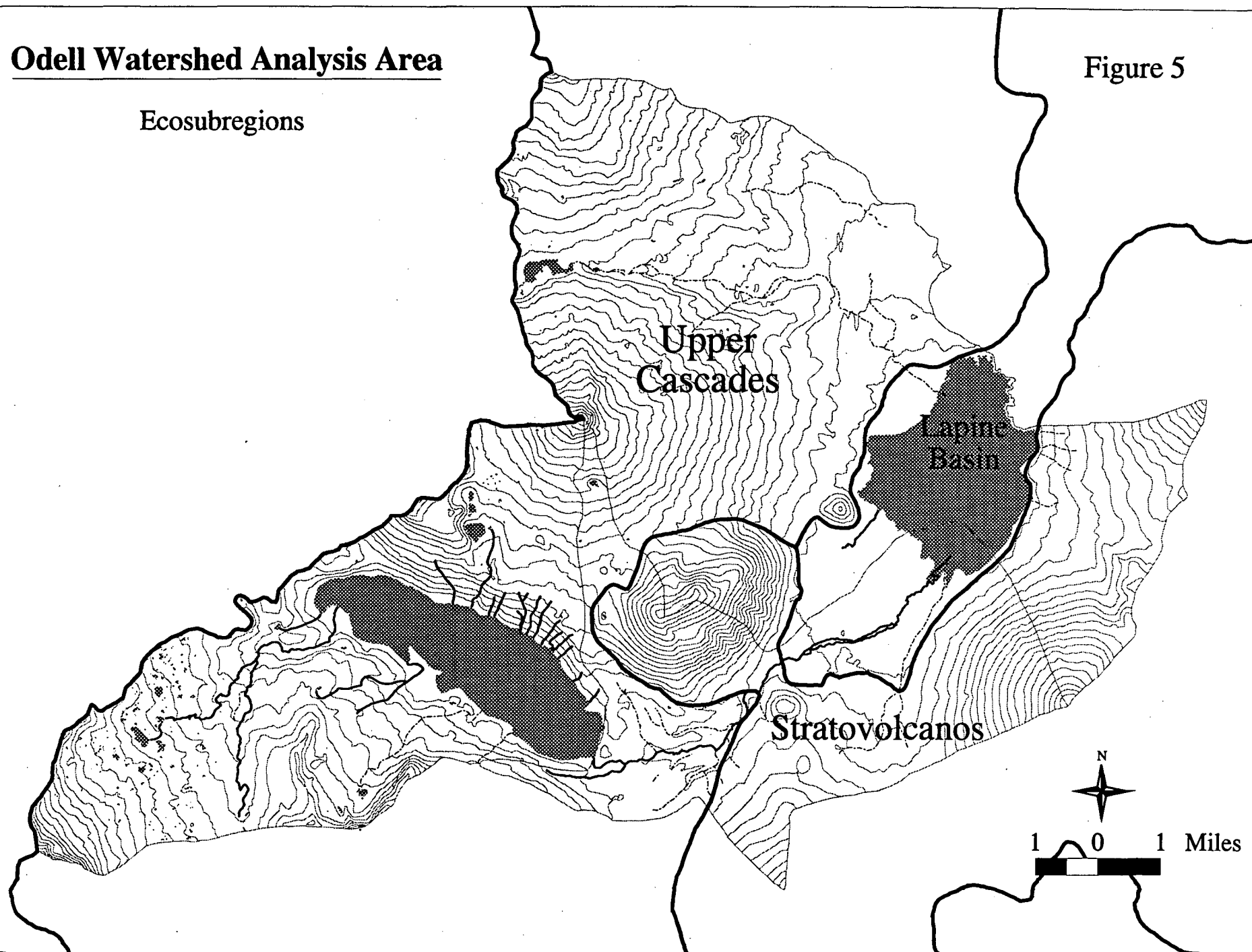
The western portion of the Odell watershed analysis area that is included within the Upper Cascades ecosubregion consists of basaltic andesite and basaltic eruptive complexes that form large, overlapping shield volcanoes. Large fields of lava are found around the bases of these eruptive complexes. Shield volcanoes include The Twins and Maiden Peak, estimated to be 100,000 to 200,000 years old, and Diamond and Lakeview Mountains, estimated to be 300,000 to 400,000 years old. These peaks and much of the lava around them have been eroded by glaciers. Since major ice ages come and go approximately every 100,000 years, the degree of glacial erosion aids in estimating the relative ages of these volcanic landforms. At lower elevations moraines have buried the volcanic landscape. Glacial landforms abound and include erosional features such as cirques, basins, valleys, and depositional features such as terminal, lateral, recessional, and ground moraines. Glacial deposits include angular to subrounded pebbles, cobbles, and boulders in a sandy to silty matrix.

The portion of the Odell watershed analysis area included in the Stratovolcanoes Ecoregion includes Maklaks Mountain, Royce Mountain, Hamner Butte, and Davis Butte. These older, isolated stratovolcanoes are stratified with layers of ash, cinders, scoria, and lava of basalt and basaltic andesite. Minor erosion has created small valleys and ridges on some of the slopes. Small cirques on Royce and Maklaks Mountains indicate that they have been glaciated on their upper, northern slopes. The ages of these volcanoes are not well-known but probably range from

Odell Watershed Analysis Area

Ecosubregions

Figure 5

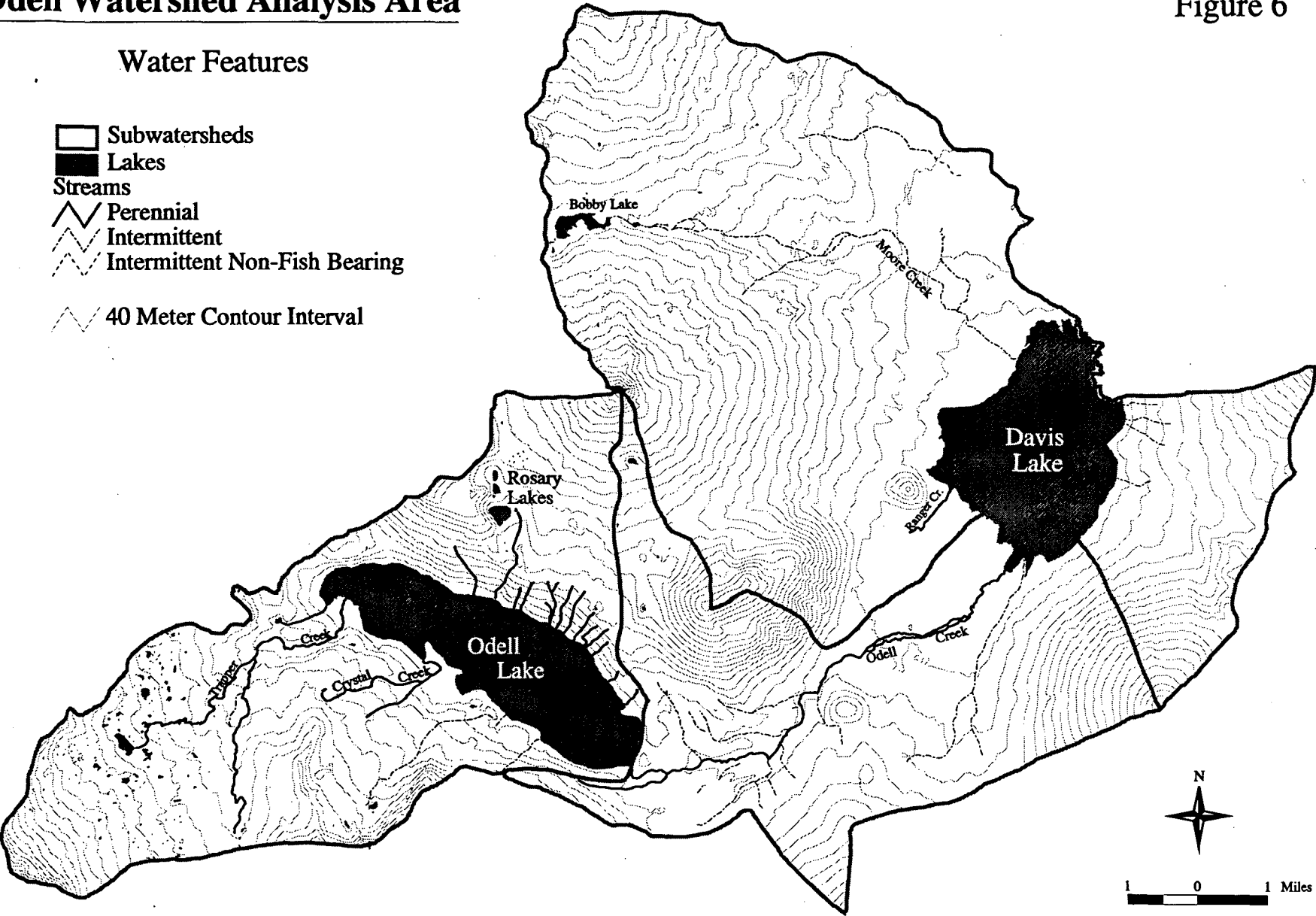


Odell Watershed Analysis Area

Figure 6

Water Features

- Subwatersheds
- Lakes
- Streams
 - Perennial
 - Intermittent
 - Intermittent Non-Fish Bearing
- 40 Meter Contour Interval



0.5 to 2 million years old. Some of these volcanoes are magnetically reversed, and the most recent reversal of the earth's magnetic field took place 780,000 years ago.

The LaPine Basin ecosubregion is part of a graben filled with up to 2,500 feet (760 m) of sediment. In the Odell watershed analysis area, older fine-grained sediments have been overlaid by a large fan of stratified glacial outwash that is greater than 40 feet (12 m) thick, which extends from its apex at McCool Butte to Davis Lake. Gravel sizes become progressively finer as the distance from the apex increases. Along Moore Creek immediately above Davis Lake, a fan of glacial outwash overlies lava.

The Davis Lake Lava Flow erupted approximately 5,500 years ago. The blocky, permeable flow dammed Odell Creek and created Davis Lake. The lake has no surface outlet, but instead drains through openings in the lava at about the rate of inflow from Odell Creek. Evaporation and local precipitation rates approximately cancel each other in the lake's water budget. Thick lake sediments at the bottom of the shallow lake consist almost entirely of diatoms and organic material. Odell Creek has contributed very little sediment into the lake. Around 6,700 years ago, the catastrophic eruption of Mount Mazama (Crater Lake) left a blanket of rhyolitic ash and pumice (20" to greater than 60" deep) over the entire landscape of the Odell watershed analysis area.

Soil Resource and Erosional Processes

Physiographic and Climatic Factors Influencing Inherent Soil Productivity

The soils in the high elevation mountainous areas are low quality due to the lack of nutrients and a short growing season.

Many areas of wet meadow, and high water table associated with riparian areas occur in the western half of the watershed and along Odell Creek. In addition the glaciation of the western half of the watershed has resulted in naturally compacted soils beneath the surface covering of Mazama pumice. This combination makes the soils of this area the most sensitive within the watershed.

The nature of the pumice soils in the area control the productive potential of the site. The soil thermal properties, with the poor ability to absorb and/or transmit heat leave low areas with a high frost potential and low regeneration success rates. There is also a lack of development due to the young nature of the pumice soils. Soil nutrients are concentrated in the surface 10 cm of soil with drastic reductions in nutrient content below that point.

The lava flow areas in the north central portion of the watershed are covered with varying depth of pumice and in several areas the pumice has been blown or eroded by water off of the lava ridges leaving areas of sparse soil and exposed lava behind.

The soil found on several of the buttes in the area differ depending on the coarseness of the particles, the length of soil development, the climate, aspect, slope gradient, and the vegetation and soil organisms operating on the site. These slopes are some of the most productive areas within the watershed.

The parent materials for the dominant soil types in this watershed are the airfall pumice and ash from the Mount Mazama eruption. The original thickness of this airfall deposit within the watershed ranged from about 16 inches (0.4 m) at the west edge (Cascade Crest) to about 60 inches (1.5 m) along the southeast edge (Royce Mountain and Hamner Butte). Particle sizes range from fine to medium sand sizes in the west, to coarse sand to small gravel sizes in the east. Since the eruption, the Mazama ash has moved considerable distances down the steeper slopes and formed thick wedges and aprons. Mazama ash has been stripped from many ridges and tops of buttes by erosion. On younger lava flows such as those north and northwest of Davis Lake, the ash has eroded off of projections and ridges of lava and accumulated in local depressions. The effect of this erosion is a more subdued, less hummocky landscape. Because the Davis Lake Lava Flow erupted after Mount Mazama, no ash is found on the lava or in the sediments of Davis Lake.

The glaciated portions of the watershed have fine sandy loam textured soils over compacted ground moraines. Here the older glacial material dominates water transport and plant growth in the area. Soil moisture regimes are Xeric in the basin and on the eastern edges of the watershed and Ustic in the more moist sections of the watershed. Soil temperature regimes range from frigid to cryic.

Soil Characteristics

Where are the sensitive and resilient soils located within the watershed?

What was the historic soil quality within the watershed and how does it compare to existing soil quality? What human and natural disturbances have impacted soil quality?

Historic Conditions

Parent material, climate, topography, organisms (both macro and micro flora and fauna) and time have worked together to establish the soil conditions found throughout the Odell watershed analysis area. High soil quality was defined as the ability to support sustained, vigorous and diverse ecosystems. This includes:

1. Sufficient vegetative cover to inhibit surface soil erosion
2. Soil organic carbon levels that have evolved over time due to natural processes
3. Soil physical properties that allow water and air movement into and through the soil profile and that facilitate biological activity

Other researchers (Doran 1994) have defined soil quality as a combination of physical, chemical, and biological properties. Soil quality describes how effectively soils:

1. Accept, hold, and release nutrients and other chemical constituents
2. Accept, hold, and release water to plants, streams, and groundwater

3. Promote and sustain root growth
4. Maintain suitable soil biotic habitat
5. Respond to management and resist degradation

The above are the functions of soils. Maintenance or enhancement of soil quality will protect or improve the soil's ability to carry out these functions. Many soil processes control the ability of a soil to function adequately. These include, among others:

- Erosion
- Nutrient Cycling
- Water Cycling
- Soil Formation

Many components are involved in the above processes. It was felt that these are the dominant processes that affect changes in the ecosystem. By accelerating, decelerating, or truncating any one of these processes, an impact on the ability of the soil to function adequately can be assessed.

A map of inherent (or historical) soil quality was created utilizing the plant association groupings for potential natural plant communities that were developed by the assessment team. The delineation of soil quality was based on the assumption that the most productive sites result from a variety of soil forming factors; in addition, the quality of the soil can be expressed by the plants that have the potential to grow on a site. The accompanying map indicates historic soil quality, Figure 8. The delineation of high, moderate and low soil quality is based on the following groupings of plant associations:

Table 3. Soil Quality and Associated PAGs

Soil Quality	Potential Natural Plant Community
High	Mixed Conifer Wet
	Meadows
Moderate	Mixed Conifer Dry
	Mountain Hemlock
	Lodgepole with Mountain Hemlock
	High Elevation Lodgepole
	Lodgepole Moist/Wet
Low	Lodgepole Dry
	Ponderosa

Current Conditions and trends

Harvest, reforestation and fuel treatment activities have been concentrated in the eastern half of the watershed and on the younger shield volcanoes. These activities have left much of the area compacted and resulted in a loss of hydrologic function due to reduced infiltration (water movement into the soil) and percolation (water movement through the soil) of water. Many activities have also removed all or a portion of the nutrient and biologically rich surface soil horizons. Both of these trends have reduced the soil quality and the ability of the soil complex to function in the most productive manner to enhance vegetative growth.

Recreational activities and user-created roads have concentrated around water and riparian areas. As a result soil has been compacted and erosion and loss of vegetation is apparent in several areas (e.g. north and west sides of Davis Lake, Ranger Creek, and Odell Creek). A by-product of soil loss through erosion is the loss of archaeological (subsurface) materials and context within their original depositional settings. Numerous examples of this are evident in campgrounds and dispersed sites where archaeological sites are also present, typically around water and riparian areas. (See a discussion of this trend in the "Social Domain" section).

In addition to an assessment of the historic soil quality, an assessment of the sensitivity of each soil mapping unit to erosion, nutrient loss, and compaction was made. The sensitivity rating was based on inherent soil properties. The Soil Resource Inventory (SRI) for the Deschutes National Forest completed in 1976 was the source of most of the basic soil property information utilized in this assessment. The most accurate information applies to the eastern portion of the watershed which had been designated "General Forest" area by the Deschutes Land and Resource Management Plan (LRMP). The intensity of and, therefore, the reliability of the inventory decreases in areas designated as "Wilderness" or "Dispersed Recreation". See Figure 4 for a map of the LRMP designations. The only area that was determined to be not accurately depicted, even in a general sort of way, is north of Davis Lake where the SRI shows the area of glaciation and glacial outwash (SRI Landtype 25). Lava is the dominant in this area, not glacial outwash

Data from the SRI were incorporated into a database to facilitate an evaluation of the susceptibility, resiliency, and overall sensitivity of each soil mapping unit delineation to the forces of erosion, nutrient loss, and compaction. (See Appendix B - Soils, Tables 1-6 for factors used to make this determination.) From that assessment, a map of overall sensitivity of the soils in the watershed was created. Soil mapping units were grouped into low, moderate, or high sensitivity (See Appendix B - Soils, Tables 7-9 for classification of each mapping unit). Some mapping units are complexes of several mapping units and those sensitivities are reflected by the individual values for each separate mapping unit component i.e. low/high or low/moderate designations.

The watershed has 46% of its area with highly sensitive soil properties, 29% has a moderate sensitivity, and 25% has a low sensitivity. The location of sensitive soils is depicted in Figure 7. Knowing a soil's sensitivity class can be used to determine effects to soil quality from various resources activities or ground-disturbing activities.

Most of the areas that are highly sensitive include places where there are harsh climatic conditions and the period of biological activity is short. Higher sensitivity ratings also can be found in areas of the watershed where there are finer soil textures and few coarse fragments to resist the impacts. In the glaciated portion of the watershed, the depth to a restrictive layer, either rock or compacted till, restricts rooting depth and results in less resilience and, therefore, higher sensitivity ratings.

The soils in the analysis area are highly susceptible to the loss of nutrients. This is due to the ease of soil displacement, which results from the lack of soil structure. The surface textures are coarse and occur as individual particles. Organic debris and litter on the surface of the soil decrease the susceptibility to nutrient loss. Carbon concentrations in the top 30 centimeters, depth of rooting,

Odell Watershed Analysis Area

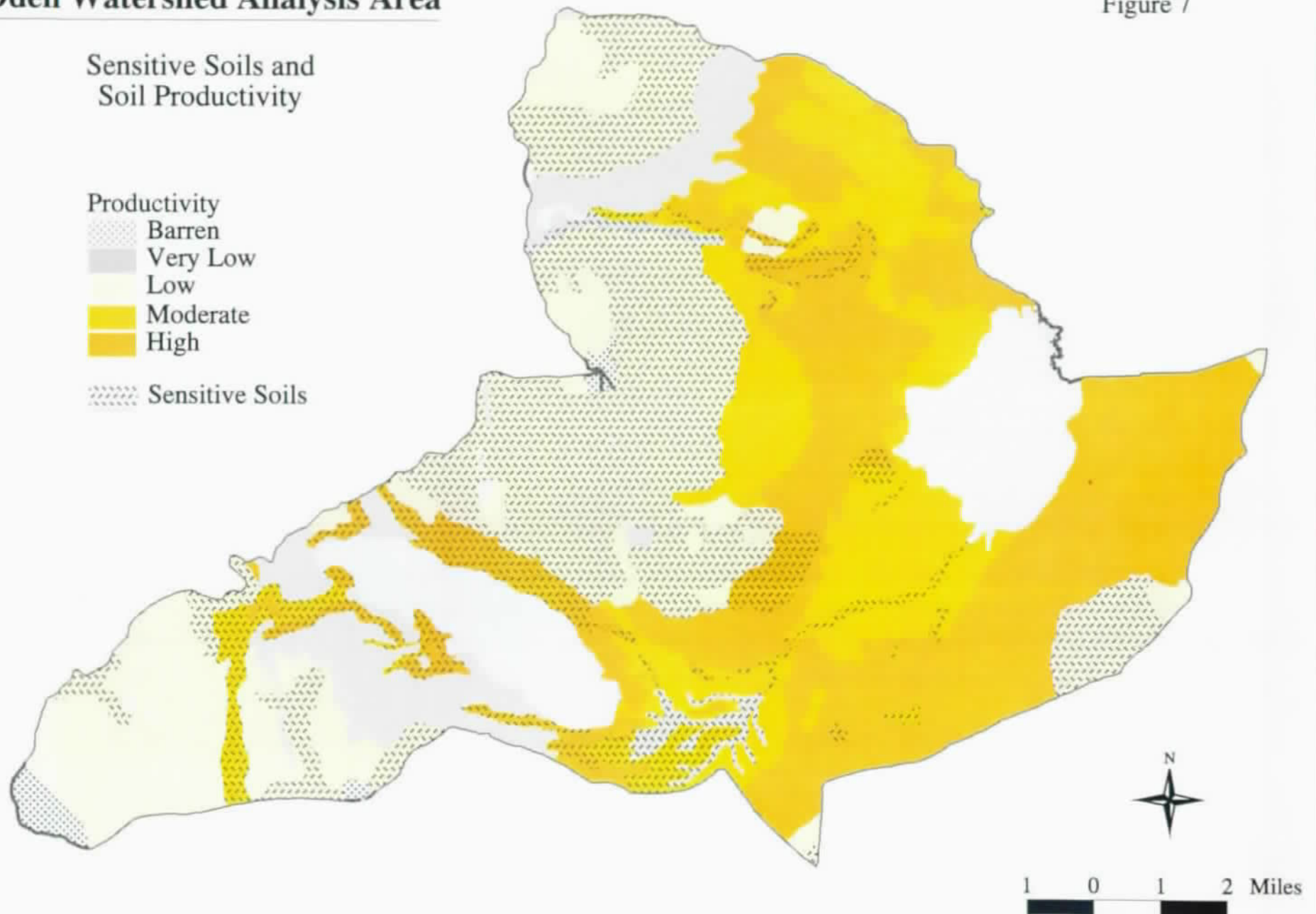
Figure 7

Sensitive Soils and Soil Productivity

Productivity

- Barren
- Very Low
- Low
- Moderate
- High

Sensitive Soils



and soil texture all help to determine a soil's resiliency to nutrient loss. In the analysis area most of the soils have little ability to restore soil conditions once nutrient loss has occurred.

The soils in the Odell watershed analysis area are highly to moderately susceptible to compaction depending predominantly on the soil texture, the amount of cobbles and stones, and the amount of carbon in the top 30 cm of soil. Due to frost heaving of the top 4-6 inches of soil, compaction can be alleviated on the surface over time. Below that depth, however, these soils have a low to moderate ability to restore infiltration and aeration features of the soil profile once detrimental soil damage has occurred.

Soil Condition Class

A determination of the detrimental impact that has occurred due to past management activities in the watershed was made. Definitions of a detrimental soil condition come from the Forest Service Manual 2520.13. An aerial photo analysis was undertaken in 1994 (USDA, 1994). Through that analysis, with some ground verification of results, it was determined that on the portion of the watershed where the majority of management activities have occurred (i.e. watershed acres minus large water bodies, dispersed recreation, and wilderness), the following percentages of detrimental soil condition were found:

46% in Condition Class A = < 11% detrimentally impacted

19% in Condition Class B = 11-20% detrimentally impacted

18% in Condition Class C = 21-40% detrimentally impacted

17% in Condition Class D = > 40% detrimentally impacted

When the detrimental soil condition analysis is determined over the entire watershed acreage, including lakes, wilderness and dispersed recreation areas, the following percentages of detrimental soil condition were found:

69% in Condition Class A = < 11% detrimentally impacted

11% in Condition Class B = 11-20% detrimentally impacted

10% in Condition Class C = 21-40% detrimentally impacted

10% in Condition Class D = > 40% detrimentally impacted

The quality of the soil resource has been decreased on 7,267 acres, 11% of the watershed, by activities that detrimentally impact the soils.

The existing soil quality is a combination of the historic soil quality, the sensitivity of the site (ability to resist change combined with the ability to self-restore), and the degree of detrimental impact imposed on that site by human activities. A spatial depiction of the existing soil quality is in Figure 10. The following chart was used to assess changes in soil quality:

Table 4. Changes in Soil Quality

Historic Soil Quality	Sensitive*	Detrimental Condition Class+	Existing Soil Quality
High	No	A, B, C	High
		D	Moderate
High	Yes	A, B	High
		C	Moderate
		D	Low
Moderate	No	A, B, C	Moderate
		D	Low
Moderate	Yes	A, B	Moderate
		C, D	Low
Low	No	A, B, C	Low
		D	Very Low
Low	Yes	A, B	Low
		C, D	Very Low

* Sensitive ratings are as follows:

Yes – if the individual sensitivity was low-high, medium, medium-high, or high.

No – if the individual sensitivity was low or low-moderate.

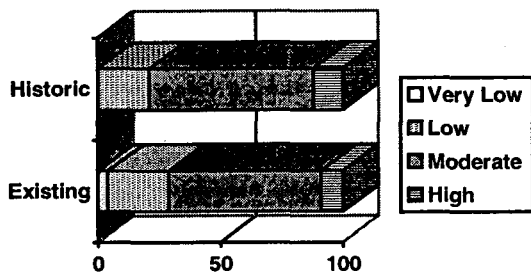
+ Detrimental Condition Class implies the percentage of soils detrimentally impacted.

A = ≤ 10%; B = 11-20%; C = 21-40%; D = > 40%

The table below show the changes between historic and existing soil quality.

Table 5. Soil Quality

	Very Low	Low	Moderate	High
Historic	0%	21%	67%	12%
Existing	4%	25%	62%	9%



System roads occupy 0.83% of the total watershed and 1.27% of the portion of the watershed that has had the majority of management activity. 30% of this road network has been closed by blocking entry or allowing natural succession processes to proceed on these compacted surfaces. No road obliteration (defined as restoring the hydrologic function of the area) has occurred in the area. Sediment delivery to the water network has been identified as a pollution source of concern in the watershed. Half of the watershed is roaded. In a small portion of the watershed, road densities exceed 10 miles per square mile. This road network has disrupted the hydrologic function of that land base (e.g. Maklaks and Royce Mountains and Ranger and McCool Buttes).

It was found during this analysis that the skid trail systems from past harvest activities are often acting as ephemeral stream channels and conducting water to the system roads. Evidence of this occurs in areas where sideslopes exceed 15%. This results in erosion not only on the skid trail but also on the road prism and displacement of sediment from the road to the forest below where it is deposited. In many cases the erosion is deposited in stream channels that only flow during extreme storm events. Nevertheless, conditions are being established where those landscape altering events could transport a substantial accumulation of material that is unconsolidated and readily moved with those storm flows.

Skid trails, logging, and post harvest (mechanized) fuel reduction and other treatments have caused the majority of the detrimental soil condition by displacing organic material, litter, and the nutrient-rich surface soil horizons and by compacting the soil. As mechanized harvesting was introduced in the 1980s, more soil was compacted by heavy equipment operation, since equipment made several passes over the same ground to access timber. These sort of ground-disturbing activities have caused the shift in soil quality from historic to existing, as shown in Table 4, page 22.

Machine planting operations also degraded soil quality by removing large and fine organics and surface soil horizons during the planting operations.

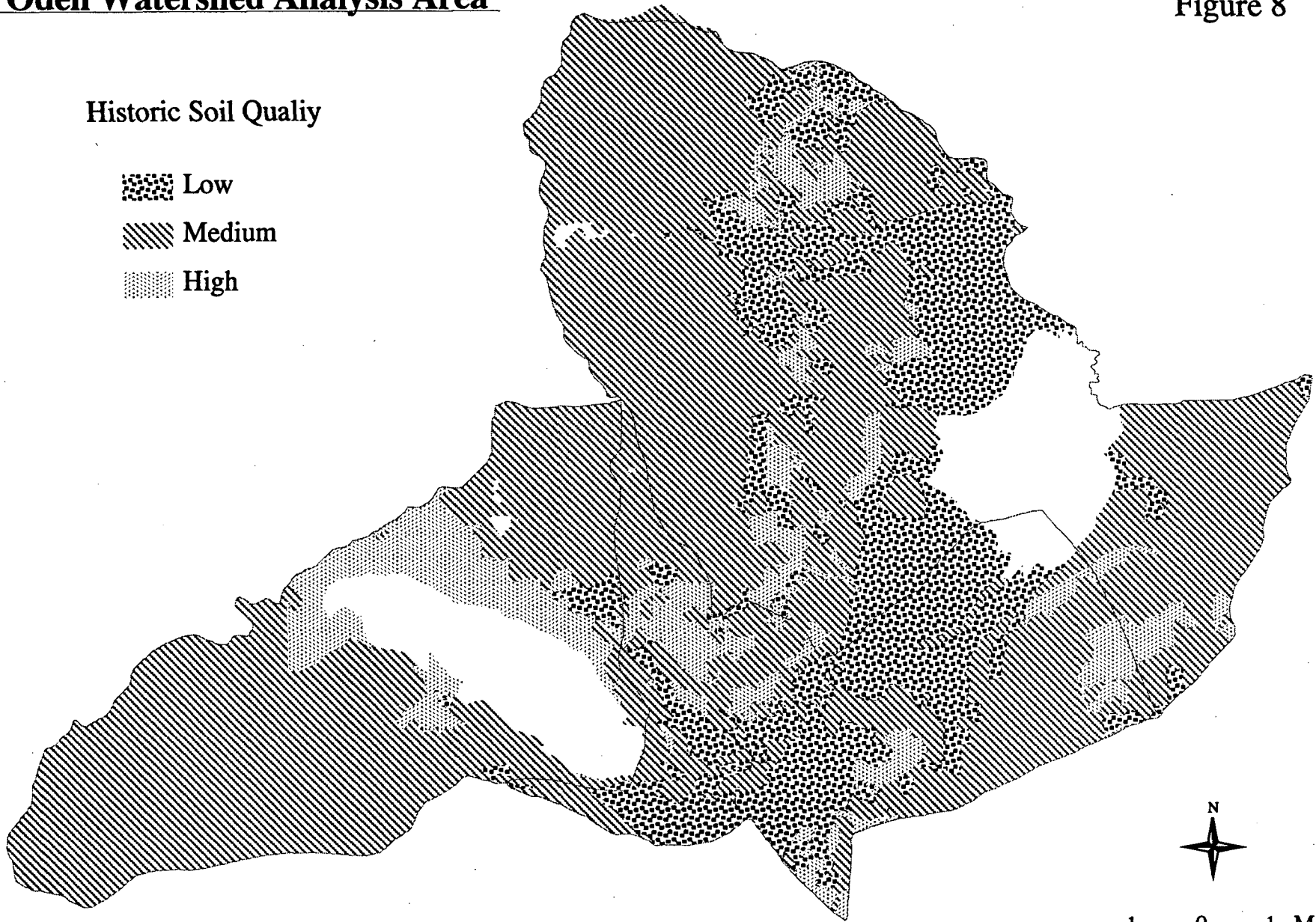
Prescribed fire, which has been utilized as a management tool in the northeast portion of the watershed, was not considered to cause detrimental soil conditions. The burns left behind surface litter and covered the area in mosaic patterns. Burning of slash piles, however, significantly reduced the soil organic matter component immediately under the slash piles.

Odell Watershed Analysis Area

Figure 8

Historic Soil Quality

-  Low
-  Medium
-  High



1 0 1 Miles

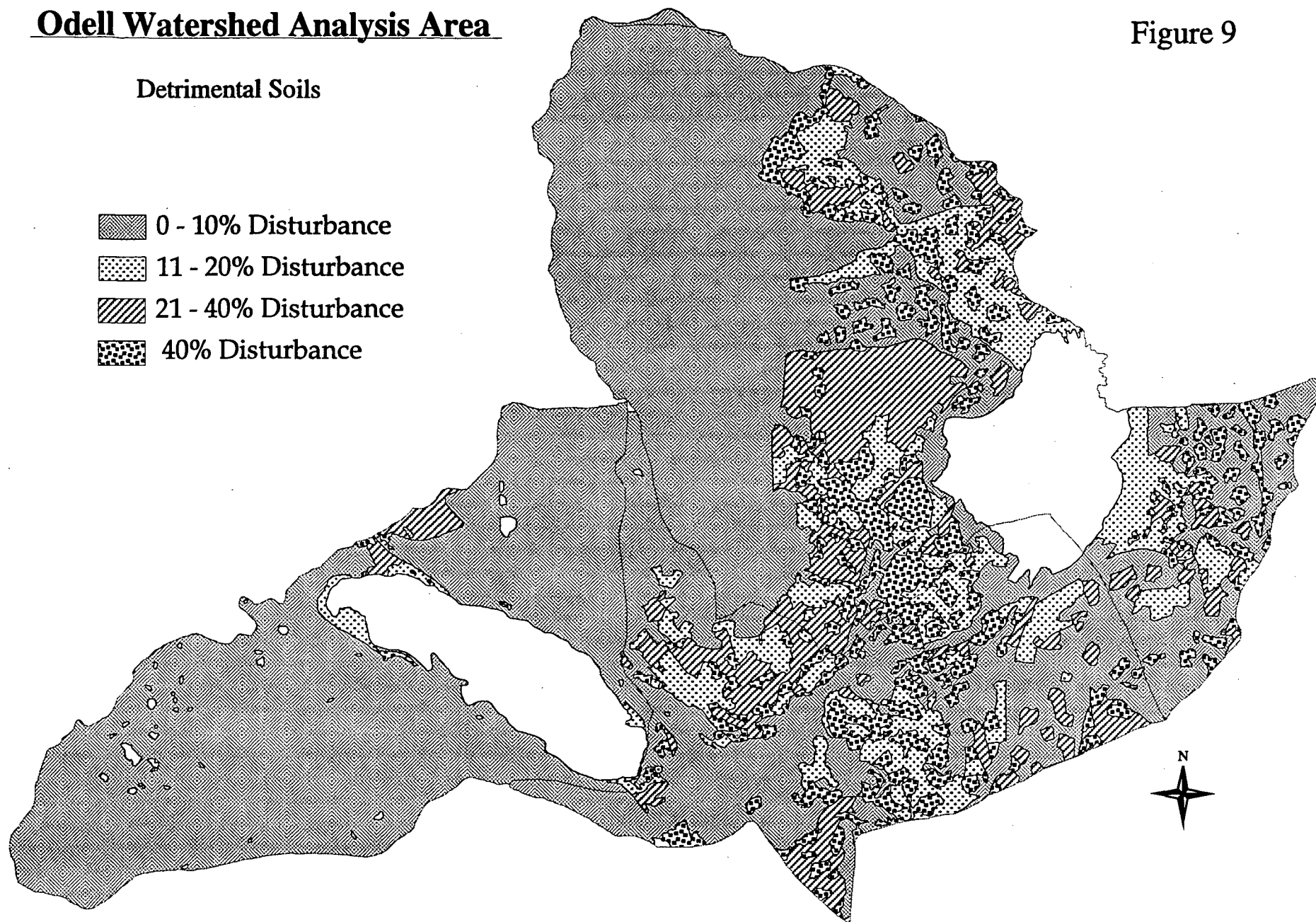


Odell Watershed Analysis Area

Figure 9

Detrimental Soils

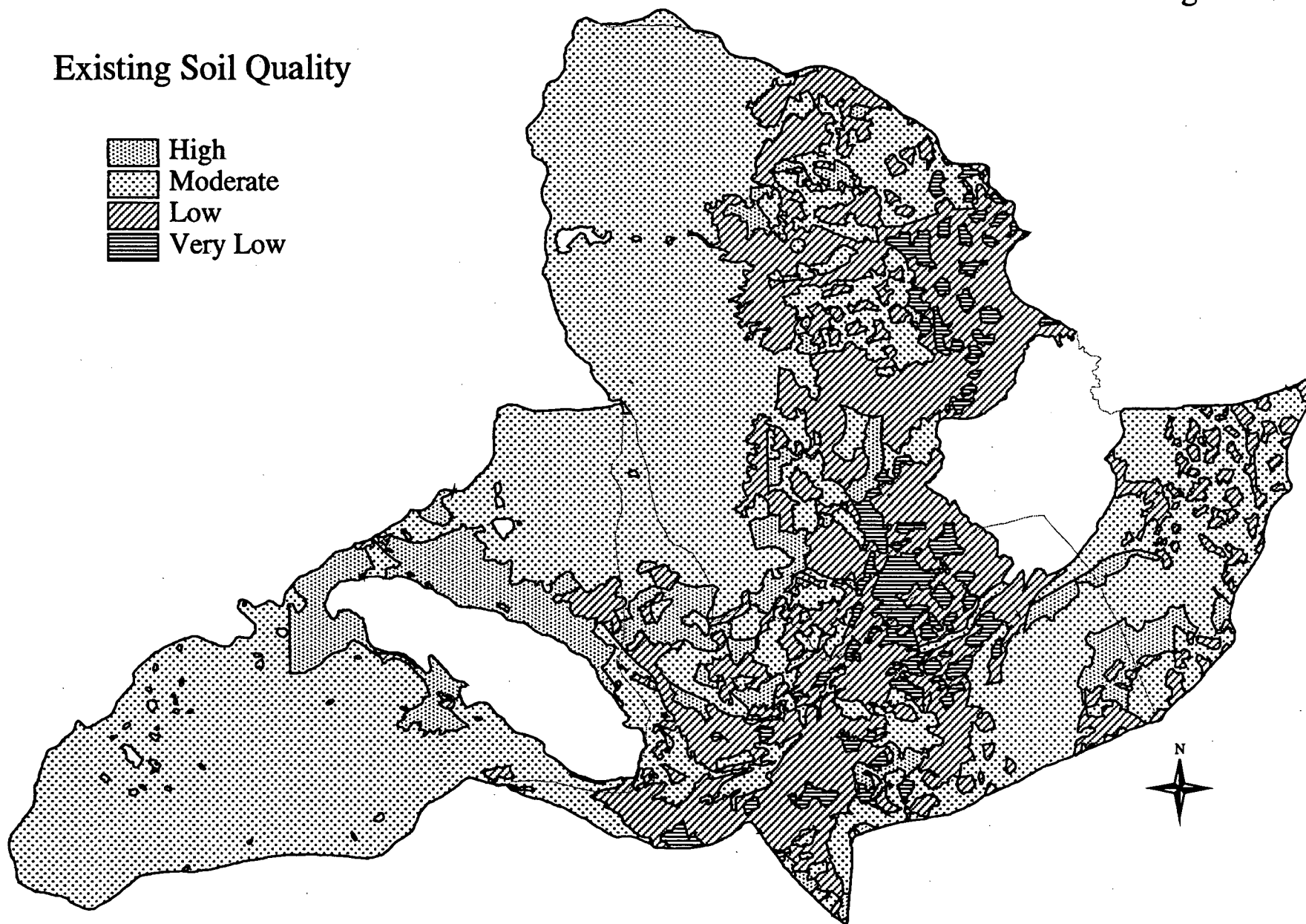
-  0 - 10% Disturbance
-  11 - 20% Disturbance
-  21 - 40% Disturbance
-  40% Disturbance



Odell Watershed Analysis Area

Figure 10

Existing Soil Quality



Erosion Processes

What are the historical erosion processes within the watershed (surface erosion processes, mass wasting) and where have they occurred?

What erosion processes are dominant with the watershed (surface, mass wasting, etc)? Where have they occurred and where are they likely to occur?

What are the current conditions and trends of the dominant erosion processes prevalent in the watershed?

Historic Erosion Processes

Erosional processes within the analysis area were primarily surface in origin, although some slopes in the upper portions of the Odell Watershed analysis area are steep enough to exhibit mass wasting. Landforms and cyclic climatic patterns probably generated rain on snow and thunderstorm events that accumulated significant overland flows capable of eroding the low cohesion soil materials on the surface. Slope stability within a given subwatershed was primarily influenced by the level of fire disturbance that had occurred in the years prior to a significant rainfall run-off event, most notably the extent of surface mineral soil exposed as a result of biomass consumption from fires. Although fire was a part of all the plant associations within the watersheds, the frequency and behavior of these events varied enough to provide different degrees and extents of slope susceptibility to erosion.

Natural fire cycles in the mixed conifer, lodgepole, and mountain hemlock plant associations often led to stand replacement fires capable of consuming a majority of live and dead organic matter on the soil surface. These conditions left bare mineral soil susceptible to wind and water erosion in the years following a fire. Fire cycles within the ponderosa pine plant associations were likely lower intensity fires that occurred at a return interval of 5 to 20 years. Fire in ponderosa pine areas generally did not consume all of the organic cover on the soil surface which resulted in less bare mineral soil and less erosion.

Current Erosion Processes

Erosional processes within the Odell watershed analysis area are primarily surface in origin. Summer thunderstorms and rain on snow events can produce sediment transport despite the rapid infiltration rates of the surface mineral soil component. Infiltration rates are offset in part by the low cohesion properties of the ash and pumice mineral soil. Soil particles are readily detached by raindrop impact and overland flow energies, especially in areas where bare mineral soil is exposed and slopes and impervious litter layers contribute to overland flow accumulations and rates. Rain on snow events and high intensity summer thunderstorms are the primary mechanisms for sediment transport in the analysis area. Natural erosion rates have been accelerated in the managed portion of this analysis area through such activities as road construction, timber harvesting, dispersed recreation, ORVs, etc.

Hydrology

What are the dominant hydrological characteristics (discharge, peak flows, minimum flows) and other notable processes or features (cold water seeps, ground water recharge areas)?

What are the historic hydrologic characteristics (discharge, peak flows, minimum flows) and notable features (cold water seeps, ground water recharge areas)?

What are the current conditions and trends of the dominant hydrologic characteristics and features in the watershed?

The beneficial uses of water identified by the Oregon's Water Quality Standards for the Odell watershed analysis area are resident fish, aquatic life, domestic water supply, water contact recreation, and aesthetic quality. Beneficial uses most sensitive to activities associated with forest management are those related to aquatic biota and human use. Water temperature, dissolved oxygen, turbidity, sedimentation of bed materials, channel and pool parameters, large woody material, and biological criteria are factors used to determine the health of this watershed.

Historic Condition:

The Davis/Odell Lake watershed drains approximately 75,075 acres, contains sixteen named lakes, as well as numerous other water bodies less than five acres in size, and seven fish bearing streams. (Figures 3 and 5) The water resources within the Odell watershed analysis area include an abundance of small lakes in the headwater area above Odell Lake, springs and small streams that flow into Odell Lake, Odell Lake itself as the main water supply source for Odell Creek, several small tributaries to Odell Creek along its traverse to Davis Lake, and two creeks and several small intermittent drainages feeding Davis Lake. Davis Lake may provide the water source for the springs located in the Davis arm of Wickiup Reservoir. This hypothesis cannot be tested until the routing times through the fractures in the lava are known or measured.

Due to both the porosity of the glacial outwash and the Mazama ash that blanketed the area, surface creeks and/or any expression of surface runoff are rare to nonexistent over much of the lower basin. The volcanic cones are also comprised of very porous materials which exhibit little to no drainage pattern, and, consequently, no streams flow over this landscape. As a result, over two-thirds of the Odell Basin acts like a sponge, absorbing water, from precipitation and releasing its water throughout the year in the form of springs. This hydrologic generalization is applicable throughout the area with the exception of the glacial till zone which includes the portions of the wilderness that drain into Odell Lake.

Bobby, Yoran, and the three Rosary Lakes are headwater lakes having drainage basins less than 5,000 acres in size. These lakes have little effect on the routing time of rainfall or snow melt within the basin.

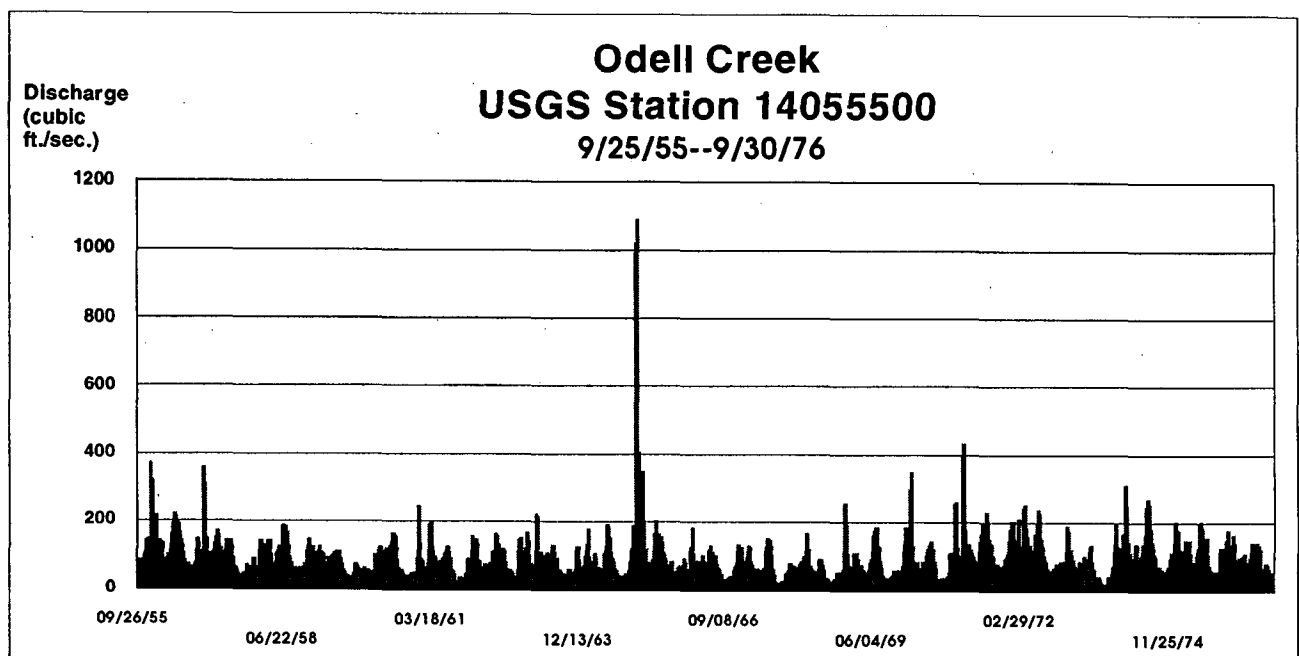
Odell Lake, fed from headwater lakes, springs and small streams, is 3,600 surface acres in size and is recognized as one of the largest lakes in the Oregon Cascades. Odell Lake has a deep,

elongate lake basin with steep sides that was formed by glaciation. A terminal moraine blocks the lake outlet on the eastern border. Odell Lake has a maximum depth of 282 feet and average of 132 feet, with only a small percentage of the lake having a depth less than 10 feet. Little growth of aquatic macrophytes occurs in the lake, since there is a limited amount of rocky shoreline and shallow water. The deep water in the lake remains very cold (39° F) throughout the year due to the depth of the lake and its elevation (4,787 feet). The lake occasionally freezes over during the winter. The water column in summer develops a pronounced thermal stratification.

Trapper Creek drains the glacial till zone and is the lone tributary into Odell Lake that responds directly to runoff generating events.

Odell Creek which is approximately seven miles in length, collects several small tributaries before reaching Davis Lake. The creek is confined for nearly half of its length by recessional moraine features, while the remainder lies in a glacial outwash plain. Odell Creek historically flowed directly into the Deschutes River prior to being dammed by the Davis Lake Lava Flow. The creek's discharge is determined, for the most part, by the outflow of Odell Lake.

Maklaks Creek, the perennial tributary to Odell Creek provides an important cold water source. This cold water reduces the temperature of Odell Creek downstream of its confluence with Maklaks Creek. Above the confluence, the water temperatures are warmer, since the flow of Odell Creek is derived from the warmer surface water temperatures of Odell Lake. Odell Lake's surface water temperatures can exceed 65°F, which is above the desirable temperatures for salmonids. The range and frequency of Odell Creek's discharge have been well documented (USGS, 1999). Flows range from 9 cubic feet per second (cfs) to 1,100 cfs. Approximately 50% of Odell Creek's runoff occurs during two peak periods, December to January and May to June. The base flow period takes place during August and September, when less than 10% of the runoff occurs.



Groundwater in the McCool-Davis outwash fan lies more than 30 feet (9 m) below Odell Creek in the upper part of the fan. In the lower part, the level of Davis Lake approximates the level of groundwater. Water from Odell Creek percolates into the sand and gravel of the fan. Thin, nearly impervious silt layers within the fan apparently act to perch infiltrating surface water. Along Odell Creek these layers are essentially nonexistent at the head of the fan but increase toward Davis Lake and probably account for the increasing downstream amount of riparian vegetation.

Davis Lake, whose size ranges from 40 to 3,000 acres, is the terminus of the water supply in the Odell Basin. It receives its water supply from two creeks and several small intermittent drainages. Water levels fluctuate greatly on an annual basis. Davis Lake can be reduced to approximately 40 surface acres in size during the fall of the year. Its outflow is controlled by "leaks" in the lava along the northeast shoreline and bottom of the lake. Due to its shallow nature, 10 to 20 feet in depth, temperatures in Davis Lake can rise above 70° F over much of the lake body during mid to late summer.

In addition to the major lakes and fish bearing streams, there are numerous other water bodies (seasonal and perennial) within the watershed that support macro invertebrates, phytoplankton and zooplankton species, crustaceans, and provide habitat for amphibians. Information on the aquatic organisms inhabiting the smaller seasonal water bodies is limited to anecdotal information.

Current Condition:

Hydrologic Disturbance

Changes in evapo-transpiration rates, peak flow volume and peak flow duration, which may result from management activities, can potentially alter stream channel stability and sediment transport capability. Stable stream channels are capable of transporting sediment supplied from the contributing watershed. Over time, stable channels maintain their beds and banks, and do not experience net erosion or deposition. Shifts in evapo-transpiration rates and/or detectable water yield increases may have the potential to make stream channels less stable. Management activities (e.g. conifer removal, road construction/reconstruction, prescribed or wild fires, etc.), may also result in a reduction in the inherent productivity of a site (e.g. as a result of soil displacement, erosion, compaction, nutrient cycle alterations, etc.). Proposed activities in conjunction with past activities may have an effect (positive and/or negative) on watershed condition and integrity.

Research by Cheng (1989) and King (1989) found that when a watershed approached 25 to 30 percent clearcut, changes in peak flows were documented. With this change in peak flows, there is the potential to alter stream channel stability and the amount of sediment being transported.

Research by Troendle et. al. (1998) found that when a watershed approached 25 percent clearcut, changes (reductions) in net evapo-transpiration resulted in higher seasonal streamflows (mainly May and June during the period between April and October), and that the duration of higher, near bankful discharges were extended. With this change in seasonal streamflows and particularly in the extended duration of near bankful discharges, the result is an increase in sediment production from channel scour.

Recovery time is determined by the age of the activity that modified the vegetation on a site (e.g. timber harvest, wildfire, etc.). Based on experimental results from the Fool Creek watershed in Colorado (Alexander and Watkins, 1977), maximum water yield increases were sustained for 15 years after treatment. A linear decline was assumed for the next 45 years until pre-harvest levels were reached. Effects from roads would remain as long as the road was present and non-vegetated. Other studies have shown a longer time interval to reach pre-harvest levels. For this exercise a 60 year recovery period was used to determine the amount of area recovered from past manipulations (from GIS data base). This results in an approximate 1.67% annual recovery from the time of the manipulation until age 60 when it would be back to pre-harvest conditions.

Hydrologic disturbance was calculated by taking the amount of area that has been disturbed (modified by a coefficient based on the amount of basal area removed) within a subwatershed and factoring in recovery (based on when the manipulation occurred).

Calculated hydrologic disturbance for the three subwatershed within the analysis area:

- Moore: 15%
- Odell: 13%
- Odell Lake: 1%

Riparian Health

Floodplain function and the quality of the riparian vegetation have been maintained in over 99% of the watershed. The basin is in excellent shape, except in localized recreation sites where human influences have altered both form and function of riparian and floodplain areas. Vegetation in these areas has either been destroyed or trampled, and the moist soils have been compacted. Riparian vegetation has also been adversely altered or destroyed in the high concentration use zones (resorts and campgrounds). The stream banks and lakeshores in many of these areas have been trampled and protective vegetation has often been eliminated. This is particularly apparent along Trapper Creek near the campground. A few trails (hiking, OHV, and snowmobile) traverse or parallel riparian zones and have detrimentally impacted some wet meadows. There are several sites adjacent to Davis Lake where four-wheel drive vehicle networks have been developed in riparian zones causing vegetation damage and concentrating water flow through the meadow which disrupts hydrologic function. The impacts associated with the concentration of people in riparian zones include: trampled vegetation; slight increase in runoff, erosion, and sediment delivery to the water body; and damage to the streambanks.

The riparian conditions within the watershed are believed to be similar to what they were prior to the 1850s. One possible exception is in the lodgepole and mixed conifer plant association groups where fire played an active role in creating open patches (open meadows in this plant association intermixed with the lodgepole and mixed conifer) in the landscape. Historically, a greater percentage of open meadows was present in the watershed. Within these areas where fire has been suppressed, fuel loading (both live and dead) is higher than the perceived natural range of variability, and conifers are encroaching. The addition of fire to these areas would produce a mosaic of vegetative types and seral stages. Continued fire suppression will allow additional

buildup of fuels in the riparian/wetlands/floodplains, which will result in increased susceptibility to fire and a decline in the species dependent on herb/shrub meadows. As the human population in Oregon and the neighboring states increases, a greater number of people will be recreating in the Odell watershed analysis area at established and dispersed sites. The resulting effects from this trend is increased pressure on the existing riparian zones including trampled vegetation, compacted soils, and damaged streambanks.

The presence of roads can be used to identify aquatic influence zones whose health and function might be negatively influenced by these features. Roads can add sediment to streams, influence stream movement, reduce floodplain efficiency, affect riparian vegetation, etc. Road densities within aquatic influence zones (riparian areas) and within perennial stream reaches will assist in identifying where roads might be adversely affecting riparian health and function. These areas will then serve as places to conduct improvement need inventories to 1) determine if problems exist, 2) develop restoration strategies, 3) monitor.

Table 6. Percent of area occupied by roads within Aquatic Influence Zones for the three subwatersheds in the analysis area:

Subwatershed	% Area in Roads w/i AIZs	% Area in Roads w/i perennial AIZs
Moore	1%	4%
Odell	1%	.8%
Odell Lake	.6%	.6%

Stream Channels and Habitat

What are the basic morphological characteristics of stream valleys or segments and the general sediment transport and deposition processes in the watershed? (e.g. stratification using accepted classification system).

What are the historic morphological characteristics of stream valleys and what is the general sediment transport and deposition processes in the watershed?

What are the historical morphological characteristics of stream valleys and general sediment transport and deposition processes in the watershed?

Odell Creek

Odell Creek flows out a glacial moraine on the eastern border and is partially controlled by a low rock weir that Odell Lake Lodge maintains to increase water level in their marina.

Current Conditions

As early as 1913, the Oregon Fish and Game Commission (now called Oregon Department of Fish and Wildlife, ODFW) authorized construction and operation of a fish hatchery on Odell Creek which cultured rainbow trout and non-indigenous brook trout. The Odell Creek hatchery supplied fish for many other waters. Increased demands for recreational fishing in Central Oregon spurred introductions of other fish species as well. Kokanee salmon (*Oncorhynchus nerka*, landlocked sockeye salmon) and lake trout (*Salvelinus namaycush*, also called mackinaw) were successfully introduced in the 1910s through 1920s to provide a fishery in Odell Lake. In addition, chubs used by anglers as baitfish were illegally introduced into Odell and Davis Lakes in the 1920s.

Most of the current condition information was determined from Level II and III stream surveys done on the Crescent Ranger District from 1990 to 1999 by the Forest Service.

ODELL CREEK 1998 Level II Stream Inventory

Reaches were designated as follows:

Reach 1 from high water mark at Davis Lake Campground to Road 4660

Reach 2 from Road 4660 to the confluence with Maklaks Creek

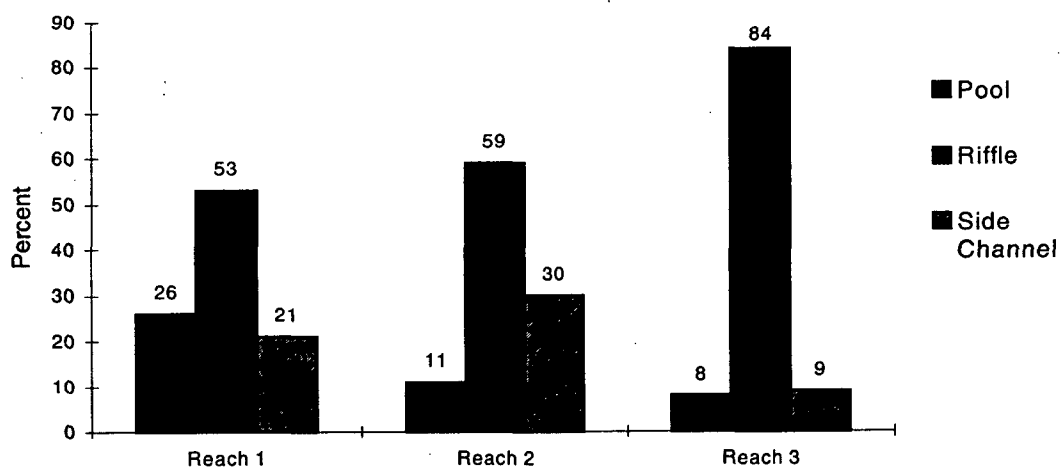
Reach 3 is from the confluence with Maklaks Creek to the Outlet of Odell Lake

Riffle habitat dominates Odell Creek with more pool and side channel habitat in reaches 1 and 2 where the gradient is most gentle.

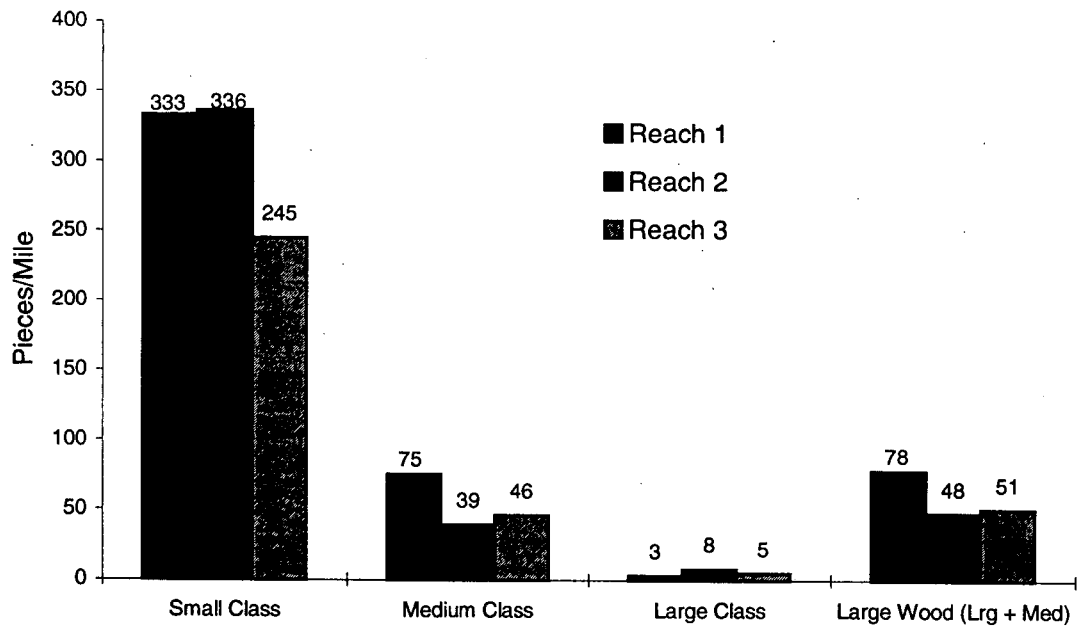
Vegetation treatments within the riparian zone have taken place along the two miles of Odell Creek immediately upstream of Davis Lake. These treatments included the removal of lodgepole pine killed by the mountain pine beetle. This overstory removal altered small segments of the forest adjacent to the creek. Removal of the lodgepole pine has occurred on approximately 500 feet of the streambank that has caused the loss of stream shade.

Table 7. Odell Creek habitat attributes measured during 1998 stream survey.

Reach Number (stream length)	Rosgen Channel Classification	Number of Pools	Pools /Mile	Pools>3 ft Deep/Mile	Pools with 1-3 pieces of LWM (>12 in dia)	Pools with >3 pieces of LWM (>12 in dia)	Bankfull width to depth ratio
1 (1.7mi)	C4	32	16.9	15.9	14	5	25.6
2 (2.1mi)	C3/4	25	12.3	9.4	10	1	24.9
3 (3.5mi)	B3	25	7.3	1.2	11	0	34.6



Percent available aquatic habitat by reach (Dachtler 1998).



Woody debris per mile by size class (Dachtler 1998).

Undercut (>1ft deep) stream banks and unstable (actively eroding, or sloughing banks above bankfull) banks linear distances were estimated in 1998. Undercut banks were found in higher percentages than unstable banks.

Table 8. Estimated percent of undercut and stable stream banks in Odell Creek.

Reach	Stability (percent)	Undercut (percent)
1	99.3	11.9
2	99.2	20.8
3	98.6	12.6

Trapper and Crystal Creeks

Reference Conditions

It is likely that historically Trapper Creek abandoned and re-founded different channels throughout the alluvial fan before it entered Odell Lake. Habitat complexity was probably higher than it is today due to channel modification that have been made to protect adjacent facilities and bridges. Large woody debris was also removed from Trapper Creek in the past thus was more abundant than current levels.

Crystal Creek is a spring-fed stream that has probably always lacked the sediment flushing ability.

Current Conditions

Trapper and Crystal creeks entering Odell Lake and up to the Union Pacific Railroad are Rosgen B and C type channels. Upstream of the railroad the majority of the channels are Rosgen A type channels.

Trapper Creek has been impacted greatly for approximately ½ miles from the mouth at Odell Lake to the Union Pacific Railroad bridge. Trapper Creek has been channelized to allow more favorable passage through railroad and vehicle bridges, its banks have also been hardened to protect a campground area near the mouth. Trapper Creek lacks cover, the dominant cover type in Trapper Creek is turbulence. More preferable types of cover include overhanging vegetation, undercut banks and large woody debris. Large woody debris is lacking in Trapper Creek. A restoration project was completed in Trapper Creek in 1992 that installed 38 in-stream wood and boulder structures. Floodwaters in 1996 moved 14 structures off site and shifted 10 other to less favorable locations.

Table 9. Habitat Changes in Trapper Creek from Mouth to Railroad Bridge.

	1990 Level II Survey	1991 Level III Survey	1992 Level III Survey	1996 Level III Survey
Pool area (ft ²)	47,382	38,425	695,310	207,418
Large woody debris (>35ft long and >12in dia. at the small end)	34	16	77	14
Pool/Riffle/Glide Ratio	6/16/3	11/20/10	30/25/4	19/24/2

Crystal Creek is a spring-fed system containing approximately one mile of low gradient fish habitat. The lower half mile of stream contains excellent rearing habitat for fish, and an abundant large woody debris supply. The habitat in Crystal Creek is primarily glide habitat.

Trends for Trapper and Crystal Creeks

As soils continue to be compacted around riparian areas, primarily Trapper and Crystal Creeks, riparian vegetation will continue to be lacking and indications in the stream channel characteristics will continue to worsen.

Maklaks Creek

Maklaks Creek was surveyed in 1995 from the mouth at Odell Creek to the headwaters which develops from several small spring-fed forks. The major cover types in Maklaks Creek is large woody debris and undercut banks. Maklaks Creek is shallow and provides good cover for juveniles but poor spawning potential.

Habitat consisted of 17 riffles, 2 pools and 1 glide. The stream was sampled for fish using electrofishing. No fish were seen during this survey. Rainbow trout were seen in Maklaks Creek during a snorkeling survey conducted in the spring of 1998.

Unnamed tributaries to Odell Creek

Two unnamed tributaries that have significant cold spring water sources were surveyed to inventory fish habitat for the first time in 1999. Snorkeling and electrofishing in these tributaries revealed a presence of redband (rainbow) trout, brook trout, and tailed frogs.

Table 10. Road densities and crossing in the Odell watershed.

Subwatershed	Acres	Area of Riparian Reserves (acres)	Road Crossings	Road densities in Riparian Reserves (mi/mi ²)
Odell Lake	21,702	1,811	20	1.0
Odell Creek	16,627	1,773	21	2.0
Moore Creek	36,526	1,248	20	2.3

Table 11. Water Temperatures in the Odell Watershed.

Location	Year of Record	Period of Record	Maximum °C	7-day average Max °C	DEQ's 7-day average Max Standard °C
Upper Odell Creek near outlet of Odell Lake	1995	1/1/95 to 11/27/95	23.6	22.4	17.8
	1998	6/17/98 to 10/13/98	25.2	23.4	17.8
Odell Creek near Davis Lake	1994	7/15/94 to 11/7/94	23.23	20.4	17.8
Trapper Creek	1994 near 5810 rd. bridge	7/15/94 to 11/10/94	6.9	6.7	17.8
Crystal Creek	1994	7/15/94 to 11/10/94	6.9	6.7	17.8
Maklaks Creek	1994	7/15/94 to 11/10/94	6.9	6.7	17.8
Ranger Creek	1994	9/1/94 to 11/7/94	6.1	5.8	17.8

Lakes

Large woody material was removed from Odell Lake to accommodate small watercraft. This activity caused negligible impacts to the aquatic resources in Odell Lake, but significantly impacted the fisheries population in Davis Lake. Odell Lake has a very small percentage of littoral zone with a high level of cobble and boulder size substrate. Davis Lake is within the glacial outwash zone and contains an extensive littoral area with substrate that is dominated by fine sediments. When Davis Lake experiences low lake level periods, fish are forced to swim through a half mile of extremely shallow riffle and glide habitat in order to reach cooler stream water of adequate depth to provide protection from predators. Restoration activities in the 1990's will include the addition of large woody material to the lake and planting of willow trees along the banks for cover. Continued degradation/suppression of the riparian vegetation is occurring due to the proximity of East and West Davis Lake Campgrounds to the confluence of Davis Lake and Odell Creek.

The water quality standards determined to meet biological criteria for aquatic life are adequate within the watershed. These standards include water temperature, turbidity, fine sediments in the substrates, other parameters for resident fish, as well as habitat for aquatic organisms. Measured adverse water quality effects have been reported for Odell Lake. Using information collected from other lakes in the area, the conclusion has been drawn that Odell Lake was oligotrophic (nutrient poor) prior to the development of the two resorts, five campgrounds and sixty-six summer homes along its shore. From data collected on Odell Lake including sechi disc, lake sediment, and plankton analysis, a trend towards an eutrophic condition (high in nutrients) was observed and documented in the late 1960s. Increased nutrients stimulated an increase in the growth of phytoplankton, including an initial appearance of blue green algae and a subsequent decrease in water clarity. Water quality (decrease in introduced nutrients) should improve slightly in the future as the summer homes improve/upgrade their septic systems.

The State of Oregon in compliance with Section 303(d) of Clean Water Act listed Odell Lake as being water quality limited for pH and of potential concern for Chlorophyll (a) (ODEQ, 1998).

A continued threat to Odell Creek and Lake is as the population increases, the risk of hazardous material spills along Highway 58 increases. There have been numerous spills in the watershed, but none have contaminated the water bodies.

Water Quality

What are the historic water quality characteristics of the watershed?

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

Reference Conditions

Using information collected from other lakes in the area, the conclusion has been drawn that Odell Lake was oligotrophic prior to the development of the two resorts, five campgrounds and sixty-six summer homes along its shore.

Current Condition

Data collected at Odell Lake including secchi disc, lake sediments, and plankton analysis, a trend towards an eutrophic condition was observed and documented in the late 1960s. Increased nutrients stimulated an increase in the growth of phytoplankton, including an initial appearance of blue green algae and a subsequent decrease in water clarity. This trend was reversed in the late 1970s when the two resorts significantly improved their waste water treatments (leach lines). In addition, Forest Service campground facilities have been converted to sealed vaults (with the exception of Crystal Creek), and most summer homes have upgraded their septic systems. The lake is currently classified as mesotrophic (Johnson et. al. 1985).

Odell Lake is also on the Oregon Department of Environmental Quality's 303(d) list for exceeding the pH standard (6.5-8.5) during the summer. Odell Lake is especially susceptible to cultural eutrophication due to the porous soil in the watershed that cannot absorb and hold nutrients (Johnson et. al. 1995).

Zooplankton sampled from Odell Lake in 1998 that the mean density of edible zooplankton in Odell was $20,100 \pm 14,400$ animals per cubic meter. This value indicated that the condition of the 1998 zooplankton assemblage in Odell Lake was healthy, the highest possible status (Vogel 1998). Another interesting finding from the zooplankton analysis was the presence of the rotifer *Keratella taurocephala* which is an indicator species for low pH and/or conductivity (Stemberger 1979 in Vogel 1998).

Odell Lake is currently listed on the 303(d) list for water quality limited water bodies for exceeding pH level standards. Water samples were collected from Odell Lake during the summer of 1998. The samples were analyzed for total phosphorus, nitrates and nitrites, pH, alkalinity (HCO_3^- -C), conductivity, sodium, calcium, magnesium, sulfates, chlorine, chlorophyll, phytoplankton, and zooplankton. Samples were collected from the epilimnion (3ft), thermocline (55ft), and the hypolimnion (240ft).

Table 12. Water chemistry of Odell Lake during the summer of 1998.

DATE	DEPTH	Dslvd Tot-P mg/l	NO ₃ -N +NO ₂ - N mg/l	pH	Alkal HCO ₃ - C mg/l	Cond ●S/c m	Dslvd Na mg/l	Dslvd K mg/l	Dslvd Ca mg/l	Dslvd Mg mg/l
7/31/98	55 ft	.020	*.001	6.8	4.12	31.9	2.41	0.80	2.80	.866
9/10/98	3 ft	.011	*.001	8.2	4.20	32.9	2.41	0.78	2.32	.843
9/10/98	55 ft	.013	*.001	7.1	3.35	26.0	1.72	0.56	2.40	.657
9/10/98	240 ft	.036	.128	7.1	3.97	32.5	2.29	0.78	2.74	.839
10/21/98	3 ft	.011	*.001	7.4	2.51	18.5	2.41	0.81	2.38	.865
10/21/98	70 ft	.019	*.001	7.2	3.95	31.0	2.21	0.73	2.73	.815
10/21/98	240 ft	.039	.165	7.0	3.38	28.3	1.91	0.63	2.39	.731

* indicates value is below level of detection

Total Phosphorus mg/l

Total phosphorus levels in all strata of Odell Lake are typical of lakes with high productivity. The marked increase in total phosphorus towards the bottom of the lake is especially pronounced during late summer/early fall. Phosphorus levels can fluctuate widely with variations in plankton populations, both in the living community near the water surface and the dead organisms found near the bottom. The exchange of phosphorus between sediments and the overlying water is a major component of the phosphorous cycle in natural water bodies.

Nitrates and Nitrites

Nitrogen levels were detected at very low levels or not detected at all. The sources of nitrogen can include precipitation, inputs from groundwater and surface drainage, decomposition of aquatic vascular plants, guano from birds (especially heavy concentrations of migratory birds), and man-made pollutants. The higher concentrations of nitrogen in the hypolimnion may be attributable to the ability of colder water to hold higher concentrations of dissolved gases. Another possibility is the bacterial nitrification of NH₄⁺ through oxidation into several intermediate compounds to NO₂⁻ and NO₃⁻. Low levels of nitrite and nitrate may exist because of low levels of organic-matter pollutants, often man-made. Nitrogen is often a limiting factor in the production of aquatic plants. The low levels of nitrogen compounds in the water chemistry may partially explain the presence of blue-green algae in the phytoplankton assemblage, since they are able to fix atmospheric nitrogen for their growth needs.

pH

A body of water which is acidic (<7) has some free hydrogen ion activity in the water. A basic solution has less free hydrogen ion activity in the water. Two samples taken near the surface on different dates had the highest pH levels. The highest measurements were 7.4 and 8.2 and may be attributable to the photosynthetic utilization of CO₂ by phytoplankton; as CO₂ content of the

water is reduced, pH levels rise. The low alkalinity of Odell Lake makes it susceptible to acid rain, this is common of Cascade and westside lakes in Oregon. However, no evidence of acid rain exists in Odell Lake.

Conductivity

Specific conductance is a measure of water's resistance of electrical flow. There is a positive correlation between conductance and pH. Resistance to electrical flow declines with increasing ion content. The major mechanisms controlling salinity in water are rock dominance, atmospheric precipitation, and the evaporation-precipitation process.

Total Inorganic Ions

A sum of the total inorganic ions seems to indicate a trophic level of oligomesotrophic, a trophic state between oligotrophic and mesotrophic. The average of all the samples taken is 98.02 mg/l. Odell Lake has an assemblage of ions typical of drainages comprised of igneous rock. The cation proportions are usually $\text{Ca} > \text{Na} > \text{Mg} > \text{K}$. A measure of total salinity includes the anions HCO_3^- , CO_3^{2-} , SO_4^{2-} , and Cl^- . These anions, as well as other elements or compounds, are of major importance in osmotic regulation of metabolism and in the distribution of biota. The relative make-up of these different ionic components has an affect upon seasonal population succession and primary production within Odell Lake.

Trend Discussion

As recreation use increases in Oregon, the potential for further eutrophication of Odell Lake is expected to increase.

Biological Domain

Vegetative Structure

Introduction

Vegetative structure is a critical factor in evaluating the physical, biological, and social processes taking place in the Odell Pilot Watershed. The functioning of most of the processes can be directly correlated to the vegetative structures in which those processes take place. Restoration, maintenance and/or enhancement of the vegetative structure is critical to the quality and effectiveness of those processes in the future.

One of the key issues identified by the Odell Pilot Watershed Interdisciplinary Team (IDT) is the importance and the role of the vegetative structure. The vegetative structure includes the presence, species, size, and density of vegetation at any given point on the landscape, any given point in time, and in the combination of landscape and time.

Vegetative structure results as a function of, among other things, the processes associated with climate, topography, disturbance events, succession, seed supplies, and time. Climate and topography remain fairly constant over time compared with the other processes mentioned. Disturbance events include insect attacks, disease infestations, 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. Seed supplies are, in part, the result of previous disturbance events and the relative proximity of seed-bearing plants to suitable seed beds. It appears that over time a given point in the landscape will cycle through disturbance events, followed by invasion of seral species and development of vertical stand structures which, if left somewhat undisturbed, will result in the establishment of mid to late seral species until another disturbance occurs and sets the process back to an earlier successional stage.

Potential Natural Vegetation (PNV) and Plant Association Groups (PAGs)

Potential natural vegetation is the vegetation that would be expected to be established on a given site in the absence of disturbance. Field mapping of the potential natural vegetation (PNV) to the plant association level was done by service contract according to Volland (1985), with considerable input from the Area IV Ecologist and other Forest Specialists including silviculturists, ecologists, botanists, and stand exam personnel.

Plant associations were then grouped by climax species, site potential, and temperature and moisture similarities into Plant Association Groups (PAGs) using the categories listed in the Deschutes WEAVE document.

Acreages by PAG differ from the original Odell Pilot Watershed Analysis due to the changes in how certain plant associations were grouped (Table 7). Subsequent to the Odell Pilot Watershed Analysis, the silviculturists and ecologists of the Deschutes National Forest met and agreed on how plant associations would be grouped. The information in the following table represents the groupings agreed to and used in all subsequent projects on the Crescent Ranger District. The include the 7 Buttes, Landscape Assessment Plan (LAP), and the Baja analysis projects

Table 13. Plant Association Groups (PAGs) by Subwatershed.

PAG	Moore	Odell	Odell Lake	Total Acres	Percent
LPD	2,210	2,903	19	5,132	8%
LPHD	2,692	2,263	516	5,471	8%
LPW	2,710	38	0	2,748	4%
MCD	10,864	8,272	1,302	20,438	31%
MCW	1,620	18	288	1,926	3%
MHD	12,796	1,709	14,852	29,357	44%
PPD	1,127	93	0	1,220	2%
PPW	348	40	0	388	1%
Totals	34,367	15,336	16,977	66,680	100%

See Figure 11 for a map of the distribution of the PAGs.

Factors of importance discussed in this document relating to vegetative structure include impacts of landscape disturbance events, processes of vegetative succession, and fragmented vegetative structure and management direction toward late successional reserve. Each of these factors will be discussed in the context of plant association groups (PAGs). Wildlife habitat/structure needs and providing scenic quality for each PAG are discussed in separate documents. The following table shows the relative areas each of the PAGs occupies within the watershed.

Other information useful in characterizing the watershed's vegetative structure:

Species of special interest that may have been present in the past. In the mountain hemlock and lodgepole pine with hemlock PAGs, one of the primary invasion species of hemlock root rot pockets was western white pine (*Pinus monticola* Dougl.). Presently, the root rot pockets in this watershed are still being invaded by western white pine, however, a disease introduced from Europe, the white pine blister rust (*Cronartium ribicola* Fisch), has seriously impacted the ability of the white pine trees to effectively reach maturity and reproduce. Due to the blister rust, there is a higher proportion of lodgepole pine invading and maturing within the root rot pockets than historically occurred (Maffei 1994).

Indigenous peoples used fire on the east side of the Cascade Mountains. This use is well documented and most likely was for maintaining food supplies (Williams 1994).

European influence was not common until the late 1800s when some influx of sheep and cattle grazing began. In addition, development of the railroad over Willamette Pass and the subsequent fire suppression efforts, in conjunction with the interruption of indigenous use of fire, are believed to have had an effect on the structure of the ponderosa and mixed conifer dry PAGs.

Grazing occurred primarily in the Davis Lake area from the late 1800s until about 1970. A more detailed discussion is included in the Social Domain section.

Federal management activities have primarily consisted of the harvesting of timber using a variety of intensive regeneration cutting methods. These timber harvests have resulted in the current pattern of vegetative patches and fragmentation of the LP dry, LP wet, ponderosa, mixed conifer wet, and mixed conifer dry PAGs. There has been little to no impact of Federal management activity in the mountain hemlock and LP dry/mountain hemlock, and meadows PAGs.

Fire is analyzed by frequency and intensity in this analysis. It is discussed by PAG in general terms.

Flood. There is little or no evidence of significant flooding events in the watershed riparian systems.

Blowdown disturbance events are relatively infrequent as evidenced by the isolated and infrequent existence of wind-thrown trees across the watershed. As would be expected, frequencies go up with the amount of exposure and with topographic features associated with wind acceleration. (Harris 1989)

Disturbance factors primarily consist of the historic elements of insect and disease infestations, fire, and wind. In addition, harvest of timber has influenced significant portions of the lodgepole, ponderosa, and mixed conifer PAGs.

Decay processes continue in stands where fire and harvest activities are excluded. In the areas of insect activity, fuels accumulate much faster than decomposition rates. In green, healthy stands small fuel accumulation exceeds the decay somewhat, especially in duff development, but the overall fuels accumulation remains fairly stable until a disturbance agent changes the balance.

Productivity, especially on fire-excluded sites of ponderosa pine and mixed conifer, is steadily increasing as decay processes make nutrients available to green plants which occupy the site. This site productivity increase is thought to be unique to those stands which had high frequencies of low intensity (underburn) fires prior to fire suppression activities (Hopkins 1994). In general, productivity on other sites remains fairly constant except where soil composition or tree density have been modified with harvest or facilities activities.

Resource utilization has caused patches and fragmentation on those PAGs and portions of the landscape where timber harvest activities have occurred. Objectives of such past harvest activities have been to convert overmature, decadent stands of trees to young, thrifty, healthy stands of regeneration, and to provide plenty of edge habitat for wildlife, as well as forage for big game species. These objectives have also resulted in saw timber and revenues for local economies.

In most of the lodgepole pine cuts, harvest activities have utilized beetle-killed overstory trees as well as some of the green residual overstory. Within the past few years, harvesting has focused

primarily on dead trees, since firewood collection has become the predominant harvest activity within the watershed.

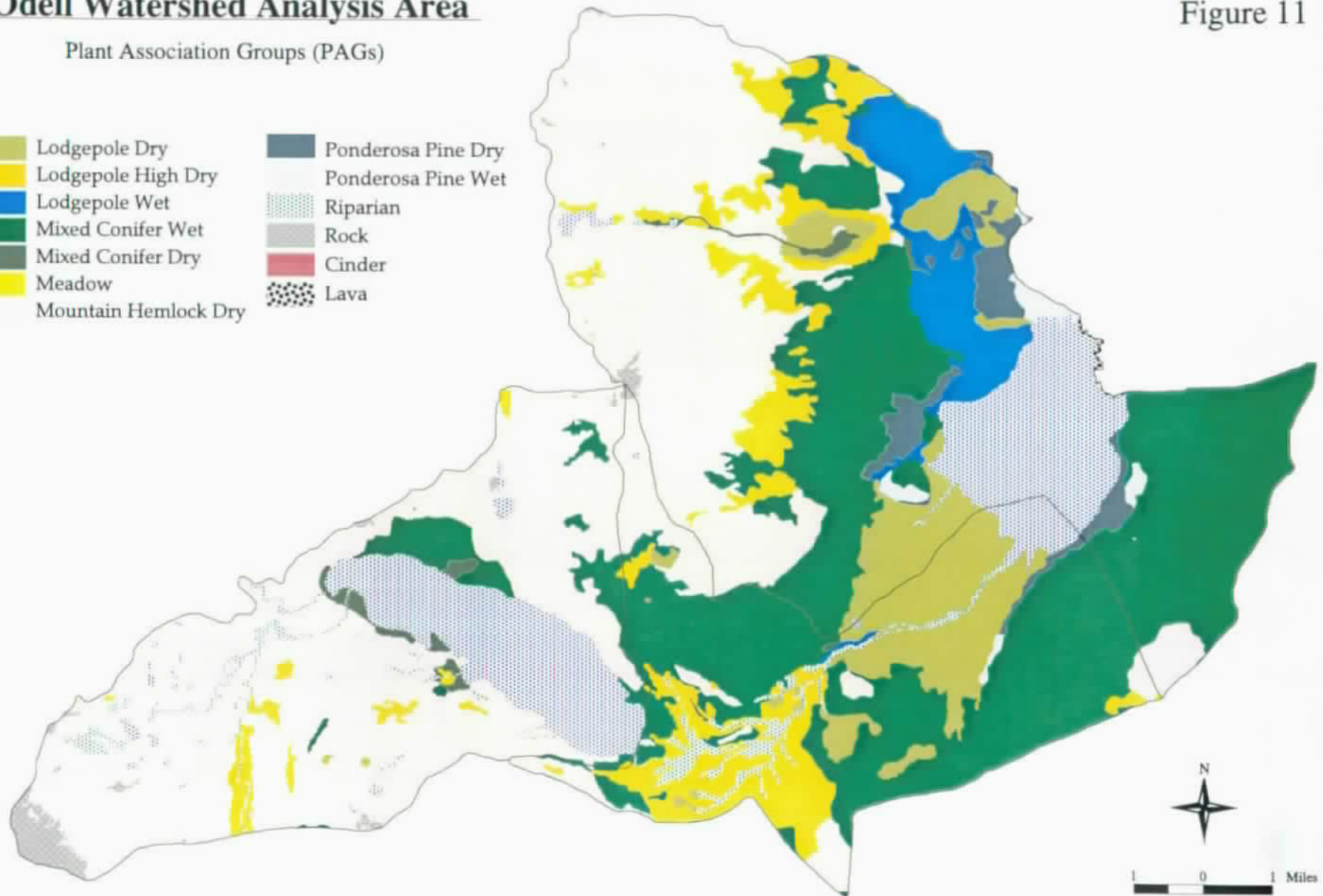
Physical processes related to the vegetation are primarily restricted to the effects of harvest activities and their impacts on soil quality. In particular, soil compaction and displacement through erosion, where they are present, may be hindering conifer tree establishment and growth.

Odell Watershed Analysis Area

Figure 11

Plant Association Groups (PAGs)

- | | |
|--|--|
|  Lodgepole Dry |  Ponderosa Pine Dry |
|  Lodgepole High Dry |  Ponderosa Pine Wet |
|  Lodgepole Wet |  Riparian |
|  Mixed Conifer Wet |  Rock |
|  Mixed Conifer Dry |  Cinder |
|  Meadow |  Lava |
|  Mountain Hemlock Dry | |



What is the historic array and landscape pattern of plant communities and seral stages in the watershed? What processes caused these patterns (i.e. fire, wind, mass wasting, insects/disease)?

What are the current conditions and trends of the prevalent plant communities and seral stages in the watershed?

Most of the changes between the Pilot watershed analysis and this iteration are updates made to match more recent processes and methods used for analyzing vegetative conditions. The ranges of Historic Variability (HRV) are the same as the Landscape Assessment Plan (LAP) of 1998. The actual ranges by structural stage are the same as the original watershed assessment except for subdividing the structural stages differently to match current direction for reporting HRV information.

Of importance to note on the following three sub watershed tables is the percentage of the acreage in the MM (mid sized, multi storied structural stage). The largest category by far is in MM on all three sub watersheds. Experience and formal stand exams have shown these stands are most likely stocked with enough larger trees to qualify the stands as late structured. This is indicative of the trend away from large tree dominated stands with disturbance regimes, towards pole-sized trees dominating the stands with the absence of disturbance agents. Hence, because of the dominance of pole-sized trees in the understory, many of these MM stands (if not most of them) have adequate large tree density to qualify them as late structured if the understories were thinned.

HISTORIC RANGE OF VARIABILITY

Vegetation was analyzed using the concept of "Historic Range of Variability" (HRV) of successional states. A pivotal assumption in the use of HRV is that an element or process that is outside the range of natural variability cannot be sustained naturally (Caraher et al. 1992). Native species have adapted to the natural disturbance events of the environment and require those conditions for their survival (Swanson et al. 1993).

In determining the historic ranges of variation, two approaches were integrated: 1) the notion of "natural states", as described by Swanson et al. (1993), and 2) the natural disturbance regimes associated with each plant association group.

The first approach assumes that the landscape is composed of definable vegetative "states" or conditions that change through time as they are altered by succession and by the specific disturbance regimes that pertain to them. This approach for characterizing range of variation has been widely used in describing the historical conditions throughout the western United States (Swanson et al. 1993). In this approach, the length of time required to pass through each of these "states" is critical in determining how much of the landscape will be characterized by a state at any point in time. Also important is the total length of time required to progress from bare ground to the climax vegetative state. For instance, in lodgepole pine, the "climax state" could be reached in 100 years, whereas this condition in mountain hemlock associations may require 300 or more years to attain.

The disturbance regimes are distinct for each group of plant associations and vary in terms of the agents involved, their periodicity, intensity, and magnitude of the area affected. Low intensity, high frequency disturbances modify the natural state much less dramatically than high intensity, low frequency disturbances such as stand replacement fires. Where high intensity disturbances affecting a large area are likely to occur, the range of variation must necessarily be broad in order to encompass the entire array of natural states that could occur through time.

As the progression through natural states was integrated with the disturbance regime for each plant association group (PAG), estimates were made as to how much of each condition would exist on the ground at any point in time. (It is a requisite that each state is represented to some degree at all times, in order that the next state can be reached through natural succession). These numbers were adjusted to include consideration of the stability of each state and the length of time required to pass to the next state. The ranges of numbers reflect the natural variation through time, and take into consideration the dynamic nature of the system where succession and disturbances are continually operating.

Some of the numbers for range of historical variation for Odell Watershed were extracted from the Ochoco Viable Ecosystems Guide. Specifically, the numbers developed for the ponderosa pine and mixed conifer PAGs on the Ochoco NF were used, given that the plant associations in Odell Watershed were similar and, therefore, most likely subject to similar disturbance regimes and natural succession patterns.

The numbers for the lodgepole pine PAGs were developed using the concepts of succession and disturbance described above.

The mountain hemlock associations were assumed to be within their historic range of variation, since there is an extremely long interval between fire disturbances and lack of human intervention in those high-altitude areas.

Historic condition (also referred to as reference condition), as used in this document, describes vegetative and animal conditions prior to being notably influenced by direct and indirect effects of European settlement. Historic records, fire-scarred stumps, tree ages, and other documented studies were used to gather information to estimate historic conditions.

Use of historic conditions as a basis for comparison assumes vegetative and wildlife populations were viable and sustainable across the landscape. While such an approach and assumptions may not be perfect, this approach was chosen to approximate past conditions, to compare historic and present conditions, and to estimate the desired conditions that might reasonably be expected to maintain a sustainable, viable ecosystem.

Table 14. Historic Range of Variability (HRV) by Plant Association Group (PAG).

Structural Stage	<i>PLANT ASSOCIATION GROUP</i> (Percent for Plant Association Groups (PAG) on the Crescent District)						
	MH	PPD PPW	LPD	LPW	MCD	MCW	LPHD
ES	NE	0-20	0-70	0-30	0-20	0-10	0-30
EM	NE	5-30	0-10	0-50	15-50	0-15	0-25
MO	NE	13-50	0-20	0-20	15-50	5-20	5-50
MC	NE	0-10	0-50	5-50	7-20	8-20	0-10
MM	NE	15-60	0-10	5-50	10-55	10-40	0-25
LM	NE	0-20	0-10	0-80	8-30	10-40	0-20
LS	NE	20-50	0-30	0-60	15-60	10-40	10-40

NOTE: NE = No HRV established for this PAG.

Table 15. The following is a brief description of the codes used to define structural stages used for analyzing HRV and comparing existing conditions with historic conditions.

CODE	STRUCTURAL	DESCRIPTION
	STAGE	
ES	Stand Initiation	One canopy stratum (may be broken or continuous), on dominant cohort of seedlings or saplings. Grass, forbs or shrubs may be present with seral trees.
EM	Understory Reinitiation	The overstory canopy is discontinuous. Two or more canopy layers are present. Overstory trees may be poles or of small or medium diameter. Understory trees are seedlings or poles.
MO	Stem Exclusion: Open Canopy	One discontinuous canopy stratum. One cohort of tree stems excluding competition. Trees may be poles of small or medium diameter. Understory shrubs, grasses, or forbs may be present.
MC	Stem Exclusion: Closed Canopy	Canopy layer is closed and continuous. One or more canopy strata may be present. Lower canopy strata, if present, is the same age as the upper stratum. Trees may be poles or small or medium diameter. Understory shrubs, grasses, or forbs may be present.
MM	Multi-stratum without Large Trees	The overstory canopy is discontinuous. Two or more canopy layers are present. Large trees are uncommon in the overstory. Horizontal and vertical stand structure and tree sizes are diverse. The stand may be a mix of seedlings, saplings, poles, or small or medium diameter trees.
LM	Multi-stratum with Large Trees	The overstory is broken or discontinuous. Two or more canopy layers are present. Medium and large sized trees dominate the overstory. Trees of all sizes may be present. Horizontal and vertical stand structure and tree sizes are diverse.
LS	Single Stratum with Large Trees	The single dominant stratum consists of medium sized or large trees. One or more cohort of trees may be present. An understory may be absent or consist of sparse or clumpy seedlings or saplings. Grasses, forbs, or shrubs may be present.

FOREST VEGETATION

Discussion of the forest vegetation in the watershed is in four areas: 1) Characterization, 2) Reference (Historic) Conditions, 3) Current Conditions, and 4) Trends. For the purposes of this document, these four areas will be discussed by PAG since the vegetative conditions over time are most relevant and similar by PAG.

1. *Lodgepole pine dry (LPD)*

- a. Is **characterized** by large areas in basin bottoms and low areas with considerable mountain pine beetle activity in the last 15 years. The beetles killed most of the overstory trees in these stands and many of these areas are heavily entered with firewood and fiber removal activities. Most of the overstory trees were about 110-120 years old when the beetle infestation killed them. This is typical of the 80 to 120 year cycle of lodgepole pine: maturing, being killed by bark beetles, regenerating, and

maturing again to start the cycle over. The stands are heavily fragmented in some areas where human firewood and fiber removal activities.

As evidenced by the somewhat universal age of the overstory across the landscape, these events happen on a large scale.

These stands are currently heavily dominated by seedling/saplings with some pole sized material and occasional residual overstory trees. Some areas have mistletoe, but most stands are relatively pest-free.

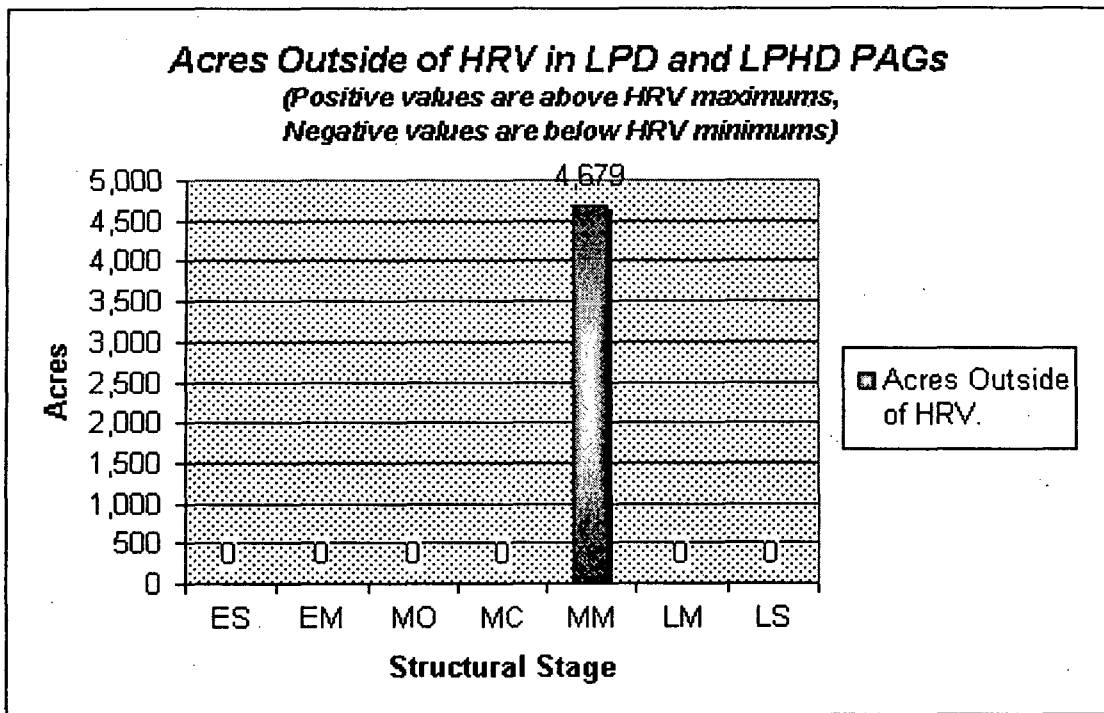
- b. **Reference conditions** are summarized by very similar structural conditions across vast acreages as a result of large-scale disturbance events, primarily the mountain pine beetle (*Dendroctonus ponderosae*). Hence, as seen in the HRV table below, the range of structural conditions may be very broad in some stages.

The very high level of multi-stratum without large trees (MM) is probably a very short-lived condition in historic cycles. It is most likely due to the effects of bark beetles killing most of the overstory, which would then historically facilitate stand replacement fires killing the remaining trees and causing a single-storied stand of regeneration.

Table 16. Structural Stages for Lodgepole Dry.

PAG: Lodgepole Dry -- Includes LPD and LPHD						
Structural Stage	HRV % (LOW)	HRV % (HIGH)	Maximum HRV Acres	Current Acres	Current %	Amount outside of HRV (acres)
ES	0%	70%	7,422	2,428	23%	0
EM	0%	70%	7,422	0	0%	0
MO	0%	50%	5,302	10	0%	0
MC	0%	50%	5,302	8	0%	0
MM	0%	25%	2,651	7,330	69%	4,679
LM	0%	20%	2,121	827	8%	0
LS	0%	40%	4,241	0	0%	0

Total PAG acres = 10,603



- c. **Current Conditions** are as shown in the table above. Most of the acres are in MM and ES structural stages due to the mortality from the mountain pine beetles and the resultant salvage harvest activities.

The stands without salvage activities are at very high risk of stand replacement fire events due to the very high levels of downed woody material.

- d. **Trends** in this PAG are within the normal historic direction of change. The ES stands will move towards MC over the next couple of decades. In the absence of fire or thinning, the MM will slowly move towards MC with little chance of moving to late structured conditions due to the densities keeping the large trees from increasing in growth sufficient to reach the larger sizes needed to meet the late structured definitions. This could continue for many decades until something intervenes: management activity, fire, or a beetle attack once sufficient numbers of trees are of suitable size.

Historic cycles of the PAG would have resulted in removal of the fuel loadings with moderate to high intensity fires, followed by regeneration establishment with natural seeding. Currently, the fuels on much of this PAG have been removed with firewood cutting and commercial fiber sales. In these areas, regeneration remains fairly in tact with 5-10 years time saved for regeneration establishment.

The trend of fiber/firewood utilization is expected to decrease as the fuels are removed from the available areas. Stand replacement fires would not be expected to be common in these areas as the resistance to control and the intensity of the fires would be lower where heavy fuels are removed.

2. *Lodgepole pine high elevation dry (LPHD)*

- a. Is **characterized** by lodgepole pine dominated stands, usually over 6,000 feet elevation and usually on south slopes of the strato-volcanic buttes. These stands have been heavily impacted by the mountain pine beetles and are characterized by heavily jack-strawed downed overstory with fairly dense regeneration coming through the heavy fuels. Mountain hemlock, western white pine, true fir, and occasional white bark pine are also found at various levels in these stands. Most of these stands have not been entered with harvest activities or roads, so fragmentation is minimal from human activities.
- b. The **reference conditions, current conditions and trends** for this PAG are almost identical to those of the LPD mentioned above. The primary difference is that these areas have had little or no fuels reduction work due to the high elevations and limited accessibility to the stands. So stand replacement events from fire remain at a higher probability for happening.

3. *Lodgepole pine wet (LPW)*

- a. Is **characterized** by lodgepole pine dominated stands, most often along riparian areas, including lakes and ephemeral or perennial streams. They are also in areas with high water tables and in areas of high productivity where ponderosa pine is a common component of stand structure. The stands associated with riparian areas tend to be linear in shape, whereas the other areas tend to be more rounded or amoebic in shape.

Many of these stands have been hit with the beetle attacks, but often have a few more residual overstory trees than in the other lodgepole pine groups.

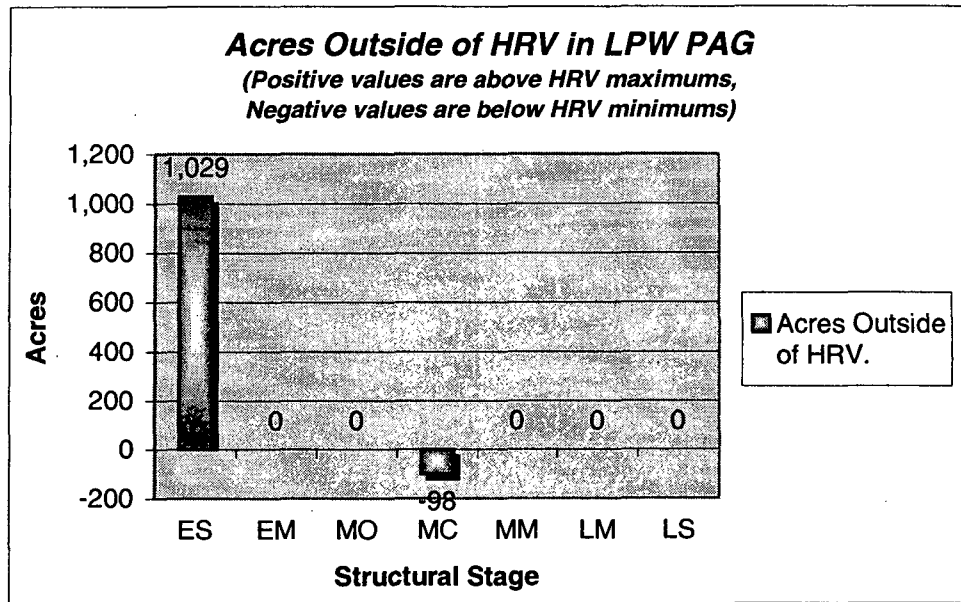
Associated species include true firs and Engelmann spruce with occasional ponderosa pine along wet areas. Ponderosa pine is common among the higher sites away from wet areas.

- b. The **reference conditions** for this PAG are as shown in the table and graph below.

Table 17. Structural Stages for Lodgepole Wet.

PAG: Lodgepole Wet (LPW)							
Structural Stage	HRV % (LOW)	HRV % (HIGH)	Minimum HRV Acres	Maximum HRV Acres	Current Acres	Current %	Amount outside of HRV (acres)
ES	0%	30%	0	824	1,853	67%	1,029
EM	0%	50%	0	1,374	0	0%	0
MO	0%	20%	0	550	11	0%	0
MC	5%	50%	137	1,374	39	1%	-98
MM	5%	50%	137	1,374	791	29%	0
LM	0%	80%	0	2,198	54	2%	0
LS	0%	60%	0	1,649	0	0%	0

Total PAG acres = 2,748



The frequency of stand replacement fires in the riparian areas of these stands may have been less than in the dry lodgepole communities. This is probably due in part to the proximity to water and the increased vigor and resistance to pests resulting from more available moisture for the trees. Hence, these stands tend to be unfragmented.

The LPW stands not associated with riparian areas are the higher productivity stands of lodgepole pine communities. These areas seem to be more susceptible to bark beetle as evidenced by the large proportion of them heavily hit by the beetles in the 1980's.

- c. The **current conditions** in this PAG are defined by excessive acres of ES structural conditions on the PAG due to beetle-killed overstory areas. These are pretty much exclusively limited to the high productivity sites away from riparian areas. Considerable harvest and fuel wood removal activity has occurred in these areas where the bark beetle infestation was more significant than in the riparian areas. These stands are fairly fragmented in structure as a result of the harvesting activities.

In the riparian-associated stands, little or no activity has been done. The stands are not fragmented and have proportionally less dead material in most of them.

4. *Mixed Conifer dry (MCD)*

- a. These areas are **characterized by** stands on slopes with good cold air drainage and ranging from about 4500' to 6000' in elevation. These stands are primarily located on the lower to mid slopes of the strato volcanoes in the watershed area. Vegetation in these stands tends to be fairly dense with multiple brush species a common component of these conifer stands.

Lodgepole pine is fairly common in these stands with most of it killed by mountain pine beetle in many areas. This means some of the stands of ponderosa pine, true fir and Douglas-fir overstory have heavy fuel loadings.

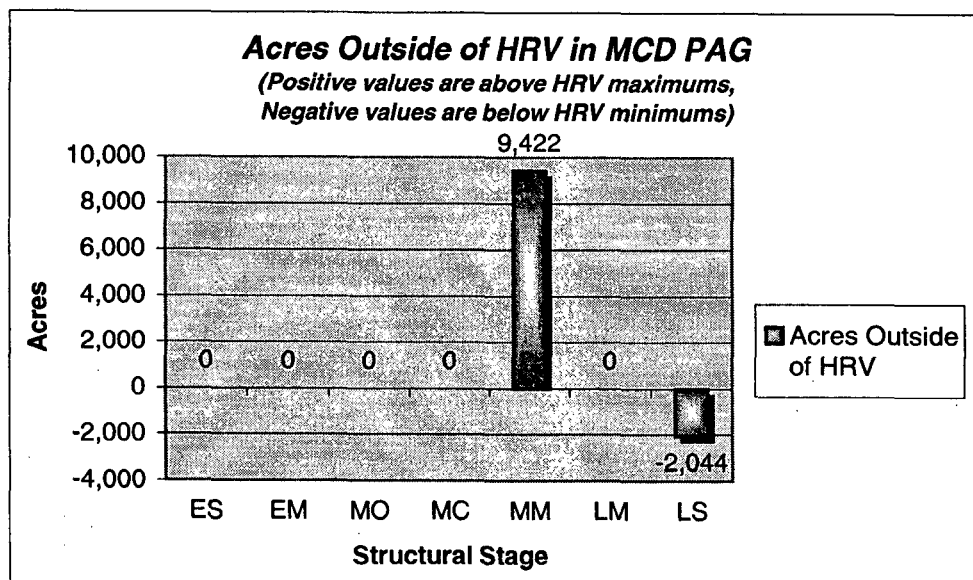
Soils tend to be 3 – 4 feet deep, with pre-Mazama soils under them. The trees frequently have root systems that tend to flourish at both the surface and at the residual soil and pumice interface.

- b. The reference conditions for this PAG are as shown in the table and graph below.

Table 18. Structural Stages for Mixed Conifer Dry.

PAG: Mixed Conifer Dry (MCD)							
Structural Stage	HRV % (LOW)	HRV % (HIGH)	Minimum HRV Acres	Maximum HRV Acres	Current Acres	Current %	Amount outside of HRV (acres)
ES	0%	30%	0	6,131	3,502	17%	0
EM	0%	25%	0	5,110	0	0%	0
MO	0%	50%	0	10,219	19	0%	0
MC	0%	10%	0	2,044	16	0%	0
MM	0%	25%	0	5,110	14,531	71%	9,422
LM	0%	20%	0	4,088	2,370	12%	0
LS	10%	40%	2,044	8,175	0	0%	-2,044

Total PAG acres = 20,438



These stands were maintained in the early seral structures by mostly low intensity fires on an estimated frequency of about 20-30 years. This is apparent even at present as we see these stands dominated by the fire resistant species of pine and Douglas-fir

250+ years old, with only occasional true fir of those ages. Fire scars are common across the PAG.

Additional evidence is that nearly all of the understory true fir is about 110-120 years old, coinciding with the beginning of fire exclusion in this area. In addition, these shade tolerant species seeded in quite heavily in many of the stands. Where the true fir didn't establish, the lodgepole pine did.

- c. The **current conditions** of this PAG are marked by early seral overstories with late seral understories. So, interpretation of the table and graph above shows a large excess of MM stands and a deficit of LS stands. Both have happened as a result of the establishment of the true fir and lodgepole understories. The historic fire frequencies kept the stands in LS conditions with pine and Douglas-fir dominating the overstories, as noted above. With the establishment of the understories, the stands became dominated by pole and immature sized stems to the extent that the LS stands are missing from the landscape and the MM stands dominate.

Of note here is that the elements for LS stands are still in tact on some of the stands. These stands still have sufficient mature early seral overstory trees to stock the stands as LS if the understories were thinned out or removed. Lighter thinning of the understories could result in LM stands on some of these stands as well.

Of great concern though is that the stands in this PAG have almost no early seral species in the understory that are capable of replacing the large trees in the overstory. So, as they die out, the early seral fire resistant species are fading out of the stands. Of equal concern is that the understories are so dense they are out competing the early seral overstories resulting in high levels of mortality in the large tree component.

- d. The general **trends** of this PAG are such that, as noted above, early seral fire resistant large trees are being replaced by late seral fire susceptible pole and immature sized trees at such densities that the stands are stagnating to the point where growth is slowed and unable to respond adequately to thinning. This is where no management activities have taken place. Also, as the lodgepole pine and the smaller trees succumb to the competition an increasing fuel problem is developing. More fuel is being added to the forest floor as well as frequent ladder fuels arranged in such a way to create large stand replacement crown fires.

These late seral stands are comprised of species not well adapted to the environment as the dominant species on the stands. They are very susceptible to fire, to drought and to a large variety of insect and disease pests endemic on the landscape. Because of this, where these trees dominate a stand in this PAG, it is believed very few of them would ever be able to reach large tree sizes even with the most advanced management techniques. However, these species mixed in with early seral species dominating a stand would provide a much greater opportunity to provide large trees of all species across the landscape as evidenced by what is on the sites now.

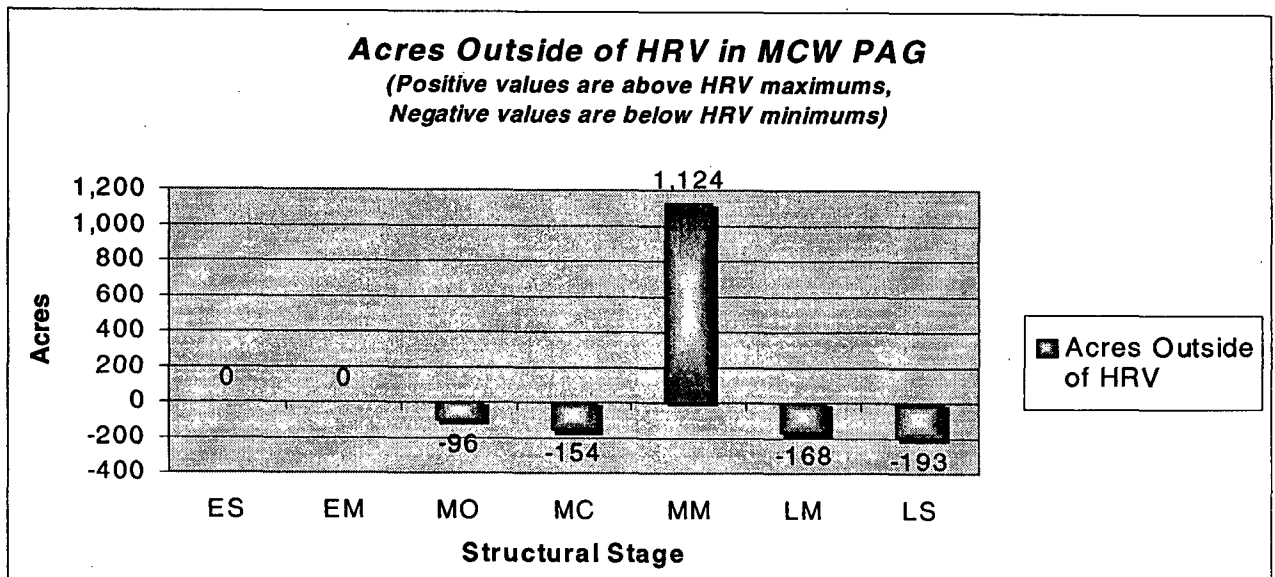
Structurally, the trend on the unentered stands is towards pole and immature sized trees dominating the stands and crowding out the larger tree component. The regeneration stands are moving towards mid seral conditions, most of which would be MC in the absence of management activities.

5. Mixed Conifer wet (MCW)

- This PAG is **characterized by** very high sites for this area which are often associated with ephemeral streams and areas of above average ground water available to the vegetation during the growing season. This PAG is a very small component of this watershed, comprising less than 3% of the acreage. Late seral species dominate the vegetation. These sites are some of the most vegetatively productive sites on the landscape.
- The **reference conditions** are summarized in the table and graph which follow.

19. Structural Stages for Mixed Conifer Wet

PAG: Mixed Conifer Wet (MCW)							
Structural Stage	HRV % (LOW)	HRV % (HIGH)	Minimum HRV Acres	Maximum HRV Acres	Current Acres	Current %	Amount outside of HRV (acres)
ES	0%	10%	0	193	7	0%	0
EM	0%	15%	0	289	0	0%	0
MO	5%	20%	96	385	0	0%	-96
MC	8%	20%	154	385	0	0%	-154
MM	10%	40%	193	770	1,894	98%	1,124
LM	10%	40%	193	770	25	1%	-168
LS	10%	40%	193	770	0	0%	-193
Total PAG acres =					1,926		



Fire frequency in these stands was believed to be less than that of the MCD. This provided for establishment and successful growth of the late seral, less fire resistant species, which dominated the stocking of these stands. However, since fires were still a part of the stand dynamics, fire exclusion has resulted in the situation as shown in the table and chart above. And, as discussed in the MCD dynamics, the MM stands have potential to become any of the deficit categories simply by applying a variety of thinning regimes.

True fir, even though well known as susceptible to fire, has sufficient bark thickness on some species to be resistant to low intensities of fire. Hence, combined with moister site conditions and limited resistance to fire, these stands benefited from periodic fire as fuel beds were kept low, ladder fuels weren't allowed to develop, and thinning from fire allowed residuals to grow larger faster.

Since these stands tend to be small and isolated from one another, they are not nearly as subject to some of the insect and disease problems as large contiguous stands of late seral species can be. So with less risk and higher productivity, these stands remain dominated by late seral species.

- c. The **current conditions** in these stands are summarized by stands relatively in tact, except for some areas becoming stagnated by overstocking in the absence of fire. The abundance of MM stands is the result. As with the MCD, it should be noted that all of the structure stages below HRV levels can probably be made almost immediately from the MM stands, since all of the structural elements necessary are contained in the MM stands.
- d. The **trends** in this PAG are towards overstocked stands dominated by pole and immature sized trees crowding out the large tree components.

6. *Mountain Hemlock Dry (MHD)*

- a. These stands are **characterized** by being limited mostly to elevations from about 5,800' up to timberline and found on and between the strato volcanoes. Mountain hemlock dominates the normal life cycle of these ecosystems, but lodgepole pine and western white pine are commonly the first conifers to establish in disturbed areas. Pockets of root rot, usually *Phellinus weirii*, are common with hemlock regeneration, lodgepole pine, and western white pine establishing in thickets as the pockets expand. Snowfall is deep in the winter and the growing season is usually very short, since the sites are only snow-free from about June – September.
- b. The **reference conditions** of these stands cannot be displayed like the other PAGs. The dynamics of these stands cycle through from regeneration through stand replacement event over a period of 600-1200 years or more. As noted above, lodgepole pine and western white pine dominate the regeneration in disturbed areas. Mountain hemlock, a shade tolerant species, replaces the lodgepole pine after about 80-120 years. It eventually crowds out the western white pine after 200-400 years, but that time is also when the root rot pockets become established, so lodgepole pine and western white pine remain components of the landscape in the root rot pockets.

During this first several hundred years, the stands are fairly fire resistant since ground fuels are minimal and ladder fuels almost non-existent outside of root rot pockets.

Fires can creep around on the ground at such low intensity that they remain undetected sometimes even for weeks after lightning storms in the summer. One such fire on Moore subwatershed remained undetected for over a month after a storm a few summers ago.

Somewhere after 600-1200 years, conditions are such that a stand replacement fire occurs over a very large area, starting the process over again.

- c. **Current conditions** are stands, generally about 200-350 years old, with areas of large root rot pockets. Only some of the stands on Hamner Butte have been entered with management activity. Thus, these stands remain uninfluenced by human activity for the most part. Even fire suppression has had relatively little effect in these stands since lightning storms often start fires reported by lookouts, but which go out before firefighters can find them.

Of note here, though, is the white pine blister rust (*Cronartium ribicola* Fisch). This disease affects all 5-needled pines and was introduced from Europe earlier in this century. The disease is usually fatal to infected trees. In this PAG it is already a major factor in eliminating western white pine from the cycle of these stands. This is considered potentially very serious as white pine contributes to the diversity of species available for the wildlife habitats of these stands. It is also the most resistant to laminated root rot of all the tree species in these stands.

Work began in the 1930's to develop rust-resistant white pine and some of the scion believed to have resistance have been planted in scattered root rot pockets and plantations across the watershed. In addition, comparison plots and long term study plots were established and a study plan is in effect to monitor these plots, hopefully for the next 50 years, to determine the effectiveness of the genetic resistance work done to date.

- d. **Trends** of these stands are towards the later seral conditions except in the root rot pockets. The pockets continue to expand, about 1 foot per year, causing mortality of the older mountain hemlock and establishment of white pine, lodgepole pine, and mountain hemlock regeneration. The mountain hemlock regeneration in the root rot pockets can grow 20-30 years, before it succumbs to the root rot. These growing root rot pockets continue to build up fuels since decomposition happens slowly on these sites.

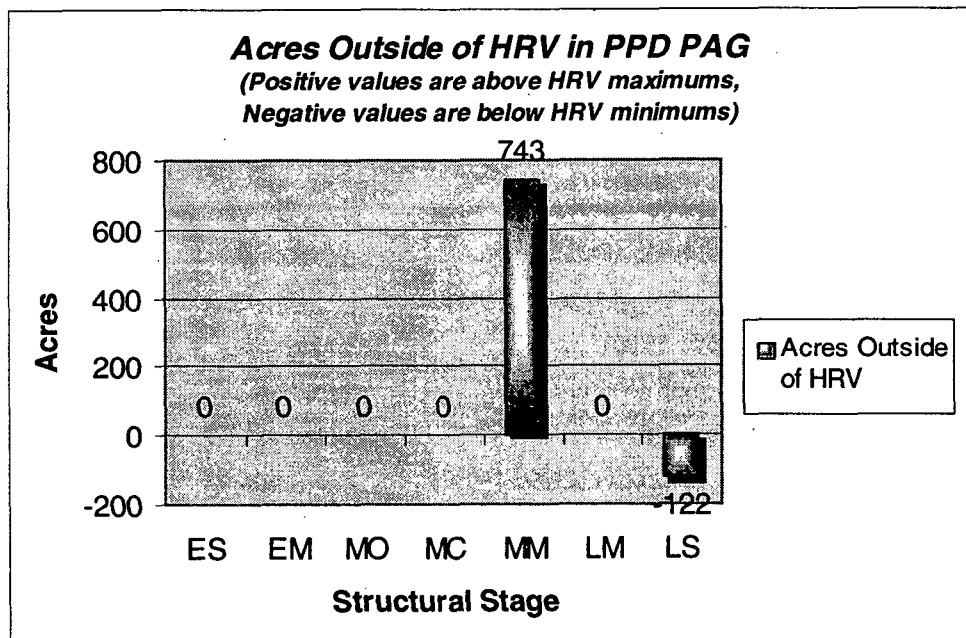
The loss of western white pine to the blister rust continues with no expected end in sight until all nonresistant trees are dead.

7. *Ponderosa pine dry (PPD)*

- a. The **character** of these sites is that they consist of the ponderosa pine sites usually below about 5,800' elevation and on slopes and rises above the basins and low areas. These stands are generally in the transition between lodgepole pine pumice flats and mixed conifer dry stands on the slopes. They frequently consist of ponderosa pine and some lodgepole pine with occasional true fir or Douglas-fir.
- b. The **reference conditions** are summarized in the table and chart below.

Table 20. Structural Stages for Ponderosa Pine Dry.

PAG: Ponderosa Pine Dry (PPD)							
Structural Stage	HRV % (LOW)	HRV % (HIGH)	Minimum HRV Acres	Maximum HRV Acres	Current Acres	Current %	Amount outside of HRV (acres)
ES	0%	30%	0	366	169	14%	0
EM	0%	25%	0	305	0	0%	0
MO	0%	50%	0	610	0	0%	0
MC	0%	10%	0	122	3	0%	0
MM	0%	25%	0	305	1,048	86%	743
LM	0%	20%	0	244	0	0%	0
LS	10%	40%	122	488	0	0%	-122
Total PAG acres =					1,220		



This PAG comprises only 2% of the watershed and is predominantly linear- shaped stands scattered and isolated from each other. The Cascade Lakes Highway transects several of these stands. These are often the stands with many dispersed recreation sites due to the aesthetic beauty of the orange barked trees.

- c. The **current conditions** of these stands are such that, as with the MCD, fire exclusion has resulted in high levels of regeneration under existing overstory trees. This explains the excess acres in MM and the lack of acres of LS. And, as in the MCD, many of the MM stands could be treated with understory removal leaving them in LS condition. It should be noted that the ES stands were historically created by stand replacement fire. However, current stands of ES were created by regeneration cuts.

In the MM stands, the high levels of understory have cause decline in the vigor of the overstory trees. This makes them susceptible to western pine beetle (*Dendroctonus occidentalis*). Many of the stands already have high levels of overstory mortality to the bark beetle, so options of moving them quickly to LM or LS are limited or gone.

A few stands are heavily infected with dwarf-mistletoe (*Arcuthobium* spp.) which can severely hamper or prevent the opportunity to grow large trees on these sites.

- d. **Trends** are towards continued increase in stand densities with a corresponding increase in risk towards insect, disease, and fire-caused stand replacement events. Until a stand replacement event, probably associated with fire, the stands will continue to lose the overstory trees to bark beetles and convert towards pole and immature sized stagnated stands.

8. *Ponderosa pine wet (PPW)*

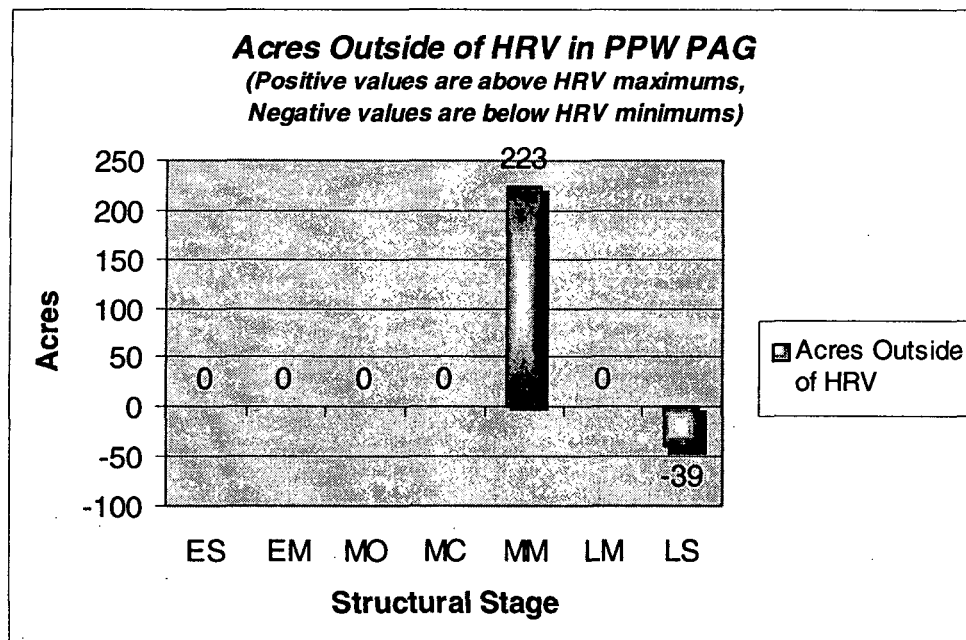
- a. The **character** of these stands consists of stands of ponderosa pine on the higher productivity sites. These sites are usually located between the ponderosa pine dry and the mixed conifer sites. There is also a large area of PPW just north of Davis Lake in the Moore sub watershed that is dominated by rolling terrain with occasional lava pressure ridges. This PAG really is very similar to the PPD stands except for being more highly productive.

NOTE: These stands comprise less than 1% of the watershed.

- b. The **reference conditions** are summarized in the table and chart below.

Table 21. Structural Stages for Ponderosa Pine Wet.

PAG: Ponderosa Pine Wet (PPW)							
Structural Stage	HRV % (LOW)	HRV % (HIGH)	Minimum HRV Acres	Maximum HRV Acres	Current Acres	Current %	Amount outside of HRV (acres)
ES	0%	30%	0	116	68	18%	0
EM	0%	25%	0	97	0	0%	0
MO	0%	50%	0	194	0	0%	0
MC	0%	10%	0	39	0	0%	0
MM	0%	25%	0	97	320	82%	223
LM	0%	20%	0	78	0	0%	0
LS	10%	40%	39	155	0	0%	-39
Total PAG acres =					388		



- c. The current conditions of these stands are such that, as with the PPD, fire exclusion has resulted in high levels of regeneration under existing overstory trees. This explains the excess acres in MM and the lack of acres of LS. And, as in the PPD, many of the MM stands could be treated with understory removal leaving them in LS condition. It should be noted that the ES stands were historically created by stand replacement fire. However, current stands of ES were created by regeneration cuts.

In the MM stands, the high levels of understory have cause decline in the vigor of the overstory trees. This makes them susceptible to western pine beetle (*Dendroctonus occidentalis*). Many of the stands already have high levels of overstory mortality to the bark beetle, so options of moving them quickly to LM or LS are limited or gone.

- d. **Trends** are towards continued increase in stand densities with a corresponding increase in risk towards insect, disease, and fire-caused stand replacement events. Until a stand replacement event, probably associated with fire, the stands will continue to lose the overstory trees to bark beetles and convert towards pole and immature sized stagnated stands.

GENERAL OBSERVATIONS

- As seen in the table below, 80% of the stands are in MM structural stage on the watershed (refer to Figure 12. Since that structural stage can (and does) include trees up to 30" dbh, there is great flexibility in the options on what to do for stages which lack sufficient acres.

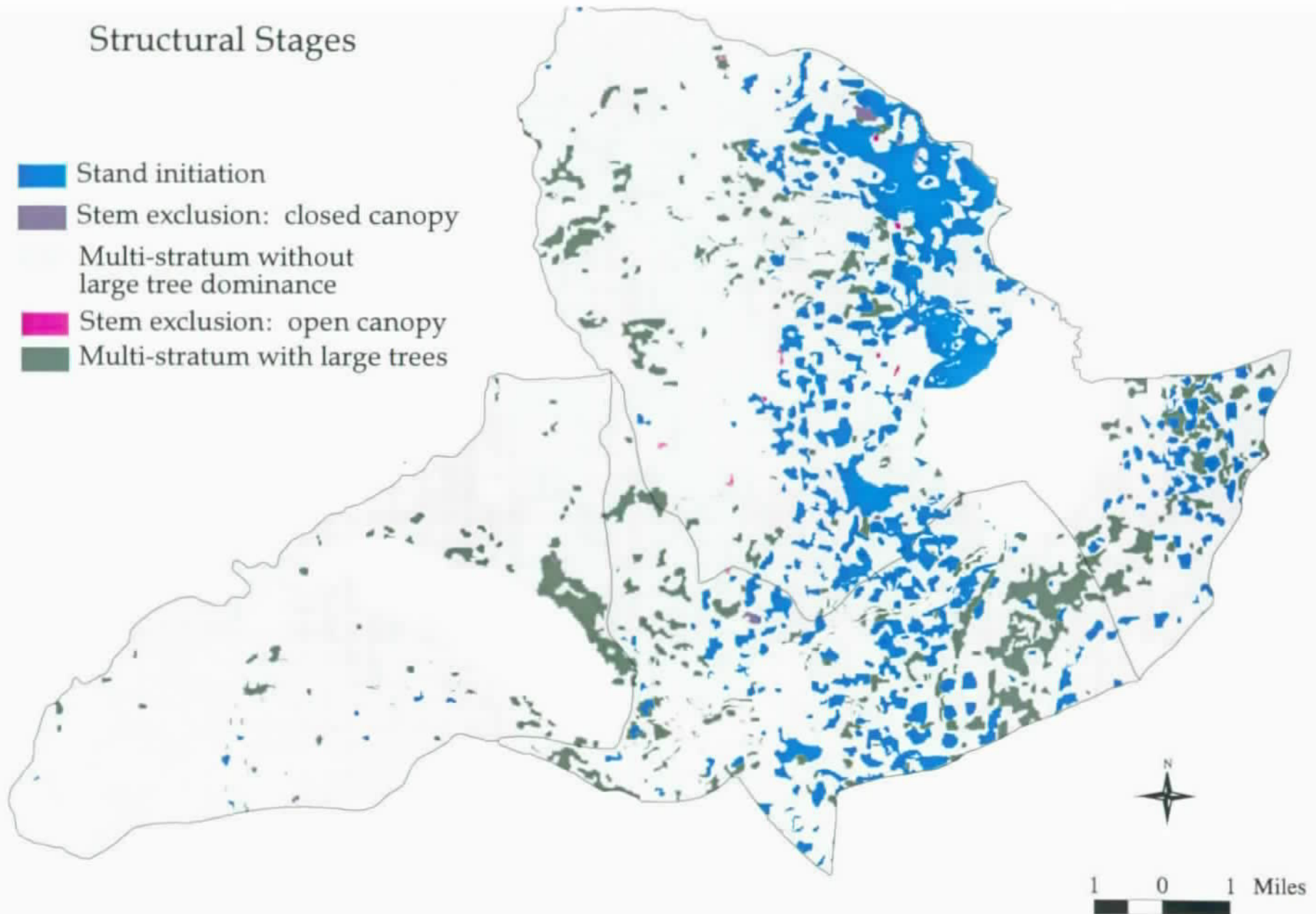
Table 22. Structural Stages for all PAGs.

<i>Total Structural Stage Acres</i>						
PAG	ES	MC	MM	MO	LM	Totals
LPD	1,900	8	2,887		337	5,132
LPHD	528		4,443	10	490	5,471
LPW	1,853	39	791	11	54	2,748
MCD	3,502	16	14,531	19	2,370	20,438
MCW	7		1,894		25	1,926
MHD	228	8	27,403	6	1,712	29,357
PPD	169	3	1,048			1,220
PPW	68		320			388
Totals	8,255	74	53,317	46	4,988	66,680
Percents	12%	0%	80%	0%	7%	100%

- The greatest potential problem I see on the landscape today is the lack of early seral overstory replacement trees on the MCD acres. In a multi-storied stand, it may take 200+ years to grow a tree from seedling to 30" dbh. In the last two decades alone we have lost about 25% of the overstory trees on these stands. We have the opportunity now, while there are still early seral overstory trees left, to retain those trees and begin to provide replacements for them. Failure to do this will have serious landscape effects for centuries on wildlife habitat quality and sustainability. Treatment (thinning) of stands is perceived to have a negative effect on wildlife habitat quality for at least the short term. However, short term reduction in quality is far superior in my opinion than long term loss of habitat!
- The opportunity then in MCD is to provide for long-term sustainability of a landscape with at least a minimal large tree component. Treatment soon emphasizing the stands with viable healthy early seral overstory trees could retain those trees for another 2-3 centuries if basal areas and fuel loadings remain below the thresholds for stand replacement beetle infestations or fires.
- Western white pine's role in the high elevation ecosystems is not fully understood. However, it may only be a few more decades before western white pine is removed from these ecosystems. Continuation of studies and out plantings of rust-resistant seedlings should be considered a Regional priority for this area. Somehow, funding and resources need to be committed to make this happen. What we have done so far is only scratch the surface of the possibilities for out-planting rust-resistant stock. An active program to continue this into the foreseeable future should be developed and fully supported by line officers and staff.

Structural Stages

-  Stand initiation
-  Stem exclusion: closed canopy
-  Multi-stratum without large tree dominance
-  Stem exclusion: open canopy
-  Multi-stratum with large trees



Fire

Fire History and Present Risk

Because of the importance of fire in shaping vegetation structure, density, and species composition, it was felt that an overall description of the fire history and present risk in the watershed was an appropriate and important part of the analysis of the biological domain.

The information in this document is based on what is known about the fire history of the Odell Watershed. Currently, the likelihood of fires that are primarily stand replacement events is not very high. Replacement fires in the modern era are significantly less frequent and smaller than they were between the years 1680 through 1918. This century, fire suppression activities have also repressed low intensity fires. Natural underburns, which are fairly easy to control, have been virtually eliminated.

As compared to Eastern Oregon as a whole, the Odell Watershed has a relatively low risk of significant fire, since this area typically receives a greater amount of moisture, which decreases the likelihood of significant fires. The above statement has been verified by recent fire history. Since 1908 there are only eight known fires which were larger than 80 acres in size within the watershed (Figure 27). The total number of acres burned by those fires was approximately 2,600 acres, with only 500 acres of those acres having burned since 1915.

Between 1970 and 1992 there were 180 fires and the largest of these was only 80 acres in size. Of those fires 109 or 61% were human caused which resulted in an ignition rate of 0.070 ignitions/1,000 acres/year. The 71 lightning caused ignitions result in a slightly lower ignition rate of 0.046 ignitions/1,000 acres/year. These numbers apply to the watershed as a whole, and demonstrate the relative "success" of fire suppression.

Of course, this information does not imply that 1,000+ acre stand replacement events will no longer occur, it is just a matter of time. The fuel loading levels that wildland fire suppression has created are their own paradox. Fire suppression adds fuel to the next fire.

Continued fire suppression will result in increased mortality, species conversion to plants less resistant to fire, and further accumulation of both horizontal and vertical fuels. Without the reintroduction of fire or other treatments that mimic fire, the likelihood of stand replacement fires will continue to increase, and overall forest health will decline.

A critical concern is the location and amount of human caused fires. Of the ignitions that occurred in the watershed between 1970 and 1992, 25% (46 fires) were located within 3/8ths of a mile of Odell Lake, and 38 of those 46 fires or 83% were human caused. (Figure 27) The increased likelihood of fire in an area that contains diverse recreational and scenic values should result in Odell Lake being given priority status for the reintroduction of low intensity underburns. Davis Lake, and to a lesser extent Rosary Lakes and Bobby Lake, share these statistics.

Using maps provided by the Bureau of Land Management (BLM), it was determined that an average of approximately 75 lightning ground strikes were recorded per fire season in the Odell Watershed between 1985-1993. The number of strikes ranged from a low of 6 strikes in 1985 to a high of 152 in 1991. Using the average from 1970-1992 of 3.1 lightning fires per year, it could

be reasonably inferred that approximately 4% of the lightning strikes cause wildfires. It should be noted that the two time periods listed above do not precisely overlap (lightning data is only available since 1985), and the lightning detection system is admittedly flawed. The disclaimer letter that accompanied the lightning data stated that a 15% error was possible.

Since 1993 the Odell Watershed has experienced an increased number of fires; these fires resulted from the carelessness of mushroom hunters and a particularly prolific lightning storm that crossed Maiden Peak in July, 1994. The data from these fires occurrences were not incorporated in the figures above but do have a tendency to reflect it. One trend is apparent, though, from a fire protection standpoint, natural ignitions are declining in importance as compared to human caused ignitions within accessible areas.

Determining the fire history in the watershed is difficult because of a lack of data. Many fire records were lost or are incomplete. Assembly of the Deschutes NF fire history was initiated only recently and is not complete. This fire history project is utilizing information obtained from the oldest Deschutes fire atlas, which dates back to 1908.

Notes by Pat McCauley, (1993) suggest that 1918 is the reasonable year to begin referencing from as the modern fire era with respect to suppression. Beginning in 1918, the number of large fires on the forest dropped dramatically, which demonstrates the relative effectiveness of the emerging fire organizations.

The difference between natural fire disturbance events and Native American management is unknown. Even if escaped campfires started by Native Americans and early white settlers are the only human caused fire starts prior to 1908, they undoubtedly had their effect. There would probably have been the tendency for this type of ignition to occur primarily in areas bordering larger water bodies. This hypothesis has not been proven, since evidence of these fires cannot be obtained.

The only known account of a human caused fire within the watershed prior to this century is a record of one which occurred on the shores of Odell Lake in 1896 and was documented by Judge John Breckenridge Waldo in his journal (Williams 1985). His accounts of the "unaltered wilderness" include only one reference of an encounter with Native Americans and discuss two "Warm Springs Indian Trails" that had been recently created in the Odell and Davis Lake areas.

Judge Waldo visited Davis and/or Odell Lake in fourteen of the years between 1880-1896. He regularly mentions smoke obscuring views and occasionally fires restricting travel. His journals record the locations of the fires, and it seems unlikely that he would have failed to observe and document fires that had occurred in the area he considered to be his favorite, Davis Lake. Judge Waldo only documents the accidental fire that occurred near Odell Lake in 1896.

Native American ignitions would, of course, alter the natural range of variability for fires. "There are at least 13 documented reasons for American Indians ecosystem burning." (Williams 1994). The emerging evidence of extensive burning in the Northwest reinforces the belief that the Native American attitude towards the role of fire in the ecosystem is nearly opposite of the views today. Unfortunately, there is no documentation that specifically records the use of fire by Native Americans within the Odell Watershed.

Determining the extent and severity of the current fuel loading problem within the watershed is somewhat subjective. The increases in down woody material from the time of stand replacement can be quantified as was done for the Mount Jefferson Wilderness (Simon 1991). The information within the Odell Watershed is too incomplete at this time to provide a picture of what the forest floor would look like if low intensity underburns had been allowed to occur naturally. These fires are the primary natural method for controlling fuel loading.

Some work has been completed that uses early aerial photos to attempt to understand the approximate fuel loading levels in the 1930s and 40s. However, this work did not include the Odell Watershed. Known historical accounts of fuel loading are limited to statements such as the following in regards to the Davis Lake area. [This area] ``may be explored quite thoroughly through here, as a horse can be ridden anywhere.' (Williams 1985). This account would tend to show that the legendary park-like stands, with their low thicket and ground fuel accumulations were prevalent here.

The fuel accumulation in the Odell Watershed is the product of both fire suppression efforts that have occurred since 1915, and the relatively limited number of low and high intensity burns that took place between the years 1881 and 1909. This generalization is corroborated by the accounts of Judge Waldo, the Deschutes Fire History, and stand examination data. The six largest fires that occurred between 1910 and 1914 burned a total of only 2,200 acres. Basically, the Odell Watershed has had a lack of significant fire activity for the past 113 years, if not longer; and the current fuel loading levels are a direct result of that.

Tree ring data has been collected during some of the stand examinations and can be used to determine basically when a stand originated. Disease and insects usually initiate stand replacement events which are finalized by fire. A series of stands that originated at the same time can demonstrate when the last stand replacement fire occurred and can give a very rough idea of the perimeter of the fire. Stand exam data has not been collected in some portions of the watershed, and where it has occurred, the year of origin information was often not collected. Combine these factors with the overlapping nature of replacement events, and we revert to a 'best guess' as to when stand replacement events occurred in some areas.

Stand exam data does show that 'major' fires occurred in approximately the years 1680, 1735, 1780, 1785, 1805, 1810, 1818, 1828, 1835, 1840 and 1855. Even without field verification these stands are spaced widely enough apart to indicate that each of these fires was over 2,000 acres in size. This incomplete data also indicates that in at least 79 of the years between 1680 and 1918, some type of replacement event occurred in the watershed, in other words, one every three years. Between 1918 and 1994 there have been just two relatively large fires. They occurred in 1930 and 1991 and totaled 400 acres with only 200 acres of that being of an intensity to cause stand replacement. This is a dramatic contrast to the period between 1730 and 1918, where the longest gap between ``large' fires was 11 years. Within the past several hundred years, there has not been a period that correlates with the modern era. It is difficult to say precisely, since we are working with yearly figures and not more desirable acreages for analysis, but the Odell Watershed, excluding the high country, is clearly outside the HRV for replacement fires.

The following is a discussion on the fire history and present risk within each of the plant association groups.

Lodgepole Dry with Mountain Hemlock, and Mountain Hemlock PAGs:

Stand exams have not been completed within most of these “high country” areas. A study completed by the University of Oregon (Dickman and Cook 1988) included the area north of Maiden Peak, Bobby Lake and The Twins. It showed that major fires occurred within this portion of the watershed circa 1528, 1618, 1813, 1868, and 1873. Data collected on this study area, which also included the west slopes of the Cascades down to Waldo Lake, showed that at least half of the 45,000 acres had stand replacement events within the last 500 years.

The fire scars from the 1813, 1868, and 1873 burns are visible on the oriented panoramic photographs taken from Maiden Peak by Osborne on July 2, 1933, due to the snow showing through the reduced timber canopies. These photos appear to show that the root rot pockets burned with much greater intensity than the surrounding areas.

The Osborne photos taken toward and beyond Odell Lake indicate only one significant fire scar, that of a 1914 fire west of Odell Lake that burned westerly onto the Willamette NF. It appears that no replacement fires of any size have occurred in the Diamond Peak Wilderness portions of the Odell Watershed for over 100 years.

Most of these lands that are either Congressionally or Administratively Withdrawn do not pose a significant fire risk, from the perspective of fire management personnel or the historic range. These wilderness or wilderness type areas have essentially 500+ year stand replacement fire occurrence rates. Even with effective suppression efforts being undertaken in these areas within the last century, no fire is known to have exceeded one acre in size since 1928. The area has not moved outside the historic range of variability.

Time moves slower within these stands, so perhaps it is appropriate to allow some monitored fires to ensure that the stands do remain within the HRV, including some control of root rot infestations by high intensity fires (Dickman & Cook 1988). Aerial photos for Dickman and Cook's fire occurrence study (1988) show a high correlation between stand replacement perimeters and significantly lower levels of root rot infection.

In order to allow lightning fires to burn in a monitored status within this area, safeguards would have to be set up that would take into consideration fuel moistures, drought conditions, specific locations, neighboring resources, and time of year, etc. Should a fire exceed its prescription, it could be placed in a suppression mode. The major limiting factors with this opportunity are smoke management concerns and public acceptance.

The mountain hemlock stands located on the south slope of Maiden Peak and the north slopes of Hamner Butte, Maklaks and Royce Mountains may have greater fire occurrence rates due to the length of the slopes located there. Stand exams for 706 acres of mountain hemlock on Maklaks Mountain show that replacement event(s) last occurred there between 1780-1784. This area probably also burned in 1680. The mountain hemlock stands located on Hamner Butte and Maklaks Mountain show advanced root rot infection and may indicate stand replacement fires may occur in these locations as a result of fuel loading. Such a high intensity replacement fire would place the surrounding east, west, and southerly exposures at great risk. These exposures would have to be “fire proofed” by underburns before a replacement fire prescription for the north slopes could be written.

Lodgepole Wet, (LPW) and Dry, (LPD) PAGs:

Lodgepole lives, dies, falls down and usually burns with such rapidity that it is difficult to manage it as Late Successional Reserve. Historically, approximately one-third of the lodgepole pine stands in the vicinity of Odell Creek probably burned every 60 years. The drier the site, the more complete the replacement. Information from a USGS map of the Forest Conditions in 1903 for the Cascade Range Forest Reserve shows two burned areas just southwest of Davis Lake. These two burns combined are nearly as large as Davis Lake at full pool, or approximately 3,000 acres.

These maps are slightly flawed when compared with the precision mapping that is available today. The maps show rounded perimeters for fire, forest, grazing and other areas, which typically did not occur. The maps appear to be accurate enough to indicate that substantial fire activities need to be reintroduced in the lodgepole PAGs, particularly with respect to meadow encroachment in riparian areas and the adjacent habitat.

The burning of lodgepole stands near riparian areas should be considered to restore meadow size. The riparian areas themselves could serve as portions of the necessary fire breaks. The other 'fire line' needed could be made by setting up portable pump sprinkler operations which would reduce the need for ground disturbance. This type of prescribed fire would be best used in the West Odell Creek area in 5 to 50 acre parcels.

The drier lodgepole stands found in the eastern half of the Odell Creek drainage would best be served by duplicating the larger fires shown on the USGS report. This would avoid the fragmentation that has occurred in the recent past that is detrimental to numerous wildlife species.

Mixed Conifer Wet, (MCW) & Dry, (MCD) PAGs:

Of the MCW and MCD stands, 52% have had stand examinations completed on them. Information collected from these stands shows that the average year of the last stand replacement event weighted by acreage was 1814 for the MCW and 1820 for the MCD. The number of years since the last stand replacement event ranges from 97-314 years ago. The fires that occurred in 1910, 1914 and 1930 also included some mixed conifer acreage. A few of the mixed conifer stands located on the southerly slopes were replaced as often as 1680, 1780, 1840 and 1860; while others have not been replaced since 1680. The 60-300 year frequency suggested here for southerly aspects is somewhat wider than the 75-150 year frequency listed in the Deschutes NF WEAVE. The WEAVE document states that the more northerly aspects of MCW have a 50-300 year replacement fire rate. The stand exams on these slopes indicate events within this range.

Stands at the base of south slopes are typically older than those located farther up the slope. This information was obtained from a fire history study that took place on the eastside of the Mount Jefferson Wilderness (Simon 1991). The mid and upper slopes receive more ignitions than the lower slopes, and on the southerly aspect typically result in backing fires that burn with less intensity, which insulates the lower stands from replacement fires. Both the mixed conifer wet and dry PAGs at the base of Maklaks Mountain date primarily from 1680. These are some of the oldest stands in the Odell Watershed. While their stand replacement occurrence rates are very low, 160-314+ for MCW on Maklaks, the low intensity underburn frequency is probably high, 10-75 years.

The lessons that can be learned from the south slopes are clear. If maintaining old growth or moving a stand towards it is the objective, two things are necessary, first, silvicultural treatments to reduce density and fire risk together with an aggressive prescribed fire program and, second, continued fire suppression until the former is achieved. Eventually, both management practices could be reduced if the underburns are maintained at the same frequency as the historic rate found on the lower south slope stands. The initial burns are the expensive, labor intensive efforts. Once the first round of underburns is completed, both fire suppression needs and expense for the next round of burns decreases.

Returning to fire resistant old growth stands will require layered removal of fuels in most areas. One type of layered removal would require a late fall burn after a soaking rain where the underside of the large diameter logs would be lighted and reduced. The next spring, after the snow melts and a two plus week drying occurs, the smaller diameter ground fuels could also be reduced. The partial removal of one fuel layer at a time lowers the intensity of each burn and increases green tree survivability. In those mixed conifer stands with high true fir ladder fuel configurations, a mechanical thinning from below of the firs would first be necessary. Following this, the burning of landings and then ground fuel reduction burns should occur. The heavy fuel loading of these stands require labor intensive efforts to prevent significant damage to these LSR stands. Oftentimes, a single burn window small enough to reasonably protect the big trees cannot be written. Ultimately, the costs of fire suppression are high.

Ponderosa Pine (PP) PAG: (Figure 19)

Stand exam data for the Odell Watershed shows a variety of age and dbh ranges for the ponderosa PAG indicating the somewhat random effects of historic natural underburning and bark beetle activity.

Stand replacement events occurred every 75-300+ years in this PAG. These stands are adjacent to and intermixed with both of the mixed conifer PAGs. The frequency rates for both stand replacement and underburns are very similar for ponderosa pine and mixed conifer stands and vary more by aspect and slope than by PAG. As with the mixed conifer, it is fairly important that the southerly ponderosa stands receive first priority for prescribed fire and other treatments for fire proofing in order to prevent large stand replacement fires.

The accumulation of ladder fuels, primarily from competition mortality and lodgepole pine ingrowth, has endangered the overstory. A series of treatments such as thinning from below followed by low intensity burning should be undertaken to restore the remaining stands to a more reasonable fire resistant level.

Fire as a Disturbance Factor

The transition from historic fire frequency, intensity, size, timing, and duration to fire as a present disturbance factor within the watershed will take additional work. While this is an important step in analyzing future outcomes of management scenarios, the modeling done with this watershed analysis proved to be inadequate. Appendix D contains additional fire information.

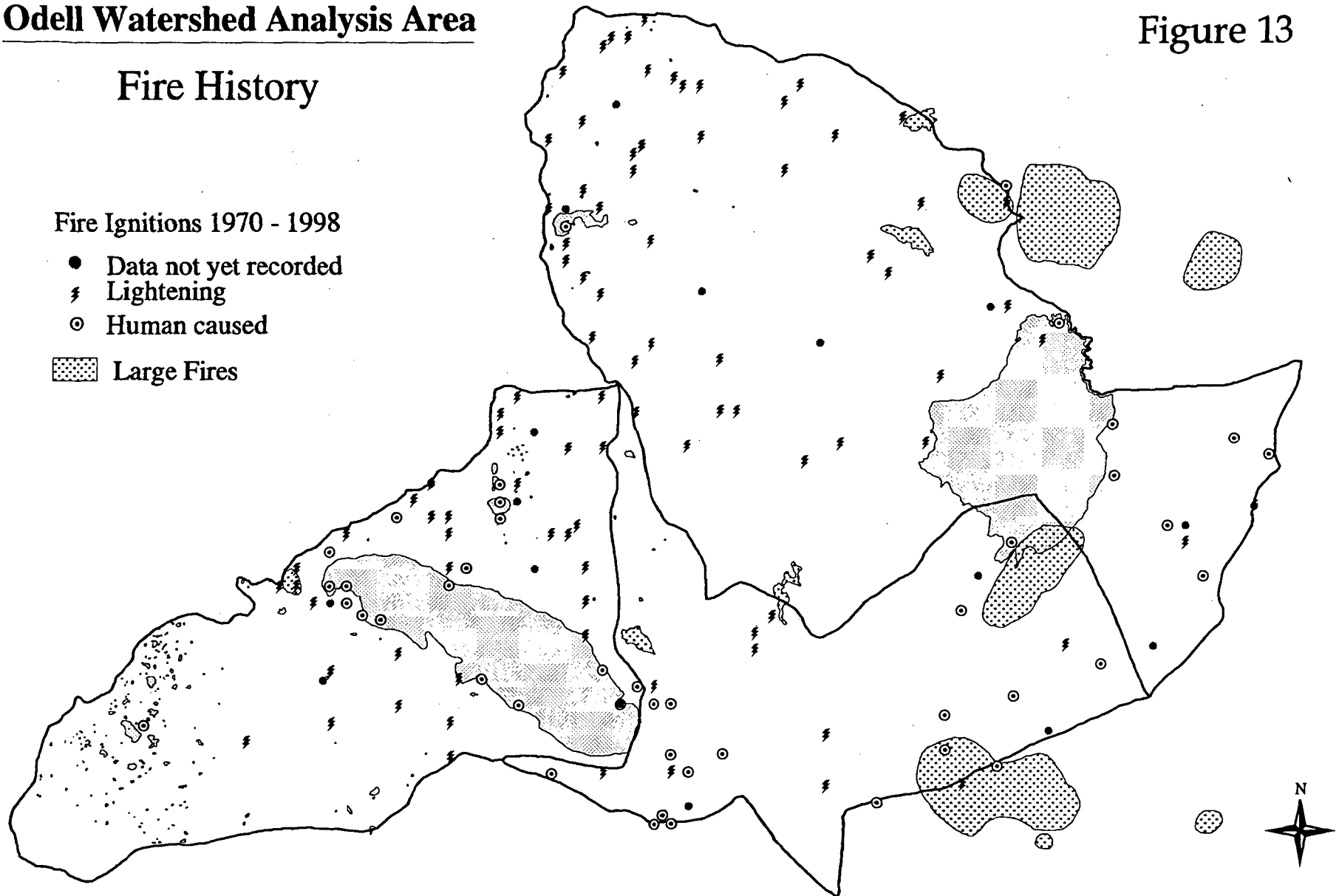
Odell Watershed Analysis Area

Figure 13

Fire History

Fire Ignitions 1970 - 1998

- Data not yet recorded
- ⚡ Lightning
- ⊙ Human caused
- ▨ Large Fires



Note: Fire origin locations are accurate to the nearest quarter of a quarter section.

1 0 1 Miles

Plant Species of Concern

What is the relative abundance and distribution of plant species of concern that are important in the watershed (threatened or endangered species, special status species, species emphasized in other plants)?

The Odell Watershed Analysis Area contains a variety of habitats that are home to many rare and sensitive plant species. Protection status for these species vary, however, each species has been identified because of its unique contribution to biological diversity.

The plant species known to occur in the Odell Watershed Analysis Area are listed in Table XX. Much of the area has not been surveyed and other rare species have the potential to occur. Species with potential to occur are listed in Table XX.

No Threatened or Endangered plant species are known to occur in the watershed. One plant on the Regional Forester's Sensitive Plant List has been reported. Also present are five Survey and Manage plants, listed in the Northwest Forest Plan, which have a strong association with old-growth forests. Three plants listed in the Oregon Natural Heritage Program's Rare, Threatened and Endangered Species of Oregon are also known to be present.

The Odell Watershed Analysis Area also contains habitats for many non-native plant species including noxious weeds. These are listed in Table 25.

Table 23 Plant Species of Concern found in Odell Watershed

SPECIES	TYPE	STATUS	OCCURRENCE	PAG	HABITAT NOTES
<i>Astragalus peckii</i>	Vascular plant	Sensitive	Central Oregon endemic	LP, MCW	Exposed areas and sandy pumice. Small Herbarium collection: 7/15/41; OSC. T23S.R6E.Sec15. Odell Lake. This site was not relocated during 1999 surveys.
<i>Albatrellus c.f. caeruleoporus</i>	Fungus	SM 1,3	WA Cascades, OR Coast Range, NE US	MC	Ectomycorrhizal with <i>Tsuga</i> species. Trapper Creek.
<i>Allotropa virgata</i>	Vascular plant	SM 1,2	West Coast endemic	MCD, MCW, LP	Symbiotic with conifers and their ectomycorrhizal fungi. Associated with closed canopy Douglas fir or old-growth ponderosa pine, and matsutake. Many occurrences in Odell Watershed.
<i>Buxbaumia aphylla</i>	Moss	ONHP 3	PNW. Only 4-5 known sites in OR as of 4/99.	MCD	Moist, acidic soil in upper montane to alpine zones. West end Odell Lake and Royce Mt.
<i>Buxbaumia viridis</i>	Moss	PB	Interupptedly circumboreal	Riparian MCW	On rotten logs, in shady humid forests. Stream terraces and floodplains. North of Odell

					Lake, Maklaks Mt. and Royce Mt.
<i>Calicium glaucellum</i>	Pin lichen	SM 4	PNW, N. Europe	MCW, LP, PP	On medium to large snags without bark. Mountain hemlock, shasta red fir, pine species. NE of Bobby Lake.
<i>Clavariadelphus truncatus</i>	Club fungus	SM 3,4	Widely distributed West Coast to Rocky Mountains, but uncommon	MCW	Scattered to gregarious in duff under conifers. Trapper Creek.
<i>Hieracium bolanderi</i>	Vascular plant	ONHP 4	West Coast endemic	MC	MC and nonforested areas in open, exposed, dry, well-drained, usually rocky sites. Diamond Peak Wilderness.
<i>Lycopodium annotinum</i>	Vascular cryptogam	ONHP 4	Circumboreal	MCW	Moist coniferous forest below timberline. Crystal Creek.
<i>Mimulus jepsonii</i>	Vascular plant	ONHP 2	Central Oregon/Northern California eastside endemic	LP, MCD, PPD	Dry, open forest or forest openings with exposed soil, flat to very gentle slopes. Many occurrences in Odell Watershed.
<i>Rhizopogon truncatus</i>	False truffle	SM 3	Western North America	MC	Grows under conifers, particularly white pines. Yoran Lake.
<i>Shistostega pennata</i>	Moss	PB	Interruptedly circumboreal	MCW, riparian	Occurs on mineral soil in shaded pockets of overturned tree roots (often with standing water much of the year), and in moist crevices and caves. Requires high humidity and densely shaded microsites. Odell Lake.
<i>Tritomaria exsectiformis</i>	liverwort	SM 1,2	Eastside, central Cascades in OR. Only known sites in NW are on DNF	Riparian	On rotting wood, peaty, or humic soil, often on creek banks where shady and moist. Ranger Creek.

Sensitive = Region 6 USFS List; SM = Survey & Manage Species List, categories 1,2,3,4, Northwest Forest Plan; PB = Protection Buffer Species, Northwest Forest Plan; ONHP = Oregon Natural Heritage Program Lists 1,2,3,4.

Bold Lettering indicates taxa that require surveys.

Table 24 Plant Species of Concern that have potential to occur in Odell Watershed

SPECIES	TYPE	STATUS	OCCURRENCE	PAG	HABITAT NOTES
VASCULAR PLANTS					
<i>Agoseris elata</i>	Vascular plant	Sensitive	PNW endemic	PP	Meadows and open woods, dry edges of moist ecotones.
<i>Arnica viscosa</i>	Vascular plant	Sensitive	OR and CA	High elev. forest and lava	Rocky places, scree and talus slopes, at or above timberline.
<i>Botrychium minganense</i>	Vascular plant	SM 1,2 Sensitive	OR, WA, Canada and northern US	LP, PIEN	Stream terraces with LP, PIEN and <i>Vaccinium myrtillus</i> . Also,

			to east coast.		high elevation, boggy, flat areas in cold, moist forests.
<i>Botrychium montanum</i>	Vascular plant	SM 1,2 Sensitive	OR, WA, British Columbia, Montana	LP, PIEN	Known to occur in areas heavily used by elk, in LP openings with <i>Vaccinium scoparium</i> , <i>Fragaria virginiana</i> , <i>Viola adunca</i> , and <i>Hypericum anagalloides</i> . Forest openings with oversory of PIEN and LP. Often occurs with <i>Botrychium minganense</i> .
<i>Collomia debilis</i> var. <i>larsenii</i>	Vascular plant	ONHP 4	WA, OR, CA	Lava rock	Talus slopes on the high peaks of the Cascades.
<i>Cypripedium montanum</i>	Vascular plant	SM 1,2	Within range of NWFP	MCW, PP	Found in scattered sites on both sides of the Cascades. Mainly in moist woods.
<i>Lobelia dortmanna</i>	Vascular plant	Sensitive	1 known site in OR. On Sisters RD	Lake, riparian	In shallow water.
<i>Lycopodiella inundata</i>	Vascular cryptogam	Sensitive	Interruptedly circumboreal	Peat bogs, pond margins	Terrestrial in bogs, on shores of ponds, streambanks, and in meadows that may be periodically inundated. Bingham Lakes, Nip&Tuck Lakes.
FUNGI					
<i>Alpova alexsmithii</i>	Rare false truffle	SM 1,3	Cascade endemic	High elev. forest	With roots of conifers, particularly mountain hemlock.
<i>Bondarzewia mesenterica</i> (= <i>B. montana</i>)	Bondarzewia Polypore	SM 1,2,3	WA, OR, CA, BC, Germany, Switzerland	MC	Duff/soil in mixed conifer forests. Often associated with stumps and snags.
<i>Bridgeoporus nobilissimus</i>	Polypore	SM 1,2,3	OR endemic	ABPR, ABAM	On stumps, standing dead or live >43" dbh <i>Abies procera</i> or <i>Abies amabilis</i> .
<i>Cantharellus subalbidus</i>	Fungus	SM 3,4	Regional endemic	MCD, MCW	On ground, often with matsutake.
<i>Cortinarius wiebeae</i>	Rare gilled mushroom	SM 1,3	PNW	MCD, PP	Found in association with roots of PSME and PIPO at 3500 ft and higher.
<i>Elaphomyces anthracinus</i>	Rare truffle	SM 1,3	Local endemic	PP	One known site in N America, near Metolius River. Associated with old-growth ponderosa pine.
<i>Elaphomyces subvisidus</i>	Rare truffle	SM 1,3	2 known sites in OR	LPHD	Mycorrhizal association with lodgepole pine.
<i>Gastroboletus ruber</i>	Rare bolete fungus	SM 1,3	Cascade endemic	High elev. forest	Above 4000 ft with roots of conifers, esp. mountain hemlock, silver and noble fir and western white pine.
<i>Gastroboletus subalpinus</i>	Bolete fungus	SM 1,3	Mountain ranges of the West	High elev. forest	Found in association with the roots of assorted Pinaceae, particularly TSME, PICO, PIAL.
<i>Gomphus</i>	fungus	SM 3	North America	MCD	Conifer forests. Crescent Lake.

<i>floccosus</i>					
<i>Gymnomycetes abietis</i>	Rare false truffle	SM 1,3	Rare local endemic	High elev. forest	With roots of <i>Abies</i> and other conifers above 3000 ft.
<i>Helvella crassitunicata</i>	Rare cup fungus	SM 1,3	North America	Riparian MCW	Montane forests containing <i>Abies</i> species.
<i>Hydnотryna inordinata</i>	Rare truffle	SM 1,3	Rare local endemic	High elev forest	With roots of silver fir, Douglas fir, lodgepole, and mountain hemlock.
<i>Hygrophorus caeruleus</i>	Uncommon gilled fungus	SM 1,3	PNW endemic	MCW	Mid-elevation to montane conifer forests. May be restricted to <i>Abies</i> .
<i>Nivatogastrium nubigenum</i>	False truffle	SM 1,3	PNW	MCD	On surface of rotten <i>Abies</i> logs, often near melting snow or shortly after the snow disappears. Odell Butte.
<i>Otidea leporina</i>	Rabbit ears	PB	WA, OR, CA	Conifer forest	Aside from occurrence in conifer forest, there is no specific information for any of the <i>Otidea</i> spp. at this time.
<i>Otidea onotica</i>	Donkey ears	PB SM 3	WA, OR, CA	Conifer forest	Same as above.
<i>Polyozellus multiplex</i>	Rare chanterelle	SM 1,3 PB	Northern and montane North America	MCW, MCD	Occurs in association with roots of <i>Abies</i> species in late-successional, mid elevation, montane conifer forests.
<i>Rhizopogon evadens</i> var. <i>subalpinus</i>	Rare false truffle	SM 1,3	PNW	MHHD	Found in association with roots of TSME or <i>Abies</i> spp. at mid to high elevations.
<i>Rhizopogon flavofibrillosus</i>	Rare false truffle	SM 1,3	PNW	MCD, MCW	Found in association with the roots of various Pinaceae.
<i>Sarcosoma mexicana</i>	Giant Gel cup	PB SM 3	Western North America and Mexico	PP, MC	On duff in moist ponderosa pine, mixed conifer, and riparian zones. Preferred sites = areas of moisture accumulation (benches, bases of slopes) with much down, decayed woody debris. Higher elevation form found at receding snow lines.
<i>Sarcosphaera eximia</i> (=crassa)	Rare cup fungus	SM 3	Western North America	MC	Western conifers. Cryder Butte and Chinquapin Butte.
LICHENS					
<i>Bryoria tortuosa</i>	Lichen	SM 1,3	PNW	Coniferous forest	On bark or wood of conifers and hardwoods. Crescent Lake, Odell Butte, Ringo Butte.
<i>Cladonia norvegica</i>	Lichen	SM 3	PNW	PP, MCW	On rotten wood in humid forests.
<i>Collema</i> sp.	Riparian lichen	SM 4	Americas	Riparian	Moist riparian forests, often on hardwoods.

<i>Lobaria hallii</i>	Leafy lichen	SM 1,3	Regional endemic	MCW, Riparian forests	With old cottonwoods, maple, moist forest areas.
<i>Lobaria pulmonaria</i>	N-fixing lichen	SM 4	PNW	MCW	Large foliose lichen found on vine maple, cottonwoods, and mossy rock.
<i>Peltigera collina</i>	N-fixing lichen on soil	SM 4	PNW	MCW, MCD	On mossy bark and rock. Or riparian settings on mossy bark of cottonwoods and vine maple and some sites on mossy rock on desert fringe.
<i>Pseudocyphellaria anomala</i>	N-fixing lichen	SM 4	PNW	MCD, MCW	Moist forests, most often on hardwoods and shrubs or rocks.
<i>Pseudocyphellaria anthraxis</i>	N-fixing lichen	SM 4	PNW	MCW	Moist riparian forests.
<i>Pseudocyphellaria rainierensis</i>	N-fixing lichen	SM 1,2	PNW	MCW	Moist old-growth forests at low to mid elevations.
<i>Nephroma helveticum</i>	N-fixing lichen	SM 4	PNW	MCW	Moist riparian forests.
<i>Nephroma resupinum</i>	N-fixing lichen	SM 4	PNW	MCW	Moist riparian forests.
BRYOPHYTES					
<i>Marsupella emarginata</i> var. <i>aquatica</i>	Aquatic liverwort	SM 1,2	1 known site in OR, Waldo Lake, Central Cascades	Aquatic	Submerged in shaded, fast-moving, cold perennial stream.
<i>Scouleria marginata</i>	Moss	SM 4	Eastern Russia and Northwestern North America	Riparian	Intermittently flooded, splashed, or irrigated rock surfaces in or flanking water courses.
<i>Tetraphis geniculata</i>	Moss	PB	Interruptedly circumboreal	MCW, riparian	Dense, shady, humid forests on well-rotted stumps and logs. Almost always found with <i>Tetraphis pellucida</i> .
<i>Ulota megalospora</i>	moss	PB	PNW endemic	Riparian MCW	Epiphytic on conifers and hardwoods.

Sensitive = Region 6 USFS List; SM = Survey & Manage Species List, categories 1,2,3,4, Northwest Forest Plan; PB = Protection Buffer Species, Northwest Forest Plan; ONHP = Oregon Natural Heritage Program Lists 1,2,3,4. **Bold Lettering** indicates taxa that require surveys.

Table 25 Noxious Weeds and other non-native plants that occur or have the potential to be introduced

Species	Common Name	Subwatershed occurrence
Noxious Weeds Documented to occur		
<i>Bromus tectorum</i>	Cheatgrass	All
<i>Centaurea diffusa</i>	Diffuse knapweed	Odell Lake, Moore
<i>Centaurea maculosa</i>	Spotted knapweed	All
<i>Cirsium arvense</i>	Canada thistle	Odell Lake
<i>Cirsium vulgare</i>	Bull thistle	All
<i>Cynoglossum officinale</i>	Houndstongue	Odell Lake
<i>Cytisus scoparius</i>	Scot's broom	All
<i>Hypericum perforatum</i>	St. Johnswort	All

<i>Linaria dalmatica</i>	Dalmatian toadflax	Odell Lake
<i>Linaria vulgaris</i>	Butter and Eggs	All
<i>Onopordum acanthium</i>	Scotch thistle	Odell Lake
<i>Phalaris arundinacea</i>	Reed canarygrass	Moore
<i>Senecio jacobaea</i>	Tansy ragwort	Odell Lake, Moore
Potential to be Introduced		
<i>Cardaria draba</i>	Whitetop, Hoary Cress	
<i>Carduus nutans</i>	Musk thistle	
<i>Carduus pycnocephalus</i>	Italian thistle	
<i>Centaurea repens</i>	Russian knapweed	
<i>Centaurea solstitialis</i>	Yellow starthistle	
<i>Conium maculatum</i>	Poison hemlock	
<i>Dipsacus sylvestris</i>	Teasel	
<i>Euphorbia esula</i>	Leafy spurge	
<i>Isatis tinctoria</i>	Dyer's woad	
<i>Kochia scoparia</i>	Kochia	
<i>Lythrum salicaria</i>	Purple loosestrife	
<i>Ranunculus repens</i>	Creeping buttercup	
<i>Salvia aethiopsis</i>	Mediterranean sage	
<i>Taeniatherum caput-medusae</i>	Madusahead	
Undesirable Non-natives		
<i>Anagallis arvensis</i>	Scarlet pimpernel	Odell
<i>Anchusa officinalis</i>	Common bugloss	Odell
<i>Brassica campestris</i>	Field mustard	Odell
<i>Brassica kaber</i>	Wild mustard	Odell
<i>Brassica campestris</i>	Field mustard	Odell
<i>Brassica kaber</i>	Wild mustard	Odell
<i>Calandrinia ciliata</i>	Red maids	Odell
<i>Capsella bursa-pastoris</i>	Shepherd's purse	Odell
<i>Daucus carota</i>	Wild carrot	Odell Lake, Odell
<i>Hypochaeris radicata</i>	Hairy cats-ear	Odell Lake, Odell
<i>Melilotus alba & officinalis</i>	Sweet clovers	Odell Lake
<i>Polygonum convolvulus</i>	Bindweed	Odell Lake
<i>Rubus discolor</i>	Himalayan blackberry	Odell
<i>Rumex acetosella</i>	Sour dock	All
<i>Rumex crispus</i>	Curly dock	Odell Lake, Odell
<i>Rumex obtusifolius</i>	Bitter dock	All
<i>Sonchus asper</i>	Prickly sow thistle	Odell
<i>Verbascum thapsus</i>	Mullein	All

The following is a summary of the status and habitat conditions in the subwatersheds in the Odell Watershed and their focal plant species. Focal species represent a variety of other species with similar habitat needs.

Odell Subwatershed

Focal Species: *Allotropa virgata* (Candystick), *Mimulus jepsonii* (Jepson's monkeyflower)

Other potential species: *Nivatogastrium nubigenum*, *Alpova alexsmithii*, *Hygrophorus caeruleus*, *Rhizopogon flavofibrillosus*, *R. evadens* var. *subalpinus*, *R. truncatus*, *Elaphomyces anthracinus*, *E. subviscidus*.

Characterizations: *Allotropa virgata* occurs in closed canopy, mature, and old-growth seral stages usually in mixed conifer forests. Inland populations in the Bitterroot range of Montana and Idaho are found in lodgepole pine stands. It occupies dry, well-drained soils with abundant coarse woody debris, especially decay classes 4 and 5. *Allotropa virgata* is a mycotroph - a plant that obtains necessary nutrients and carbon compounds from a fungus associated with its roots. The mycelium of the fungus is associated with roots of conifer that indirectly 'feeds' the mycotroph via the fungus. Dependence of mycotrophic plants on the conifer host suggests that anything that destroys the tree component or severs the mycorrhizal relationship will result in death of the mycotroph. One of its fungal associates is *Tricholoma magnivelare*, matsutake mushroom (Wogen and Lippert, 1998).

Mimulus jepsonii is an annual forb species that most often grows in dry, open lodgepole pine forest or forest openings with bare to light needle litter on sand, loamy sand, or sandy loam soils on flat to 5% slopes. Important factors in maintaining the viability of *Mimulus jepsonii* are abundant moisture and light, abundant insect pollinators, and light to moderate disturbance.

Reference conditions: The historical distribution and abundance of *Allotropa virgata* and *Mimulus jepsonii* and other plant species of concern associated with these habitats are not known. Habitat conditions and species composition before management activities such as fire exclusion and stand management were probably quite different than they are now. Generally, fires occurred more frequently and were of lower intensity before the mid-1800s. *Mimulus jepsonii* habitat was probably concentrated in open areas where bare mineral soil was exposed by run-off, or in areas where the duff was burned away by natural fires to bare mineral soil in the alluvial areas around the bases of the buttes. *Allotropa virgata* habitat was probably concentrated in old-growth mixed-conifer stands where fire occurred less frequently than in lodgepole or ponderosa pine plant associations.

Current Condition and Human-Caused Changes:

Allotropa virgata is found consistently in older mixed-conifer dry stands across the district and is usually concentrated on the northerly aspects of the buttes (matsutake mushroom also occurs with greater density in these areas). It has NOT been found to occur on this district in regeneration harvest units less than 20 years since harvest. Older harvest units have not been surveyed because no activities have been planned there. Some selective harvesting was done in the past and in stands where older trees and coarse woody debris have been retained and the canopy is relatively closed, *Allotropa virgata* has been found to occur. Evidence of

historical fire events have been found at several *Allotropa virgata* sites, suggesting forest processes (not limited to fire) may have historically provided the coarse woody debris for *Allotropa virgata* and its fungal associates to colonize. Activities that directly or indirectly affect the species and its associated habitat outside the core area include: (1) Reduction of coarse woody debris below Northwest Forest Plan levels will impact current and future habitat; (2) Actions that disturb mycorrhizal networks; (3) Actions that accelerate decomposition of the duff layer; and (4) Actions that reduce reproductive potential.

Habitat for *Allotropa virgata* has been reduced in the last 80 years by development, recreation (campgrounds, summer homes, etc.), timber harvest, and road building. In precommercial thinning units where trees were clear-cut in the 1970's and 1980's, *Allotropa virgata* has not been observed during plant surveys. ALVI has been observed in older stands adjacent to harvest units and in wildlife clumps within some units where downed wood was left and bigger older trees were not harvested. Activities that have removed host trees and down woody debris required by the mycorrhizal fungi associated with *Allotropa virgata* have reduced the available habitat for this species.

Noxious Weeds and other undesirable non-native plants

Characterization: Travel, recreation, and harvest activities have been the primary modes of introduction for noxious weeds and other undesirable non-native plants. Weeds are non-native plants introduced from other countries that take advantage of disturbed areas such as roadsides and harvest units. Noxious weed species that have been treated in Odell Subwatershed include spotted knapweed (*Centaurea maculosa*, CENMAC), and bull thistle (*Cirsium vulgare*, CIRVUL). Other noxious weeds and undesirable non-natives occur in Odell Subwatershed including St. Johnswort (*Hypericum perforatum*, HYPPER), houndstongue, Scot's broom (*Cytisus scoparius*, CYTSCO) and others. Most of the weeds are found along Highway 58 where seeds are carried by vehicles and hay trucks from other locations. One weed site just east of Odell Creek has soil and weeds characteristic of the west side. It is speculated that a load of dirt from an unknown location on the west side was dumped at this site.

Reference conditions: Noxious weeds and other undesirable non-native plants are not likely to have occurred in the Odell Watershed before the early to mid 1800's. Natural processes, including fire, weather cycles, floods, etc., maintained the native plant communities in the watershed.

Current Conditions and Human-caused changes: Noxious weeds harm native plant communities and wildlife habitat, damage watersheds, increase soil erosion, reduce recreational opportunities, reduce crop yields, reduce land values, and poison and kill animals and humans. Weeds have been and are continuing to be introduced into Odell Watershed along travel corridors. The number of different species and the highest density of weeds occur along major travelways which include State Highway 58, the Railroad, and Cascade Lakes Highway (Road 46).

Harvest units can also have a high incidence of weeds. In harvest units, weed species with the highest concentrations and that are of the most concern in the watershed are tansy ragwort, bull thistle, and common mullein. Weed seeds are brought in on logging equipment

that has not been thoroughly cleaned before moving from and through infested areas to weed-free areas.

Odell Lake Subwatershed

Focal Species: *Buxbaumia viridis*, *Buxbaumia aphylla*, *Schistostega pennata*, *Astragalus peckii*, *Albatrellus* c.f. *caeruleoporus*, *Clavariadelphus truncatus*, *Rhizopogon truncatus*, *Allotropa virgata*.

Other species of concern: *Hieracium bolanderi*, *Arnica viscosa*, *Collomia debilis* var. *larsenii*, *Cypripedium montanum*, *Lycopodiella inundata*, plus other fungi, lichens, and bryophytes on Table 2.

Noxious weeds and other undesirable non-natives: Spotted and diffuse knapweeds, Canada and bull thistles, St. Johnswort, Scot's broom, houndstongue, bindweed, sweet clover, and others.

Characterization: This subwatershed is characterized by alpine and subalpine habitats and high Cascades lakes on the east slope of Diamond Peak, and streams that flow into Odell Lake on both the north and south sides. The predominate plant association groups are high elevation mountain hemlock and lodgepole, and mixed conifer wet. There are potential habitats for fungus, lichen, and bryophyte species of concern identified in the Northwest Forest Plan.

Buxbaumia viridis was found to occur in the Odell Lake subwatershed during surveys conducted in 1999. This species occurs on decorticated, well-rotted logs or stumps in moist microsites in dense forest. *Buxbaumia aphylla* was also found to occur. Habitat for this species is disturbed soil (old skid trails or cut banks) in old-growth forests.

Schistostega pennata was discovered to occur in the Odell Lake subwatershed on October 25, 1999. This species was found on a root wad about 100 feet from the shoreline in a mixed conifer stand at the northwest end of Odell Lake. Habitat for this species is depressions with little light on mineral soil, or sometimes rock, associated with upturned tree roots or caves.

The Odell Lake area receives heavy recreation use. The recreation residences and resorts are visited year round and the campgrounds are open during snow-free periods in the summer and early fall.

The Railroad on the south side of Odell Lake and Highway 58 on the north are the main travel routes through the Odell Lake Subwatershed. The Pacific Crest National Scenic Trail and other hiking trails into Diamond Peak Wilderness are limited to foot travel only. The railroad and highway are the main corridors for dispersal of noxious weeds and other undesirable non-native plants. The potential for spread of weeds into the roadless and wilderness areas is high along the trails.

Reference Conditions: The historical abundance and distribution of plant species of concern in Odell Lake Subwatershed are not known. Records of inventory and surveys for vascular plants are available only from the recent past. A search of herbarium records for bryophytes, fungi, lichens, and vascular plants that have been collected in the past from the Odell Watershed has not been done. Oregon Natural Heritage Program records show a collection of *Astragalus peckii* was made on July 15, 1941 on the north side of Odell Lake.

The occurrence of noxious weeds and other undesirable non-native plants in Odell Lake Subwatershed was very rare or none prior to the 1900's. Travel through the area over the years by horses and wagons, trains, cars, and trucks has increased occurrences and the chances for dispersal of non-native weedy species along travel routes.

Current Conditions and Human-caused Changes: The areas of Odell Lake Subwatershed in Diamond Peak Wilderness and in the roadless area have experienced comparatively little human-caused disturbance. No mechanized travel in wilderness and no roads for motorized travel in the roadless area have kept ground disturbance at very low levels in these areas. In 1997 during inventories to relocate historic sites of species of concern, a taxon identified as *Hieracium bolanderi* by J. Kagan and confirmed by Dr. Chambers was found in the vicinity of the headwaters of Mountain Creek on the southeast slope of Diamond Peak. It was noted that these high elevation south Cascades plants appeared to be significantly different from typical *Hieracium bolanderi* found on serpentine habitats of southwestern Oregon and could be an undescribed taxon. If other populations of this taxon are found, additional taxonomic work may be warranted. Since the population does not appear to be threatened, perhaps this uncertainty is not a problem (Kagan, 1997).

Habitats around Odell Lake have been altered, reduced or eliminated by intense human use. The highway on the north side of the lake and the railroad on the south side have irreversibly altered the landscape and habitats. Development of the recreation residences, resorts, campgrounds, and day-use areas have also changed the character of the habitats around the lake. During a recent survey in the area of the 1941 *Astragalus peckii* siting, this species was not found.

Moore Subwatershed

Focal Species: *Tritomaria exsectiformis*, *Calicium glaucellum*, *Allotropa virgata*.

Other species of concern: *Mimulus jepsonii*.

Noxious weeds and other undesirable non-natives: Tansy ragwort, bull thistle, common mullein, reed canarygrass, spotted and diffuse knapweeds, and others.

Characterization: Moore Subwatershed extends from the Cascade crest east to the slopes of Davis Mountain and Hamner Butte. Plant association groups in the watershed are high elevation mountain hemlock and lodgepole pine, mixed conifer, and ponderosa pine. Bobby Lake, Moore Creek, Ranger Creek, and Davis Lake are the main water bodies in the subwatershed. The western part of the subwatershed is in roadless area and habitats here are

relatively undisturbed. Harvest activities, roads, and recreation around Davis Lake have changed the character of the habitats in the eastern part of the subwatershed.

Tritomaria exsectiformis, a liverwort, was found on Ranger Creek during surveys conducted in 1999 for the Seven Buttes Return analysis.

Calicium glaucellum, a pin lichen, was found near Bobby Lake during lichen inventories on CVS plots performed in conjunction with lichen collection for air quality monitoring studies.

Allotropa virgata has been found during surveys for projects. It occurs predominately in the mixed conifer dry plant association group. The extent of populations in the roadless area is unknown because no management activities are planned and no surveys have been done.

Reference conditions: The abundance and distribution of species of concern in the Moore Subwatershed prior to settlement is unknown. Habitats for plant species of concern have probably not changed significantly in the high elevation forests in the roadless area since the 1800's. In the rest of the subwatershed, habitats have changed with harvest activities, recreation, and fire suppression.

Current Condition and Human-caused changes: The present distribution and abundance of many of the species of concern is unknown in Moore Subwatershed. *Mimulus jepsonii* was removed from the Regional Forester's Sensitive Plant List on May 13, 1999. Since it grows quite well on native surface roads and in skid trails and landings in harvest units, management activities do not seem to be a threat to this species.

Wildlife

Introduction

There are 268 species of wildlife that are known or suspected to utilize habitat within the Odell Watershed at some point throughout the year. The species may utilize the watershed for breeding, foraging, and/or resting habitat. Riparian areas are used by 177 of those species.

Species habitats include foraging, reproduction, roosting, perching, and any other habitat necessary to the species through its life cycle. Not only does habitat quantity and quality affect species, but disturbance may also influence the ability to forage, reproduce, or disperse. Past logging, suppression of wildfire, and increased disturbance from recreational uses has lowered the quality of habitat for many species.

Pets or Selected Wildlife Species

Since the completion of the Odell Pilot Watershed Analysis, several changes have occurred regarding the listing status of various wildlife species. For example, the U.S. Fish and Wildlife Service delisted the American peregrine falcon effective August 25, 1999 meaning it is no longer listed as an endangered species although it will now be included as a sensitive species in Region 6, the Pacific Northwest. The U.S. Fish and Wildlife Service has also proposed delisting for the northern bald eagle. If that is approved, the species would also be added to the Regional Forester's sensitive species list for Region 6.

The Canada lynx has been proposed for listing as a threatened species and the U.S. Fish and Wildlife Service is expected to issue a final decision on January 8, 2000. At the present time all projects on national forest lands that may impact suitable lynx habitat have to be reviewed by the U.S. Fish and Wildlife through conferencing procedures.

Federal status has also changed for a number of wildlife species formerly listed as candidate species. In 1996, the U.S. Fish and Wildlife Service prepared a Categorical Exclusion document and published a notice in the Federal Register which discontinued the use of category 2 candidate species. Most of these species are now designated as federal species of concern.

Because of the number of changes that have occurred, an updated Proposed, Endangered, Threatened, and Sensitive (PETS) wildlife species table is shown below with the current status of those species known or suspected to occur within the Odell Watershed Analysis area.

Table 26. Proposed, Endangered, Threatened, Sensitive (PETS) and Selected Wildlife Species Known or Suspected to Occur within the Odell Watershed.

Species	Status
Northern Bald Eagle	Threatened/Region-6 Sensitive
Northern Spotted Owl	Threatened/Region-6 Sensitive
Western Snowy Plover	Threatened/Region-6 Sensitive
Canada Lynx	Proposed
American Peregrine Falcon	Region-6 Sensitive
Pacific Fisher	Region-6 Sensitive/Species of Concern
Greater Sandhill Crane	Region-6 Sensitive/Species of Concern
Long-Billed Curlew	Region-6 Sensitive
California Wolverine	Region-6 Sensitive/Species of Concern
Preble Shrew	Region-6 Sensitive/Species of Concern
American White Pelican	Region-6 Sensitive/Species of Concern
Northern Goshawk	Species of Concern
Pileated Woodpecker	Oregon State Sensitive
White-Headed Woodpecker	ROD Protection Buffer
Great Gray Owl	ROD Protection Buffer
Black-Backed Woodpecker	ROD Protection Buffer
Flammulated Owl	ROD Protection Buffer
Blue-Gray Taildropper Slug	Survey and Manage
Crater Lake Tightcoil Snail	Survey and Manage

Canada Lynx

Historic Range and Habitat Condition

Museum records verify the presence of lynx in the Cascade Range of Oregon during historic times. The historic range of the Canada lynx in Oregon was probably similar to what currently exists today but there are no records or scientific documentation to determine population densities. Historically, same as now, natural disturbances such as wildfires, volcanic events and insect outbreaks likely determined the vegetative patterns that would have defined the distribution and abundance of suitable denning and foraging habitat for the Canada lynx. Only more recently have fire suppression and regeneration timber harvests been included as disturbance factors that have also influenced suitable lynx habitat in the Central Oregon Cascade Mountains. Dense stands of young lodgepole pine and/or subalpine fir provide ideal habitat for the snowshoe hare which is the preferred prey for the Canada lynx. Late-successional forests and/or old growth forests, particularly in the mixed conifer zone provide quality denning habitat. It is assumed those stands currently possessing late-successional and old growth forests likely provided suitable denning habitat historically. At the present time mixed conifer stands near the Cascade Crest, Maklaks Mountain, Hamner Butte, and McCool Butte are providing late-successional and old growth forests capable of providing quality denning habitat for lynx.

Current Condition

To fulfill the requirements of the Northwest Forest Plan, a standardized survey protocol was designed to regionally survey for the presence/absence of Canada lynx throughout the range of the northern spotted owl. In 1998, the Willamette, Mt. Hood, and Deschutes National Forests in Oregon were selected for lynx surveys using har-snagging techniques and DNA analysis to confirm or deny the presence of lynx. A total of five lynx detections were confirmed on the Oregon national forests with each forest confirming lynx. The detections on the Deschutes National Forest included the Crescent Ranger District.

Based on these results, the survey effort was expanded in 1999 to include all national forests in the United States with recent lynx sightings and/or where the species was known or suspected to historically occur. Survey transects were run on the Crescent Ranger District and hair samples were collected in the Odell Watershed Analysis area. The hair samples have been sent in for DNA analysis although results are not expected before January 2000.

At the present time, Canada lynx have been proposed for federal listing and a final decision is expected January 8, 2000. Any federal project that has the potential to impact Canada lynx habitat has to be evaluated and an effects determination made on the planned action as part of the conferencing and/or consultation for the species. To assist in this process each national forest and ranger district is required to map suitable lynx habitat into areas approximating the size of female lynx home ranges. These areas would be identified as lynx analysis units (LAUs). These LAUs would be used in determining effects and cumulative effects of projects and activities as well assessing connectivity of lynx habitat and fragmentation. Lynx habitat mapping by LAUs for the Deschutes National Forest is currently underway with a tentative completion date of January 2000.

Northern Spotted Owl

Historic Condition

The historic range of the spotted owl was probably much as it is today but without the extensive fragmentation that currently exists. South-facing slopes of Hamner Butte and Davis Mountain may have had a larger component of ponderosa pine with a slightly more open canopy.

Openings would have been created by natural disturbances (fire, wind, and insects), but within mixed conifer they would have been larger in scale and fewer in number versus current patch openings created by timber harvest. Historic density levels for the spotted owl are not known. However, it is highly likely that densities of spotted owls were greater prior to human settlement of the area, given the recent loss and fragmentation of suitable habitat and its status as a threatened species.

Current Condition

Location Within Range:

The watershed is located along the eastern edge of the northern spotted owl range. Spotted owl pairs are generally located within the mature/old growth mixed conifer PAGs associated with the buttes. There are five pairs of owls and one resident single owl within the watershed. Three additional pairs of owls occur within ¼ mile, 1 mile, and 2 miles of the watershed boundary, respectively. The closest owl pair south of Odell Lake is 52 miles away and is located on the Chemult Ranger District. Three other documented spotted owl activity centers occur within the Crescent Ranger District to the south and southeast of the watershed. To the north five pairs of spotted owls are adjacent to Cultus Mountain (12+ miles north of Davis Lake) on the Bend Ranger District. On the Willamette National Forest the closest known spotted owl pair is 2 ¼ miles northwest of Willamette Pass and a single response occurred 1½ miles west of the Pass. Other documented pairs occur west of Waldo Lake.

Relative Population/Habitat Within Range:

The spotted owl is federally listed as a threatened species. Eastside owl populations and Odell Watershed densities are low in comparison with population densities in the remainder of the owl range. The eastside population is at the fringe of the owl range and the birds have adapted to somewhat different habitat types than westside owls. Eastside owls may provide genetic diversity that will enhance overall species adaptability. Species adaptability has become important as optimal habitat declined throughout the range of the owl.

The habitats that the eastside spotted owls utilize are not always the same as those typically associated with the westside spotted owls. Owls on the east side of the Cascades have adapted to areas containing a slightly different stand structure, vegetative species composition, and prey base. For example, owls in the Odell Watershed utilize more xeric ponderosa pine/mixed conifer stands dominated by ponderosa pine, Shasta red fir, silver fir, grand fir, white fir, and a limited Douglas-fir component, while westside owls utilize the mesic Douglas-fir/western hemlock stands. Average stand diameter size may be slightly smaller than those typically used on the westside. Eastside habitat has scattered larger diameter trees and overall stands have a canopy cover that is slightly more open than on the westside. The dominant prey species for the westside spotted owls is the northern flying squirrel. In the Odell Watershed, dusky-footed or bushy-tailed woodrats are probably equally as important as flying squirrels in the diet of the owl. Woodrats often predominate in diet samples collected within drier mixed conifer forests. (ISC report). Although not documented, spotted owls may also utilize lodgepole pine stands as dispersal and foraging habitat given the availability, abundance, and proximity of this habitat type within owl pair home ranges.

Critical spotted owl habitat unit OR-7 is encompassed by a Late-Successional Reserve (LSR) that overlaps the watershed. The Late-Successional Reserve within the watershed is adjacent to both Congressionally and Administratively Withdrawn Areas that tie together other LSRs up and down the eastside of the Cascade Range. Dispersal habitat throughout the LSR and watershed is in fair condition even though areas have been fragmented. The heaviest fragmentation occurs

west of Davis Lake 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 PAGs. However, optimal dispersal habitat would occur throughout the mixed conifer zone if it were not so heavily fragmented. The watershed contains 16,556 acres of suitable owl habitat (nesting, roosting, and foraging) which represents 22% of the total watershed acreage.

Past timber harvest activities have reduced and fragmented suitable spotted owl habitat within the watershed. Habitat loss and fragmentation within the mixed conifer plant association groups have detrimentally affected the owl in several ways. These effects include: a reduction in the available habitat for spotted owl territories; increase in the amount of energy needed to successfully reproduce, thus reducing individual fitness and reproductive potential; reduction in dispersal capabilities; and increase in competition and predation amongst other raptors such as the great horned owl and goshawk. In addition, barred owls have recently extended their range from the east coast to the west coast of the United States. Barred owls have successfully adapted to fragmented habitats and are known to compete with the spotted owl for habitat (space) and prey; and may potentially consume spotted owls as prey. Habitat fragmentation in the mixed conifer zone has reduced north to south dispersal corridors for the spotted owl, whereas the east to west corridors that occur within the mountain hemlock zone are stable.

In the ponderosa pine plant association group and mixed conifer dry PAG, historic harvest of ponderosa pine stands and fire suppression activities have resulted in the growth of a dense understory of white fir. These activities have created better quality spotted owl habitat in the ponderosa pine and mixed conifer dry plant association groups. This habitat, however, is generally not stable over time, due to the fire history of the area, prolonged drought, and insect and disease infestations. When fire occurs in these areas, it will most likely be a large scale stand replacing fire. Prior to fire suppression, the fire cycle would typically have been comprised of short duration, small scale, ground fires that would have maintained the overstory ponderosa pine trees and thinned the understory white fir.

Fire historically acted as a controlling agent for epidemics of disease and insects which currently are infesting the stands as a result of fire suppression efforts.

Increasing demand for public and commercial mushroom harvesting 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 this important fall forage component may lead to reduced fitness or population decreases among small mammal species, which could cause a reduction in the spotted owl prey base.

Bald Eagle

Historic Condition

Bald eagles historically nested and foraged on Davis and Odell Lakes and fed on bull trout, rainbow trout, whitefish, and waterfowl.

Current Condition

The bald eagle has been proposed for delisting from the Endangered Species List, although if that is approved, the species would still remain on the Region 6 Regional Forester's Sensitive species List. The watershed provides nesting habitat for six known pairs of bald eagles around both Odell and Davis Lakes, and in mild winters the eagles may reside year-round. During

colder winters, the eagles may migrate to Klamath Marsh or other areas having an abundance of waterfowl. Bald Eagle Management Areas are located around Davis and Odell Lakes (Figure 4).

In the fall Odell Lake and its tributaries provide an opportunistic food source since the introduction of kokanee salmon. Kokanee spawn along the lake edges and in Trapper and Crystal Creeks and provide an easy prey base for bald eagles and osprey.

At Davis Lake the food base has changed from bull trout, rainbow trout, whitefish, and waterfowl to chubs, whitefish, rainbow trout, and waterfowl. The change in prey base resulted from the poisoning of Odell Creek and Davis Lake in 1959 and the introduction of non-native fish species and their associated diseases.

The change in prey species has caused the eagle to expend a greater amount of energy for the same amount of fish. Where, historically, one successful foraging trip would lead to the capture of one large bull trout, rainbow trout, or whitefish, presently, several trips may have to be made in order to acquire the same poundage of chubs and smaller fish. Since additional trips are required, the eagle expends more energy and, therefore, has to increase the poundage of fish consumed in order to maintain the same fitness level. In addition to the increased energy expenditure, a rise in the amount of recreational activity on both Odell and Davis Lakes has also occurred, which causes added disturbance during active foraging periods. This disturbance causes an increase in the amount of time and energy spent feeding.

Peregrine Falcon

Historic Condition

Limited suitable habitat historically was available within the watershed (potentially Lakeview Mountain, Maiden Peak and Diamond Peak). It is unknown what the population densities may have been. Use of toxic pesticides (2-4-5-T and DDT) reduced populations of many raptors, including bald eagle, osprey, golden eagle, and peregrine falcon, that fed on prey that had consumed pesticides. The pesticides reduced egg shell strength and during incubation many eggs were inadvertently crushed. Nestlings that did hatch were typically weak and had low survival rates.

Current Condition

The peregrine falcon has been removed from the Endangered Species List effective August 25, 1999, although it remains on the Region 6 Regional Forester's Sensitive Species List. To date peregrine falcons have only been observed migrating through the Odell Watershed. Limited habitat does exist within the watershed, but there are no known or suspected nest sites. However, available habitat may become important as the peregrine falcon recovers and new nesting territories are established. The species is not now known to occur on the Deschutes National Forest except as a seasonal migrant. If these sites become occupied by nesting peregrine falcons in the future, conflicts with recreational use (especially rock climbers) may occur, since peregrine falcons are not tolerable of human disturbance. In addition, geothermal and mining development would need to be assessed as to the potential impacts to the species.

A ban on the use of toxic pesticides was established in the United States, but these pesticides are still legally being used in Central and South America. For species such as the peregrine falcon that migrate to Central and South America, pesticides still pose a threat to populations and breeding capabilities.

Western Snowy Plover

Historic Condition

Western snowy plover habitat historically existed at Davis Lake and its associated wet meadows. The lake's dramatic water fluctuations provide excellent shorebird habitat, including that for western snowy plovers.

Current Condition

There are no documented sightings of western snowy plovers within the watershed, however, foraging and nesting habitat does exist at Davis Lake. The fluctuations at Davis Lake continue to provide exceptional foraging opportunities for the western snowy plover. The western snowy plover is currently a federally listed threatened species.

Northern Goshawk

Historic Condition

Historically, the abundance of habitat that was available for the northern goshawk was greater than that which is currently present. Suitable habitat has decreased as a result of timber harvest activities that have fragmented the habitat and removed appropriate nest sites. It is probable that goshawk numbers within the watershed were also greater.

Current Condition

The goshawk is listed as a state sensitive species due to conversion of suitable habitats to younger, even-aged stands without appropriate nest sites and open foraging areas under the canopy. The goshawk is also listed as a federal species of concern.

Goshawk habitat has been fragmented by past timber harvest activities and firewood collection. Some areas of intact lodgepole pine stands still provide primary and secondary habitat along Odell Creek. The lodgepole/mountain hemlock and mountain hemlock PAGs provide unfragmented primary and secondary habitats. Within the ponderosa and mixed conifer PAGs appropriate habitat has been reduced and fragmented, however, some areas of primary habitat still exist within the mixed conifer PAGs, but at a lower density level than was historically present.

Epidemic levels of beetles have killed many of the mature trees in the lodgepole dry PAG. Currently, these stands still provide primary habitat for the goshawk and will continue to as long as the standing dead and live tree component comprises a canopy cover of 70% or above. As these stands begin to fall apart in the next 5-15 years, these acres will change from primary habitat to secondary or foraging habitat. The number of acres that will be converted will depend on how many large trees survive the beetle epidemic. These acres will cycle back into desirable habitat within 40-50 years. During the cycling period, goshawks may relocate to adjacent suitable mixed conifer or lightly infected lodgepole pine stands.

Wolverine, Fisher and Marten

Historic Condition

Historically, wolverine, fisher, and marten were more abundant than they are today. Many of the fur-bearing mammals were trapped heavily in the 1920s and 1930s which reduced local and Cascade populations. In addition, these species may have been inadvertently killed during bait poisoning aimed at coyotes and wolves. Wolverine and marten habitats were likely similar to current conditions since few management activities have occurred in the high elevations of this watershed. However, fisher habitat has been subsequently reduced and fragmented by timber harvest activities which continue to contribute to depressed populations even though the use of bait and trapping have dramatically declined.

Current Condition

The wolverine and fisher are federal species of concern, and are also on the Region 6 Regional Forester's Sensitive Species List. And the marten is a state listed sensitive species.

Wolverine, fisher, and marten are solitary and territorial species. Little information is available on the occurrence and distribution of these species within the watershed and within Central Oregon.

Habitat for fisher, and to some extent marten, has been heavily fragmented in the Odell Watershed due to timber harvesting. Openings, decreasing amounts of mature timber, and removal of dead and down trees for firewood have detrimentally impacted the suitability of the habitat for these two species. Areas within the watershed may be fragmented to the point that they can no longer meet the habitat needs of the fisher and marten. Fragmentation may have led to isolation of small populations of these species that are too small for long-term viability. Overall population levels have most likely declined due to fragmentation.

Another rising conflict within the watershed is the increasing amount of winter disturbance from snowmobile users which causes the animals to react in adverse terrain conditions (movement through snow). This conflict may reduce the suitability of foraging areas within heavily traveled recreation areas during the winter months.

The preferred habitats of the wolverine and marten are located at higher elevations and contain a dense, continuous canopy cover. Both species prefer remote areas that lack human disturbance. Wolverine and marten corridors likely occur (north to south) through the wilderness and (east to west) along areas of high elevation through the country surrounding Bobby Lake. These corridors are relatively stable and healthy and are minimally impacted by humans.

Marten use a variety of travel corridors, since the animal can use various habitats (lodgepole pine, ponderosa pine and mixed conifers). Travel corridors are not likely a limiting factor for this species.

Little information is available regarding the population density or distribution of wolverines within the watershed and within Central Oregon. On average only one or two sightings of the species are reported annually for the entire Deschutes National Forest (M. Boehme pers. Communication 1999). However, two unverified wolverine sightings were reported to Crescent District wildlife personnel during the summer/fall of 1999. Both sightings were in the Odell Lake/Willamette Pass area. This would suggest there may be a small population of wolverines that still inhabit the Cascade Range of Central Oregon.

Prior to the summer of 1999, little information was available on the presence of fishers on the Crescent Ranger District. However, a fisher trapping and telemetry study conducted on the Prospect Ranger District of the Rogue River National Forest confirmed a juvenile male fisher traveled northeasterly over the Cascade Mountain Range during the winter of 1998-1999 and

spent the entire summer on the Crescent Ranger District. Although the animal did not summer within the Odell watershed, there may be other individual(s) present since a confirmed sighting was documented in 1986. The most suitable fisher habitat in the watershed is along Odell Lake and northwest of Davis Lake.

Preble's Shrew

Historic Condition

Potential Preble's shrew habitat likely existed along Odell Creek, some portions adjacent to Davis Lake, and other small meadows and wet areas throughout the lodgepole dry/mountain hemlock and mixed conifer wet PAGs. The historic distribution and abundance of Preble's shrews are unknown.

Current Condition

The Preble's shrew is on the Region 6 Regional Forester's Sensitive Species List and is also a federal species of concern. The species is suspected to occur on the Deschutes National Forest, but no surveys have been conducted within the watershed. Conifer encroachment may be reducing primary habitats in some locations along Odell Creek and its tributaries.

Long-billed Curlew

Historic Condition

Habitat for the long-billed curlew has existed since the creation of Davis Lake and the associated wet meadows which occurred 5,500 years ago when a lava flow blocked Odell Creek.

Current Condition

The long-billed curlew is on the Region 6 Regional Forester's Sensitive Species List and is also a federal species of concern. The bird has not been documented within the watershed, however, foraging and nesting habitat exist at Davis Lake. The dramatic fluctuation at Davis Lake provides exceptional foraging for the long-billed curlew and many other shorebirds.

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 the necessary habitat for the black-backed, 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

The black-backed woodpecker is a ROD protection buffer species. It is also considered a sensitive species in the critical category by the Oregon Department of Fish and Wildlife due to loss of snags and conversion of mature lodgepole stands to young, fast-growing stands that are free of heart rot and bark beetles (Marshall 1992a). The woodpecker is also identified in analysis and mitigation in Appendix J2, Results of Additional Species Analysis from the Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional

and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl, April 13, 1994.

Abundant habitat currently exists along Odell Creek in the lodgepole wet and dry and lodgepole dry/mountain hemlock plant association groups. Limited habitat exists in the mixed conifer plant association groups due to extensive fragmentation. The birds are currently located within the watershed and utilizing the existing habitat. Population densities are unknown. Epidemic levels of beetles have killed much of the lodgepole dry PAG, thereby creating large areas of primary habitat. As these stands start falling apart in the next 5-15 years, these acres will probably become secondary or foraging habitat rather than primary habitat. The amount of acres that will be converted will depend on how many large trees survive the beetle epidemic. These acres will cycle back into desirable habitat within 40-50 years. During the cycling period black-backed woodpeckers may relocate to adjacent suitable mixed conifer or lightly infected lodgepole stands.

Great Gray Owl

Historic Condition

Habitat historically existed within the Odell Watershed for the great gray owl, but population density information is unavailable.

Current Condition

The great gray owl is a ROD protection buffer species most common in lodgepole pine forests adjacent to meadows. Specific mitigation measures include implementing a standardized survey protocol to detect nest locations and providing a no-harvest 300-foot buffer around meadows and natural openings greater than 10 acres in size and establishing 0.25 mile protection zones around known nest sites. The great gray owl is also considered a sensitive species in the vulnerable category by the Oregon Department of Fish and Wildlife. Its status is due to the loss or elimination of nest and roost sites by logging, including salvage harvesting of lodgepole pine for mountain pine beetle control. Another reason for the owl's sensitive status is the urban sprawl in prime habitat in the LaPine, Bend and Sisters areas (Marshall 1992a). The species is also proposed for listing on the Region 6 Regional Forester's Sensitive Species List in 1995.

Currently, no great gray owls are known to exist within the watershed, however, suitable nesting and foraging habitat is present along several tributaries of Crescent Creek and along the western side of Davis Lake. The Crescent Ranger District has two documented great gray owl nest sites south of Crescent Lake in an adjoining watershed.

Flammulated Owl

Historic Condition

Historically, the amount of habitat available for the flammulated owl was greater than that which is present currently. The birds were known to exist within the watershed, but population density information is not known.

Current Condition

The flammulated owl is a ROD protection buffer species known to occur on the east slopes of the Oregon Cascades and the Klamath Province in northwestern California and southwestern

Oregon. Flammulated owls are secondary cavity-nesters and use cavities in snags and live trees created by woodpeckers, or less often, those that occur naturally. To maintain viability for this species as well as the woodpecker guild, snag habitat management is required favor those land allocations that permit timber harvest, particularly Matrix. The flammulated owl is also considered to be a sensitive species in the critical category by the Oregon Department of Fish and Wildlife due to loss of habitat. This habitat loss includes 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 1992a). The species is also proposed for listing on the Region 6 Regional Forester's Sensitive Species List in 1995.

The lack of low intensity fires due to aggressive fire suppression has reduced most of the suitable habitat for the flammulated owl within the ponderosa pine and mixed conifer PAGs and has caused the development of a more closed canopy primarily in the ponderosa pine stands.

Limited surveys for flammulated owls were conducted on the District during the spring of 1998 and 1999 including some routes into the Odell watershed. Several flammulated owl night responses were confirmed in the watershed near Saddle Butte and west of Davis Mountain.

Greater Sandhill Crane

Historic Condition

Habitat for the sandhill crane has existed within the watershed since the creation of Davis Lake and development of the associated wet meadows, which occurred 5,500 years ago when a lava flow blocked Odell Creek.

Judge John Breckenridge Waldo: Diaries and letters from the high Cascades of Oregon 1880-1907 (Williams 1985):

Davis Lake, August 14, 1883. 7:15 p.m.

"The noise of water fowl is heard from our camp. But a little while ago we heard the guttural voices of sandhill cranes. All have their representatives in this lake. Late in the evening the blue crane make wing overhead to the rocky wood."

Historic conditions for the greater sandhill cranes were likely to be similar to the conditions today since few habitat modifications have occurred around Davis Lake. However, the number of sandhill cranes using Davis Lake were likely higher historically than they are today, since species-wide population declines have occurred due to over harvesting and habitat degradation.

Current Condition

The greater sandhill crane is considered to be a sensitive species in the vulnerable category by the Oregon Department of Fish and Wildlife. Its status is due to low reproductive success caused by predation and the rising waters of Malheur Lake which is destroying habitat. Predation rates by ravens and coyotes upon chicks and nests are high. Each nesting pair requires a large area; in addition, the birds are highly sensitive to human disturbance and land use practices (Marshall 1992a). The greater sandhill crane is on the Region 6 Regional Forester's Sensitive species List and is also a federal species of concern.

Davis Lake provides nesting and foraging habitat in those areas not frequented by recreationists. During the spring and summer sandhill cranes can be heard and/or observed at Davis Lake.

Sandhill crane nests and young are susceptible to coyote, raven, raccoon, and skunk predation as well as to predation by uncontrolled domestic dogs, which accompany recreational users to the area.

American White Pelican

Historic Condition

Since the creation of Davis Lake, with its shallow depth and dramatic water fluctuations, it has provided an abundance of fish and excellent habitat for white pelicans. The birds have been documented using this lake since the earlier settlers arrived, however, there are no recorded population estimates.

Current Condition

The pelican is considered a sensitive species in the vulnerable category by the Oregon Department of Fish and Wildlife due to a shortage of suitable breeding areas (stable islands, nesting space availability, security, and sufficient forage base) (Marshall 1992a). This species is on the Region 6 Regional Forester's Sensitive Species List and is also a federal species of concern.

Pelicans are often observed foraging on Davis Lake as they migrate north and south in the spring and fall months. There is no known nesting on Davis Lake.

White-headed Woodpecker

Historic Condition

Documented provincial declines following the selective harvesting of ponderosa pine would indicate historical potential populations were greater than currently exist.

Current Condition

White-headed woodpecker is considered a sensitive species in the critical category by the Oregon Department of Fish and Wildlife. The woodpecker has been given this status due to a sparse natural population and the loss of large ponderosa pine structure and snag trees which resulted from timber harvest activities (Marshall 1992a). It is also a ROD protection buffer species. Forested stands of ponderosa pine and mixed conifer/Douglas-fir would be considered suitable habitat for this species. There are no documented white-headed woodpecker observations within the watershed. A documented sighting was recorded adjacent to the watershed on Davis Mountain in 1987. Habitat does exist around the Davis Lake area throughout the ponderosa pine and mixed conifer dry PAGs. Loss of many of the large ponderosa pines may have reduced existing populations. Another factor within the mixed conifer dry and ponderosa pine PAGs is that active fire suppression has occurred since the early 1900s, which has reduced the number and size of low intensity fires. The two PAGs may still be within the range of variability for fire frequency, but are moving towards going outside the range. Within the mixed conifer dry PAG this has resulted in the development of an understory of white fir, with ponderosa pine and Douglas-fir still being the primary large tree component but not the dominant stand component. Therefore, there is a risk of losing additional ponderosa pine

habitat through direct competition with white fir and due to a high habitat susceptibility for stand replacement fires.

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 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

The pileated woodpecker is considered a sensitive species in the critical category by the Oregon Department of Fish and Wildlife, because it is sensitive to timber harvest treatments that result in the removal of large live and dead trees which are necessary for foraging, nesting and roosting (Marshall 1992a). The species is also proposed for listing on the Region 6 Regional Forester's Sensitive Species List in 1995.

Pileated woodpeckers are known to occur within the watershed. Currently, habitat is limited to the highly fragmented mid-elevation mixed conifer forests and the sparse distribution of large diameter white fir within the watershed. Previous timber harvest activities caused the reduction of large diameter trees including white fir, eliminated patches of large diameter trees, and created fragmentation. In addition, roads were constructed to access the harvested trees, but these same roads also enabled access to the area for increasing demands of personal and commercial firewood and fiber. Fuelwood collection added to the impacts to the area due to the removal of snags and down logs, thus reducing nesting and foraging habitat.

Blue-Gray Tail-dropper Slug

Historic Condition

No historic documentation exists on the population density or distribution of the blue-gray tail-dropper slug although population fluctuations likely occurred due to natural disturbances such as wildfires and volcanic eruptions.

Current Condition

The blue-gray tail-dropper slug is a "Survey and Manage" species that was identified in the Northwest Forest Plan Record of Decision as a rare species dependent upon late-successional and/or old growth coniferous forest habitats. Prior to ground disturbing activities, a two visit survey to a standardized protocol is required to determine the presence of this species and then protect the known sites as they are located.

Suitable habitat would be described as moist and mixed conifer forests. In open or dry areas, it is usually located in sites with relatively higher shade and moisture levels than those of the general forest habitat. It is typically found in moist plant communities, such as big-leaf maple and sword fern plant associations in the western Cascade Mountains. On the eastern slopes of the Cascades it has been documented to occur in mixed conifer and lodgepole pine forests. This slug is usually associated with leaf and needle litter, wood chips from decomposing logs, mosses and is known to feed on mycorrhizal fungi species. The blue-gray tail-dropper slug has been

documented to occur from the Puget Trough south through the western Cascade Range of Washington, Oregon, and northern California.

Mollusk surveys can be conducted during the spring or fall seasons under the appropriate temperature and moisture conditions specified in the survey protocols. Mollusk surveys were first conducted on the Crescent Ranger District in the fall of 1998. At the present time there are 7 known sites of blue-gray tail-dropper slugs in the watershed primarily concentrated along several tributaries to Odell Lake including Trapper Creek and Princess Creek. Several sites have also been documented on Maklaks Mountain. An additional fifteen sites are known to occur in other watersheds on the Crescent Ranger District.

Crater Lake Tightcoil Snail

Historic Condition

No historic information exists on the population density or distribution of the Crater Lake Tightcoil snail.

Current Condition

The Crater Lake Tightcoil snail is a "Survey and Manage" species that was identified in the Northwest Forest Plan Record of Decision as a rare species dependent upon late-successional and/or old growth coniferous forest habitat. Prior to implementing ground disturbing projects on national forest lands, a two visit survey to a standardized protocol is required to determine species presence and then protect the sites as they are located.

The Crater Lake Tightcoil snail is typically found above 610 meters in elevation in moist conifer forests and among mosses and other vegetation near wetlands, springs, seeps, and riparian areas. Specimens have been found on logs, among sedges, attached to decaying leaf surfaces, in litter, or inside other shells. This species has been documented to occur on the Crescent Ranger District and south of Crater Lake in Klamath County, Oregon. They are also suspected to occur on the Winema, Umpqua and Willamette National Forests and on BLM lands adjacent to these forests east of Interstate 5. It may also occur in widely scattered populations in western Oregon.

At the present time there are 2 known sites of Crater Lake Tightcoil snails on the Crescent Ranger District both within the Odell watershed. Both populations were found in the riparian areas of Trapper Creek and Princess Creek.

Riparian Habitat

Riparian/Wetlands/Floodplain vegetation occupies in excess of 1,100 acres within the watershed. The following vegetation types are associated with these areas:

Open meadows -- either grasslands or willow/grasslands

Intermittent stream channels -- comprised of a combination of open meadows and meadows intermixed with conifer.

Stream channels -- occupied by mixed conifer as the overstory, mountain alder as the shrub component, and grasslands as the ground cover.

Of the 268 wildlife species known or suspected to utilize the Odell Watershed throughout the year, 177 species use the riparian areas as their primary or secondary habitat for breeding,

feeding, and/or resting. Several other species use the riparian areas for some purpose other than breeding. In addition to a diversity of vegetative species, riparian areas also contain a wide array of small mammals, amphibians, fungi, mollusks, reptiles, insects, and fish. Snags, down logs, large trees, willows, alder, spruce, grass, and grass-like species create the vegetative structure of riparian areas that, in turn, provides highly desirable habitat for numerous species.

Of the plant association groups within the Odell Creek Watershed, the dry lodgepole PAG has the least diverse riparian vegetation. In fact, there is little change in vegetative species composition within the riparian zone, but it is still important for many wildlife species. The predominant riparian areas for the lodgepole dry PAG are the intermittent lower portion of Moore Creek, the south and western shores of Davis Lake, and essentially all of Odell Creek.

Wet lodgepole pine PAGs contain a substantially more diverse riparian area, and include species such as white fir, Douglas-fir, ponderosa pine, spruce, alder, willow, spirea and many herbaceous species. Wet lodgepole pine riparian areas occur sporadically along Odell Creek.

Mixed conifer PAG riparian areas are also highly diverse. Mixed conifer dry and wet PAG riparian areas occur predominately around Odell Lake and the east side of Davis Lake.

Both the mountain hemlock and lodgepole dry with mountain hemlock PAGs contain diverse riparian areas. The mountain hemlock PAG within this watershed provides limited riparian areas around the Rosary Lakes and southern shore of Odell Lake. For the dry lodgepole with mountain hemlock PAG the predominate riparian areas within the watershed are the high elevation lakes within the wilderness, around the Rosary Lakes and Bobby Lake, as well as the headwater streams which drain these lakes.

Ponderosa pine PAG riparian areas are similar to those found in the lodgepole dry riparian areas, but may include patches of alder or willow which often provide for increased species diversity. Ponderosa pine PAG riparian areas are also limited to small areas around the north and eastern shore of Davis Lake.

Specific structural aspects of riparian areas provide habitat for wildlife species such as the associated aquatic habitat of streams, wet marshes/bogs, small ponds, and lakes which play a key role for amphibians, songbirds, and waterfowl. Twenty-three species including the woodduck, Barrow's and common goldeneye, downy woodpecker, mountain chickadee, long-eared owl, and long-legged myotis use cavities in association with riparian areas. Down logs along riparian areas are utilized by the golden-mantled ground squirrel, long-tailed vole, long-tailed weasel, Townsend's chipmunk, and yellow-pine chipmunk. Large trees near or along the riparian areas are used by the bald eagle, common raven, Douglas' squirrel, golden eagle, great blue heron, northern flying squirrel, northern saw-whet owl, osprey, purple martin, red-breasted sapsucker, and western gray squirrel. The loose bark on ponderosa pine and mixed conifer trees provides nesting habitat for the brown creeper and several species of bats. Willows and alder patches provide nesting and foraging habitat for the mourning dove, olive-sided flycatcher, ruffed grouse, white-breasted nuthatch, hummingbird, and various warbler species.

Riparian vegetation is used as nest lining material by birds and small mammals. The vegetation provides abundant foliage for hiding, grazing, browsing, and preying on insects, amphibians, and small mammals. The riparian area provides a cool microclimate for breeding and resting wildlife. Maintaining a constant body temperature is critical for the survival of most wildlife

species. If body temperature drops or rises too much, animals are forced to burn calories to warm or cool the body. Expenditure of calories reduces the animal's reserves that are needed to survive seasons of low food and/or harsh weather conditions. Riparian areas provide travel corridors within the watershed for numerous species and also serve as a central location for mating species.

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

Headwaters (springs and seeps) - 9 species; including belted kingfisher, long-toed salamander, northwestern salamander, Pacific treefrog, red-winged blackbird, river otter, rough-skinned newt, tailed frog, and western toad. Tailed frogs focus on cold, fast running water associated with springs.

Marsh and bog - 114 species; including common garter snake, chipping sparrow, hermit thrush, killdeer, mallard, Pacific treefrog, redhead, ruffed grouse, and winter wren.

Streams (streams and creeks) - Fast and slow moving- 11 species; including American wigeon, belted kingfisher, blue-winged teal, Caspian tern, cinnamon teal, Forster's tern, green-winged teal, mallard, river otter, rough-skinned newt, and spotted sandpiper. Slow moving only - long-toed salamander, northwestern salamander, spotted frog, and western toad. Fast moving only - tailed frog.

Lakes (Lakes, ponds, reservoirs) - 83 species; including sandhill crane, gadwall, Canada goose, cinnamon teal, common garter snake, killdeer, long-billed curlew, and northern pintail.

Aspen - 52 species; including downy woodpecker, American kestrel, black-throated gray warbler, Calliope hummingbird, chipping sparrow, MacGillivray's warbler, mountain chickadee, Nashville warbler, olive-sided flycatcher, western flycatcher, Wilson's warbler, yellow warbler, and yellow-rumped warbler.

Mesic/wet Shrublands - 40 species; including Anna's hummingbird, American robin, Brewer's blackbird, deer mouse, elk, fox sparrow, heather vole, house finch, montane vole, mountain quail, red-eyed vireo, rufous hummingbird, rufous-sided towhee, song sparrow, warbling vireo, willow flycatcher, Wilson's warbler, and yellow warbler.

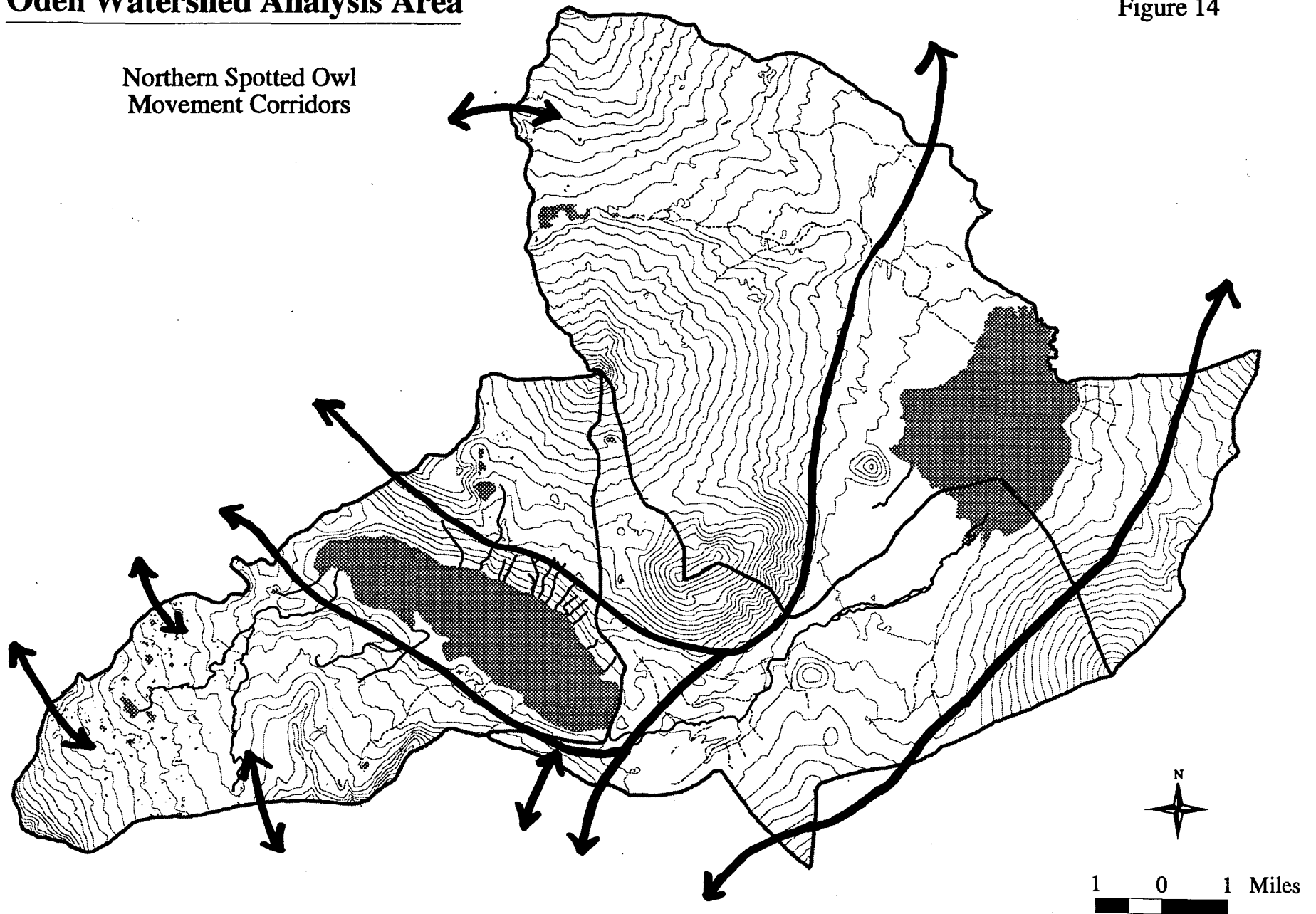
Alpine Shrublands - 28 species; including badger, bobcat, broad-footed mole, bushy-tailed woodrat, Calliope hummingbird, Cascades frog, Cassin's finch, coast mole, common raven, coyote, golden-mantled ground squirrel, heather vole, long-tailed vole, MacGillivray's warbler, merlin, northern pocket gopher, pine siskin, porcupine, red fox, rock wren, rufous hummingbird, Steller's jay, Swainson's hawk, western jumping mouse, western pocket gopher, western red-backed vole, white-crowned sparrow, and yellow-pine chipmunk.

Subalpine/Alpine Meadows - 30 species; including Calliope hummingbird, Cascades frog, ermine, fox sparrow, horned lark, Nashville warbler, pine siskin, red fox, and western red-backed vole.

Odell Watershed Analysis Area

Figure 14

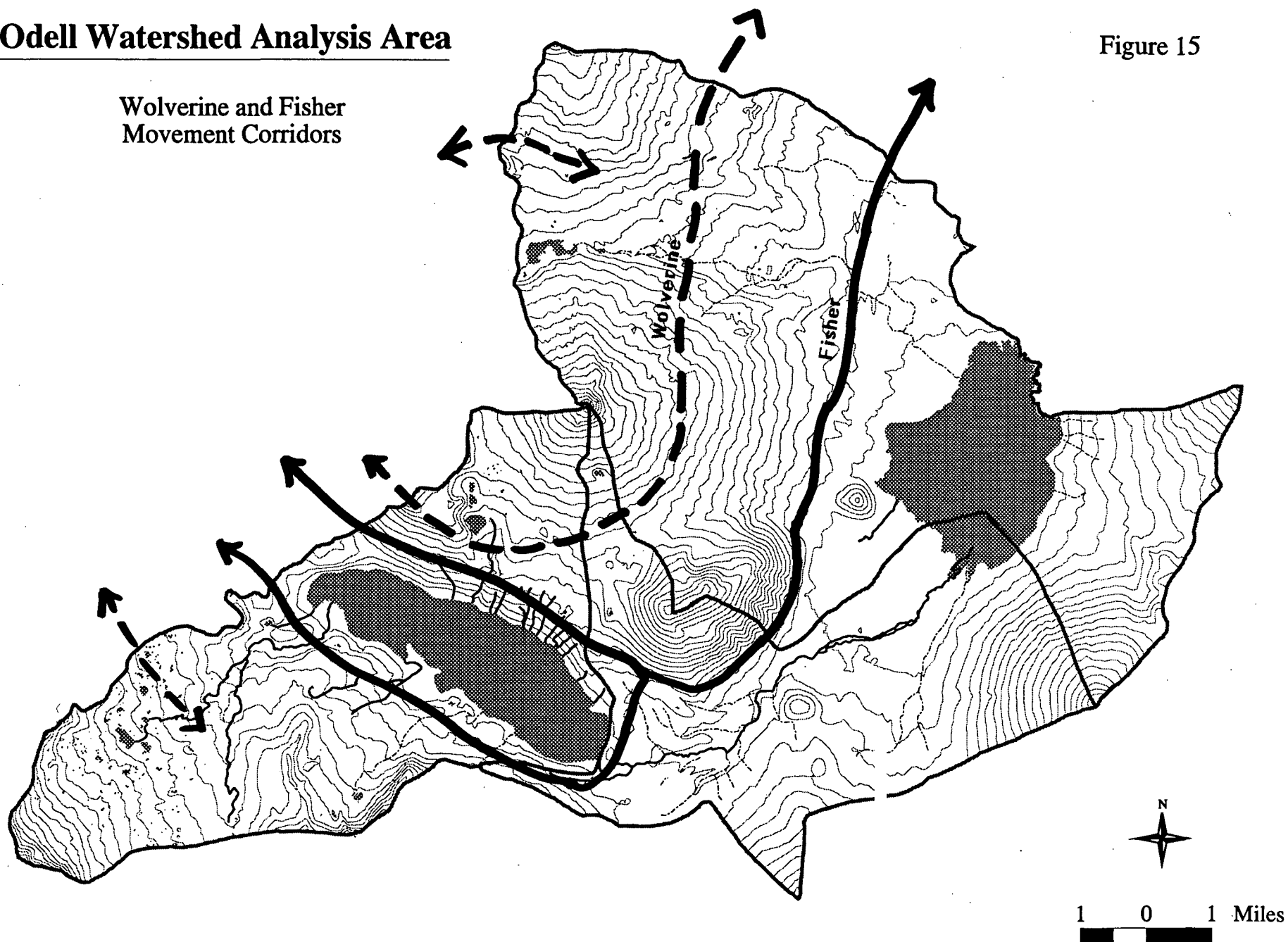
Northern Spotted Owl
Movement Corridors



Odell Watershed Analysis Area

Figure 15

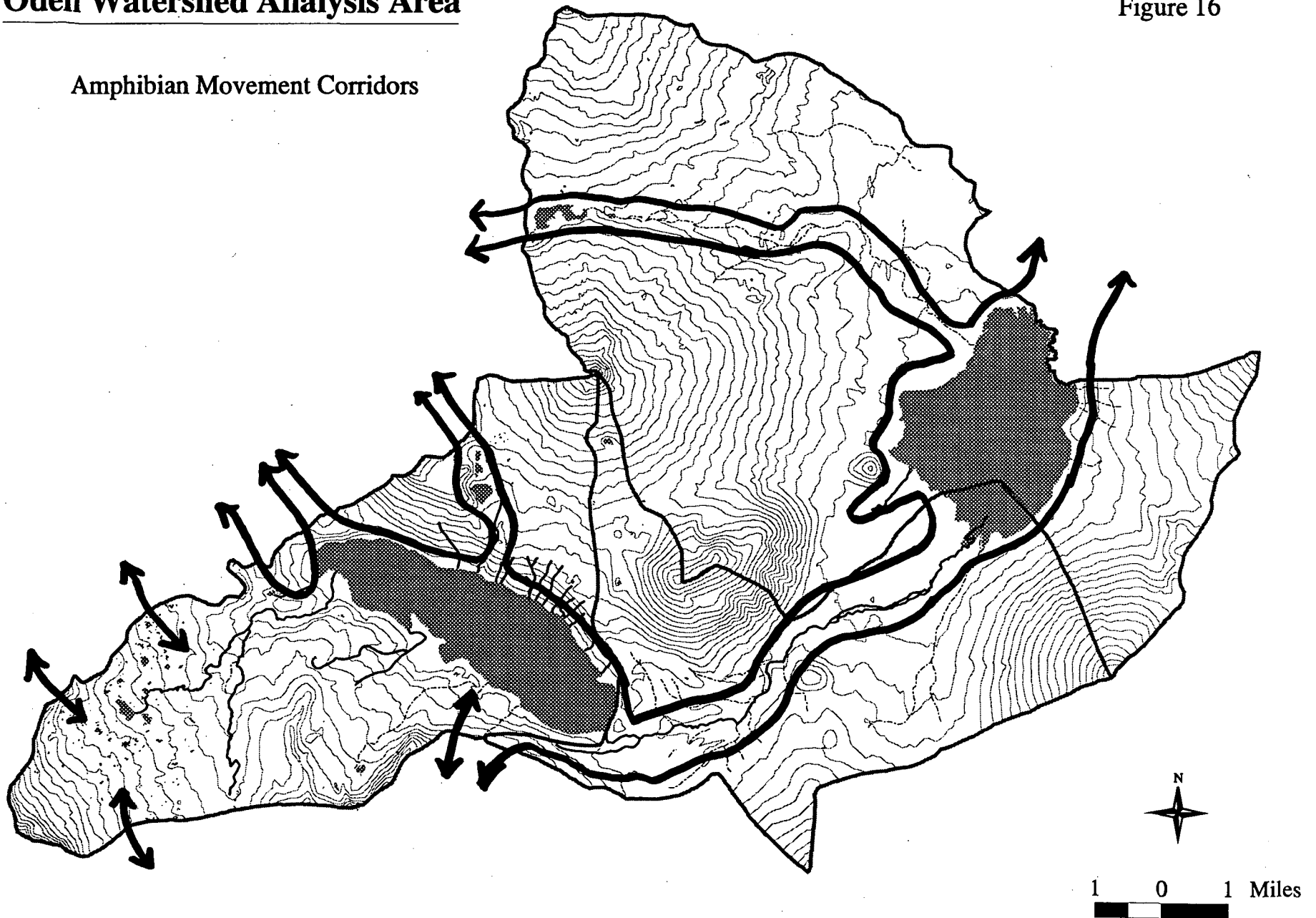
Wolverine and Fisher
Movement Corridors



Odell Watershed Analysis Area

Figure 16

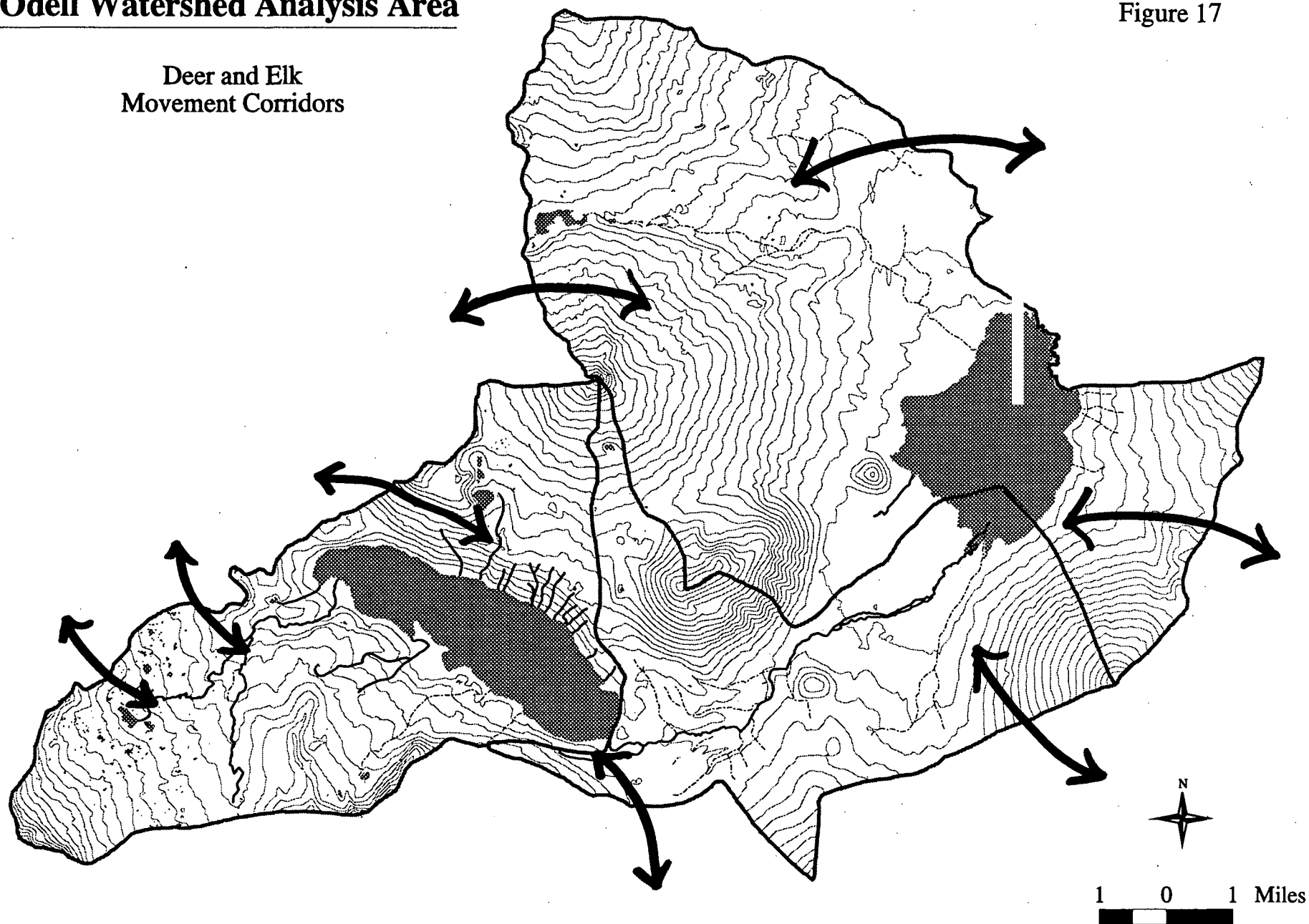
Amphibian Movement Corridors



Odell Watershed Analysis Area

Figure 17

Deer and Elk
Movement Corridors



Aquatic Species of Concern

Table 27. Aquatic Species of Concern, Odell Watershed. Key: E-endangered, T-threatened, P-petitioned/proposed for listing, S-sensitive, SoC-species of Concern, C-candidate

Species of Concern	USFWS	USFS R6	State of Oregon	Occurrence	Population Trend
Bull Trout	T	T	S	adfluvial	Unknown
Redband Trout	C	S	S	Resident/fluvial	Unknown
Cascade Apatanian Caddisfly	C	S	S	unknown	Unknown
Tailed Frog	SoC	-	S	present	unknown
Cascade Frog	SoC	-	S	present	Unknown
Oregon spotted frog	C	-	S	present	unknown

Odell Creek

Reference Conditions

Historically bull trout, redband trout and mountain whitefish were present in Odell Creek (Fies et. al. 1996). Observations of bull trout were made by Satherwaitte (1979) during snorkel surveys on Odell Creek. Satherwaitte observed low numbers (0-5 per 100 ft) of 12-18" bull trout in pools from river miles 0.0 to 1.1 and 1.75 to 3.2 (in Dachtler 1998). Bull trout probably foraged and may have spawned in some of the tributaries of Odell Creek. Adfluvial bull trout populations existed in both Davis and Odell Lakes.

Current Conditions

Level II habitat inventories were done on spring-fed tributaries to Odell Creek in the summer of 1999. Presence/absence direct observation surveys by snorkeling of a spring-fed tributary above Maklaks Creek found no bull trout but did find redband trout. An adult bull trout was sighted in Odell Creek on 11/1/98 about 100 yards below the outlet of Odell Lake (Dachtler 1998). Two bull trout were reportedly caught by anglers in this same area in 1989 (Goetz 1991).

Redband (rainbow) trout are the most abundant fish species in Odell Creek. The Oregon Department of Fish and Wildlife (ODFW) had samples from Odell Creek genetically tested in 1994 and found only a 5.8% contribution of hatchery genes (Phelps et al. 1996).

Other aquatic species that inhabit Odell Creek are Oregon spotted frogs and tailed frogs. Oregon spotted frogs are proposed species for listing under the Endangered Species Act. Tailed frogs and Cascades frogs are both listed as Oregon state sensitive species in the critical category because their populations appear to be declining. Tailed frogs are associated with the cold spring-fed water that is contributed by Maklaks Creek and other tributaries to Odell Creek. A

night time survey was conducted in 1996 in Maklaks Creek that found numerous adult tailed frogs. Tailed frogs have also been seen in the Odell Creek tributary above Maklaks Creek and in Odell Creek below the Maklaks Creek confluence during night snorkeling surveys. Oregon spotted frogs have been seen in Odell Creek in areas associated with marshy side channel/wide floodplain habitat above and below the 4660 road.

Trend Discussion

Bull trout were last documented in lower Odell Creek by Satherwaitte in 1979. There is no connectivity for refounding the Odell Lake bull trout subpopulation. Odell Creek and its tributaries were probably used by bull trout as forage habitat and potentially spawning. If the population size increases enough for this species to seek out the cold water habitat found in the Odell Creek tributaries they may utilize it once again. The warm surface water from Odell Lake may be a barrier to spawners' migration until later in the fall.

Odell Lake

Reference Condition

Bull trout, redband trout and mountain whitefish are species indigenous to Odell Lake (Fies et. al. 1996). Other discussion of the reference water quality conditions of Odell Lake are above and may have effected the primary productivity and thus the fishery in Odell Lake.

Current Condition

Bull trout (*Salvelinus confluentus*) were listed as threatened under the Endangered Species Act in July of 1998. Odell Lake contains the last natural adfluvial population of bull trout in Oregon. The only known spawning and rearing habitat known to occur in the Odell Lake subwatershed is in 0.8 miles of Trapper Creek. The bull trout population size in Odell Lake remains unknown. This population has been isolated from the Deschutes River by a lava flow that impounded Odell Creek and formed Davis Lake about 5,500 years ago (Johnson et al. 19985, Larry Chitwood, personal communication). If gene flow has been limited by either distinct barriers or distance, there is potential for local and unique adaptations to those environments (Lesica and Allendorf 1995 in Rieman et. al. 1997). Further loss of habitat could accelerate rates of extinction (Rieman and McIntyre 1995). Harvest restrictions in 1990 prohibiting the take of bull trout in Odell Lake and closing Trapper Creek to angling in 1993 may have had a positive effect on the subpopulation.

Lake trout were introduced to Odell Lake in the early 1900's (Fies et. al. 1996). Donald and Alger (1992) studied three lakes with sympatric bull trout and lake trout populations. They found that niche overlap and the potential for competition between the two char species were substantial. Brook trout are present in Trapper Creek and potential bull/brook trout hybrids have been seen during snorkeling surveys.

The Odell Lake Bull Trout Working Group is developing methods to assess the population size and plans on continuing ongoing activities such as night snorkeling, redd counts, setting trap nets in the lake, and a weir trap that gives an accurate count of the adults coming up Trapper Creek in the fall to spawn.

Night snorkeling surveys have been conducted in Trapper Creek since 1996 to monitor the trends of juvenile bull trout rearing in Trapper Creek.

Table 28. Night snorkeling surveys for Trapper Creek 1996 to 1999.

	1996					1997					1998					1999				
	0+ (<80 mm)	1+ (80- 120 mm)	2+ (120- 160 mm)	3+ (>160 mm)	Adult Spaw ners	0+ (<80 mm)	1+ (80- 120 mm)	2+ (120- 160 mm)	3+ (>160 mm)	Adult Spaw ners	0+ (<80 mm)	1+ (80- 120mm)	2+ (120- 160 mm)	3+ (>160 mm)	Adult Spaw ners	0+ (<80 mm)	1+ (80- 120 mm)	2+ (120- 160 mm)	3+ (>160 mm)	Adult Spaw ners**
<i>Mouth to 5810 road Bridge</i>	4	15	1	6	0	11	16	23	8	2	12	17	18	11	0	21	11	15	8	0
<i>5810 road Bridge to RR tracks</i>	0	0	0	0	0	1	8	7	0	1	1	3	7	4	0	6	12	5	6	0
<i>RR 7.6ft falls</i>	0	0	0	0	0	0	0	4*	0	5	0	0	0	5	4	0	1	0	0	3

*2 found between the 5.4ft falls and the 7.6ft falls

** Spawner weir trap installed near mouth of Trapper Creek

Crystal Creek

Historically (OSGC 1947), bull trout used Crystal Creek, but today it is used extensively by kokanee salmon during the spawning season.

Trends for Bull Trout Habitat at Odell Lake

Habitat degradation will continue to occur if recreational use and development in the Odell Lake subwatershed increases. Bull trout require high water quality and habitat availability. Odell Lake is currently providing very little habitat for bull trout and their decline may be compounded by other factors such as competition and isolation from nearby subpopulations.

Davis Lake

Bull trout were reported in Davis Lake as early as 1932 and again in 1950 (Borovicka 1950 in Fies et. al. 1996). Large mouth bass were illegally introduced into Davis Lake and their presence confirmed by ODFW in 1995.

In the 1960s the Oregon State Game Commission considered Davis Lake to be one of the best fish producing lakes in the state. For a number of reasons there have been several unsuccessful attempts to maintain a rainbow trout fishery in Davis Lake. Water quantity and quality have been identified as the most probable limiting factors for rainbow trout production. A series of drought years, causing increased lake water temperatures during summer months and drastically reducing the amount of habitat, are directly associated with decreased trout populations. Due to coho salmon and hatchery rainbow trout introductions, the sporozoa parasite *Ceratomyxa shasta* (*C.shasta*) became saturated in the lake. *C.shasta* is capable of causing increased mortality to endemic populations of rainbow trout and reduces the probability of reestablishing and maintaining rainbow trout in Davis Lake.

A series of wet water years has occurred and maintains a large amount of habitat year round (up to 4000 acres). When several low water years occur, the rainbow trout population has a tendency to crash. This is due to both a lack of habitat and infestation by *C.shasta* which is aggravated by high water temperatures and confined space.

The bull trout population in Davis Lake is nonexistent at this time. It is speculated that a combination of factors has prevented the bull trout population from reestablishment. Reasons suspected are:

1. Competition with other fish species for food, space, and spawning habitat
2. Hybridization with brook trout
3. Toxaphene treatment eliminated most fish in this adfluvial population
4. Historic Poaching
5. Parasite *Ceratomyxa shasta*
6. Small population size in Odell Lake

Chubs flourished after their introduction into Odell and Davis Lakes. ODFW treated Davis Lake and Odell Creek with toxafene in 1959 to reduce or eliminate the chub and whitefish populations.

Large, woody material (LWM), which provides habitat and cover for fish, was removed from the confluence of Odell Creek with Davis Lake to reduce the navigational hazards. Efforts have been made in the last few years to return LWM to this area as well as to Davis Lake itself.

Moore Creek is an intermittent stream that feeds into Davis Lake. Its headwaters are the outflow of Bobby Lake. Investigations should be made to determine if redband trout are using Moore Creek for spawning and if so are their redds de-watered before incubation of the eggs can occur.

Ranger Creek is a spring-fed creek that feeds into Davis Lake and is approximately a mile long. All pools found in Ranger Creek have been formed by beaver activity. From these beaver

formed pools there are marshy conditions that are created in the floodplain and adjacent riparian area. In August 1995 water temperatures at the headwaters of Ranger Creek were a cold 4.8 °C and increased at the treeline at Davis Lake to 13°C.

Terrestrial and Avian species Associated with the Plant Association Groups

Lodgepole Pine (Dry & Wet)
Ponderosa Pine
Mixed Conifer (Dry & Wet)
Lodgepole Pine Dry/Mountain Hemlock
Mountain Hemlock
Meadows (includes Wet Meadows, Moist (hairgrass) Meadows, and Dry Meadows)

See Appendix E - Wildlife, Tables 3 - 8 for lists of the species associated with the PAGs and the structural stages that they utilize for breeding, foraging, and/or resting habitat.

Historic Condition

Elk and deer numbers were fairly low until timber harvest activities created a greater forage base.

Historically, merlin were most likely rare in Oregon and Washington.

Early furtrapping reduced the populations of many species between 1820 and 1830. The beaver population was significantly impacted, while trapping of mink, marten, weasel, ermine, fisher, and wolverine also affected population densities of these species. Hunts to kill large numbers of wolves, coyotes, mountain lions, and other species classified as 'predators' were commonplace in the early and mid 1900s. The gray wolf is thought to be extirpated from Oregon. Mountain lion populations have been reduced from historic levels. In recent history, coyote numbers may be increasing due to reduced levels of hunting and poisoning.

Current Condition

Increased disturbance to wildlife by forest users (mushroom pickers, other forest product gatherers, recreationists, recreational vehicle traffic, and hunters) affects an animal's fitness depending on how it responds to human disturbance. Species that demonstrate a sensitivity to human activity, i.e. they tolerate low levels of activity but react to high levels include: 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 high sensitivity to human activity, i.e. react to both low and high levels of human activity include: big brown bat, California myotis, little brown myotis, long-eared myotis, long-legged myotis, peregrine falcon, silver-haired bat, wolverine, and Yuma myotis. Depending on the extent, frequency, and duration of disturbance, it may affect the animal's 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 the disturbance of wildlife. The road density, excluding the Diamond Peak Wilderness, the Dispersed Recreation Management Areas, and Odell and Davis Lake water bodies, is 3.5 miles/sq mile of open roads

and 1.5 miles/sq mile of closed roads. Not all road closures are effective in eliminating access to motorcycles, ATV's, mountain bikes, and/or snowmobiles. This analysis does not include skid trails created during timber harvest activities or recreationally created (non-forest) roads.

Not only do 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 all PAGs except the lodgepole/mountain hemlock and mountain hemlock PAGs. Fragmentation reduces habitat for species that require large home ranges with continuous habitats and species that use interior, non-edge influenced, habitats. Some of the species that are detrimentally affected by fragmentation include black-backed woodpecker, northern goshawk, spotted owl, Barrow's goldeneye, Anna's hummingbird, and wolverine. 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. Some of these species 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, Cascades 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 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.

Increasing demand for mushrooms by the public may create a decline in this food source for small mammals including squirrels, chipmunks, voles, and other species such as deer. Loss of this important fall forage component may stress the animals listed above during harsh weather periods, or may cause mortality.

In addition to habitat conditions, wildlife populations are being affected by illegal poaching including species such as elk, deer, bear, hawks, and eagles. The demand for black market body parts for aphrodisiacs, cure-alls, illegal trophy hunts, and meat is creating a large profit for those people willing to violate the law.

Deer and elk populations within the watershed 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 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 downed logs. Increased human use of riparian areas (preferred breeding habitat for deer and elk) has displaced some animals from historic breeding sites. If the Cascade Lakes Highway (Road 46) is improved, there would likely be an increase in motor vehicle collisions with deer and elk. Future land management activities with an emphasis on restoring and conserving late-successional forests in the watershed will most likely within twenty years reduce the amount of forage for deer and elk to quantities more consistent with historic levels.

There has been a loss of large trees due to timber harvesting. 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, while several species of bats (myotis) utilize this bark for roosting. Bald eagles, golden eagles, and great blue herons depend on large trees to create their nests in. Cavities in large 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 harvesting, and safety hazard reduction has eliminated much of the habitat needed by primary and secondary cavity users. Areas that typically lack snags are recreational use areas adjacent to water bodies and streams, in the lodgepole forests (firewood collection), and mixed conifer PAG's (timber harvest). Many waterfowl species including the woodduck, Barrow's goldeneye, bufflehead, common goldeneye, and common merganser, have shown a decline, possibly due to the loss of snags and disturbance by recreationists.

Increases in the number of forest users have favored some wildlife species. Species that show a positive correlation to human activity are the 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 Appendix E, Table 9.

Non-Native Wildlife Species

Aquatic Species

Bullfrog (*Rana catesbeiana*)

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 (Leonard 1993).

Current Condition

Bullfrogs are currently not known to exist within the watershed. The closest known sightings have occurred in Bend. Since the Odell Watershed drains into the Deschutes River system, there is a high potential for colonization by this species.

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 from Europe and became established in the United States between 1850 and 1867.

The brown-headed cowbird was introduced through the 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 became established in North America.

Barred owls are endemic to the eastern United States and Canada. The 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 the eggs and nestlings.

The cowbird can be found in many of the habitats within the watershed. The cowbird parasitizes many species of birds thus reducing their reproductive fitness, refer to Appendix E, Table 10. Of the 44 bird species listed as parasitism hosts, 30 of those species are known or suspected to occur within the watershed. The cowbird may also affect the insect population. The bird's diet includes spiders, snails, grass, and forb seeds. The predominate diet of the cowbird host species consists almost entirely of insects and a few berries (Ehrlich 1988). Therefore, reductions in the population density of the host species may result in greater numbers of insects.

The starling can be found throughout the watershed. It is not known how this species may interact or compete with other native wildlife species in the watershed.

Records to date have found only one response from a barred owl within the watershed. Due to the fragmented habitat, the barred owl is able to adapt/use these habitats and thus compete for food and space with the spotted owl, and may potentially prey upon the spotted owl.

Fish

Davis Lake

In the 1960s the Oregon State Game Commission considered Davis Lake to be one of the best fish producing lakes in the state. For a number of reasons there have been several unsuccessful

attempts to maintain a rainbow trout fishery in Davis Lake. Water quantity and quality have been identified as the most probable limiting factors for rainbow trout production. A series of drought years, causing increased lake water temperatures during summer months and drastically reducing the amount of habitat, are directly associated with decreased trout populations. Due to coho salmon and hatchery rainbow trout introductions, the sporozoa parasite *Ceratomyxa shasta* (C.shasta) became saturated in the lake. C. shasta is capable of causing increased mortality to endemic populations of rainbow trout and reduces the probability of reestablishing and maintaining rainbow trout in Davis Lake.

Rainbow trout can become prolific in Davis Lake again, if a series of wet water years occurs that maintains a large amount of habitat year round (up to 4000 acres). When several low water years occur, the rainbow trout population has a tendency to crash. This is due to both a lack of habitat and infestation by C.shasta which is aggravated by high water temperatures and confined space.

The bull trout population in Davis Lake is nonexistent at this time. It is speculated that a combination of factors has prevented the bull trout population from reestablishment. Reasons suspected are:

1. Competition with other fish species for food, space, and spawning habitat
2. Hybridization with brook trout
3. Toxaphene treatment eliminated most fish in this adfluvial population
4. Historic Poaching
5. Parasite *Ceratomyxa shasta*

Chubs flourished after their introduction into Odell and Davis Lakes. ODFW treated Davis Lake and Odell Creek with toxafene in 1959 to reduce or eliminate the chub and whitefish populations.

Large, woody material (LWM), which provides habitat and cover for fish, was removed from the confluence of Odell Creek with Davis Lake to reduce the navigational hazards. Efforts have been made in the last few years to return LWM to this area as well as to Davis Lake itself.

There is a desire by some to retain additional water in Davis Lake to improve the temperature regime for the aquatic biota. Due to the shallow nature of the lake, it heats up each summer, and exceeds the comfort level for the trout. Increasing the late summer lake level would improve the aquatic biota condition.

Odell Lake

The primary recreational activity on Odell Lake is fishing for kokanee salmon, however, anglers fish for mackinaw and rainbow trout as well.

Currently all of the native and introduced fish species are self-sustaining, with the possible exception of the bull trout, whose population status is unknown at this time but is considered by ODFW to be extremely depressed. Reasons suspected for the depressed low bull trout population levels are:

1. Angling mortality

2. Competition with other fish species for food, space, and spawning habitat
3. Hybridization with brook trout
4. Limited spawning and rearing habitat in the tributaries of Odell Lake (naturally high % fines in Crystal Creek, and low gravel and LWM levels in Trapper Creek)
5. Partial barriers created at the railroad crossings of the spawning tributaries, limiting access to upstream habitat
6. Historic poaching in tributaries
7. Kokanee superimposing redds on the bull trout redds

The bull trout population at Odell Lake is considered to be the last natural remaining adfluvial population of bull trout in Oregon. Recently, during surveys, only a small number of bull trout adults were captured and released near Odell Creek. Currently, there is insufficient information available to determine a reliable estimate for the bull trout population in Odell Lake and its tributaries, but it is known that the population is extremely small. Because of the severity of the situation, Odell Lake and its tributaries have been closed to fishing for bull trout since 1992. All bull trout must be released unharmed if caught in the lake. Trapper Creek is closed to all fishing.

When the railroad was built along the south shore of the lake, the hydrologic functions of the streams were disrupted. The railroad crossing on Trapper Creek created a fish barrier which eliminated access to a quarter mile of bull trout spawning and rearing habitat (half of the accessible habitat within the creek). The barrier was removed in the summer of 1994.

Crystal Creek was reported in the 1950s to have bull trout spawning and rearing in the lower half mile of the stream, but, in recent history, no bull trout have been found to be using the creek. Ideal spawning gravels in Crystal Creek are lacking, because of the source material in the watershed and the gradient alteration created by the culvert at the railroad. The spawning gravels and the jump and rest pool at the culvert crossing were improved in the summer of 1994.

Currently, the lake outlet of Odell Lake is partially controlled by a low rock weir which maintains that water level at a depth one foot higher than its normal water level. This held over water increases the low flows to Davis Lake in mid to late summer. The net affect on the Davis Lake fishery is negligible, because the increased volume released at that time of the year is insignificant as compared to the volume lost to the holes in the lava. The loss to the lava averages 150 cfs annually, but during mid to late summer the losses exceed the input.

Odell Creek

Odell Creek is dominated by riffle habitat, while pool habitat makes up the other significant portion of the stream. The substrates are primarily cobble and the primary pool and side channel forming factor is the abundant supply of large woody material (LWM) in the stream. Rainbow and whitefish are common throughout, but are concentrated in areas where velocity barriers are located. Stream temperatures range from 10-18o\$ C in the summer. Shade from vegetative cover, which is mostly supplied by conifers and mountain alder, averages 35%. LWM is deficient in the lower half mile of Odell Creek, from the East and West Davis Lake Campgrounds to the lake itself. Historically, this material was removed to provide access for anglers from the campgrounds to the lake. In the past few years, restoration efforts have been made to increase the level of LWM in this portion of the creek. The continued supplementation of this segment of the creek with additional LWM would provide additional benefits. This

segment of Odell Creek functions as a stream when the water levels in Davis Lake are low, and is considered to be part of Davis Lake during high water periods.

Trapper Creek

Trapper Creek is the only tributary to Odell Lake with a known resident fish population. There is a natural fish barrier located approximately 7/8 mile upstream from the mouth of the creek. Above and below that barrier, brook trout are found. Seasonally, kokanee salmon and bull trout spawn below the barrier. Trapper Creek has approximately four miles of fish-bearing waters.

Crystal Creek

Crystal Creek is a spring-driven system containing approximately one mile of low gradient fish habitat. Historically, bull trout used Crystal Creek, but today it is used extensively by kokanee salmon during the spawning season. The lower half mile of stream contains excellent rearing habitat for fish, since it is low gradient, has extensive pool formation, and an abundant LWM supply.

High Country Lakes

Within the Odell Watershed there are fourteen high country lakes that support fish populations. These lakes contain brook trout, char, and a few contain rainbow trout. These fish populations are restocked biennially by ODFW and are utilized by backcountry users. There are 30+ lakes in the backcountry that exceed one acre in size and a substantially larger number that are less than one acre or are intermittent. Most of these water bodies support native aquatic flora and fauna, but some have been altered in various degrees by attempts in the past to establish fish populations.

SOCIAL DOMAIN

Human Uses/Characterization

What are the major human uses, including tribal uses and treaty rights? Where do they generally occur in the watershed (e.g. map the location of important human uses such as cultural sites, recreation developments, and infrastructure)?

Throughout history many people have utilized the resources within the Odell Watershed to accommodate their specific needs and desires which range from gathering food to recreating. For this social analysis, these various social needs and desires have been represented by seven types of communities. Each of these communities has its own expectations for the use and management of the Odell Watershed based on its unique culture, history, economy, and geographic location. These communities include:

Americans Indians: Klamath Tribe, Burns Paiute, Confederates Tribes of the Warm Springs

Communities west of the Cascades: Eugene, Oakridge

Local, rural industrial communities: Crescent, Gilchrist

Local, rural recreation/residential communities: Crescent Lake Junction, LaPine

Central Oregon urban area: Bend

Transient commercial mushroom pickers

National community of Forest users: United States of America.

To illustrate how the Odell Watershed functions from the social perspective, geographic areas within the watershed that share similar social expectations have been delineated on a map. These areas include: **Willamette Pass-Odell Lake area, High Cascade Crest, Stratovolcanoes and similar conical, volcanic features, Davis Lake, Odell Creek, and the LaPine Basin (Figure).**

Willamette Pass-Odell Lake Area

This area includes the many recreation sites around Odell Lake and the main access to and from the Willamette Valley. The water features have attracted users from prehistoric times to the present. The area is rich with cultural resources, scenic beauty, fishing and other recreation, and wildlife values.

The inherent opportunities for summer and winter recreation with supportive facilities makes this area a destination for many people. This type of use provides the most stable flow of income for resorts, businesses in Crescent Lake Junction, campground concessionaires, and the Willamette Pass Ski Area. The quality of the outdoor setting including the facilities, fishery, wildlife, access, and scenery must be maintained in this area to sustain or increase its constituency. In the early 1900s, a fish hatchery operated in the area near Odell Lake, but it no longer exists (History Papers). In comparison to other creeks outside of the Odell Watershed, the Odell Creek area is not very popular for fishing, camping, and hunting.

High Cascade Crest

The High Cascade Crest within the Odell Watershed is also valued by communities at the local, regional, and national scales. This rugged, glaciated terrain which includes Diamond Peak (8,744 feet in elevation), Mount Yoran, and Maiden Peak, discouraged the building of roads and remains roadless today. The value of this wild area has been recognized at the national level through legislative acts of Congress. The Diamond Peak area was added to the National Wilderness Preservation System in 1965, and the Oregon Skyline Trail was designated as part of the Pacific Crest National Scenic Trail (Figure 19). The remainder of the Cascade Crest has been allocated to provide dispersed recreation in an undeveloped environment by the LRMP (Figure 4). These designations have prevented development, timber harvesting, and other environmentally altering activities from occurring and recognizes the value of retaining some areas where the presence of humans remains subordinate to the wild environment.

The High Cascade Crest has not been developed for commercial and commodity use, but the recreational opportunities within the Diamond Peak Wilderness and the undeveloped recreation areas attract additional users to facilities and businesses at Willamette Pass and Crescent Lake Junction. Trailheads to the area are located adjacent to Shelter Cove and Odell Lake Resorts and the Willamette Pass Ski Lodge. Currently, the Shelter Cove Resort provides special services to through-hikers of the Pacific Crest Trail. Hikers can receive or buy supplies and have designated overnight accommodations.

Stratovolcanoes

The social expectations for recreation, transportation, and wilderness that dominate the use and management of the Willamette Pass-Odell Lake area and the High Cascade Crest are now being expanded to the rest of the watershed. Within the last decade, the social expectations for management of the Odell Watershed stratovolcanoes such as Davis Mountain, Hamner Butte, and Ranger Butte, have increased and diversified. Historically, these mountains and buttes were utilized for their valuable timber that supported the economy of local, rural industrial communities and, more recently, industries on the westside of the Cascades. Access to the area was limited to primitive roads built to facilitate timber harvesting.

Today, a national scenic byway has been designated through this area which highlights the scenic value of these mountains and buttes. The Cascade Lakes Scenic Byway brings new users to the area with expectations of viewing forested landscapes without evidence of timber harvesting. Since 1988 another community, transient commercial mushroom pickers, have discovered the wealth of matsutake mushrooms growing on these buttes. Mushroom collecting occurs annually during the permitted fall season that coincides with the area's big game hunting season.

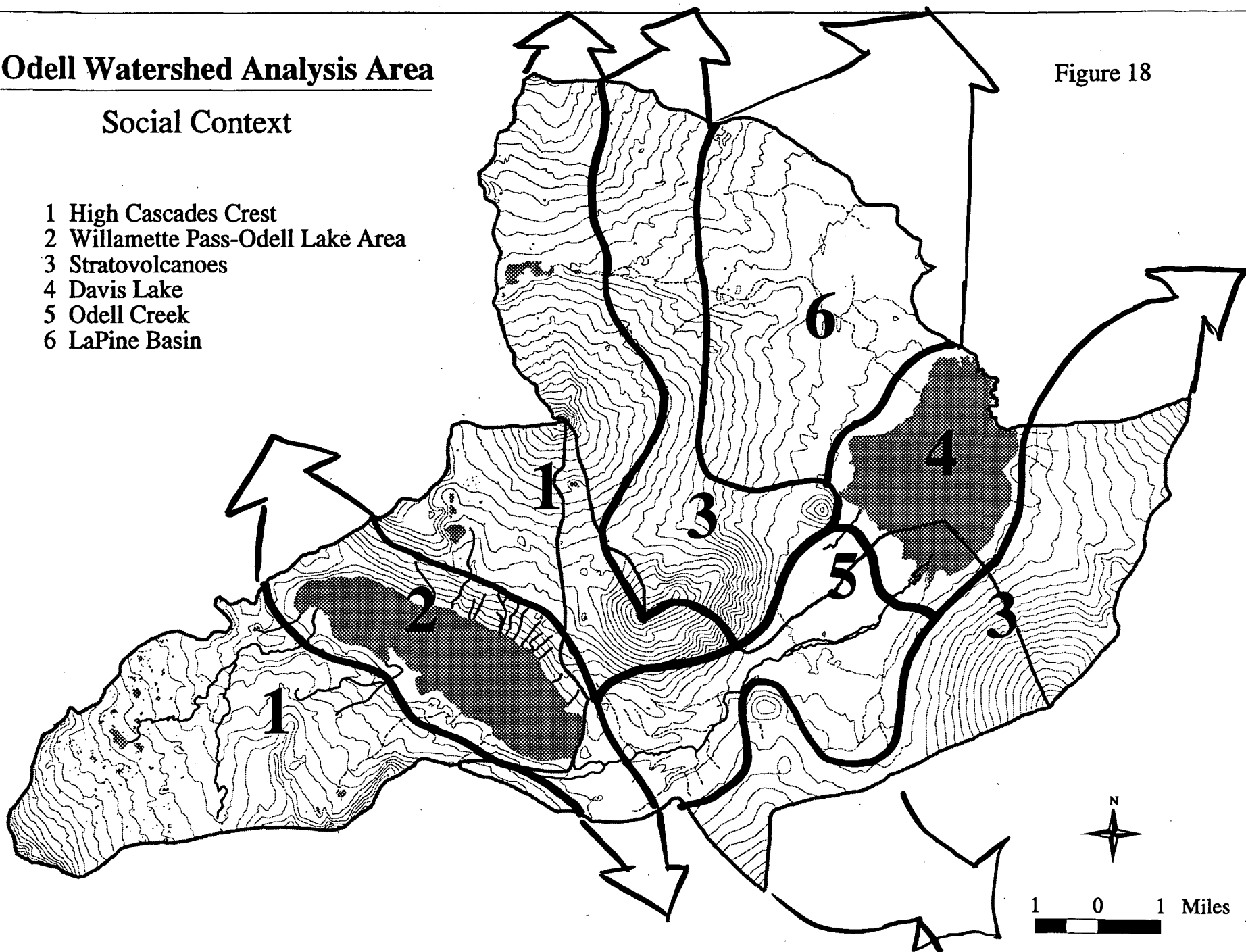
In April 1994 The Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl (ROD) allocated this area to provide habitat for a variety of wildlife species. This amendment to the LRMP highlights a national expectation to conserve the remaining old growth trees in the National Forests and the associated ecosystems. Native Americans also value this area because of the likely prehistoric use of these volcanic mountains for vision quest and burial sites.

Odell Watershed Analysis Area

Social Context

Figure 18

- 1 High Cascades Crest
- 2 Willamette Pass-Odell Lake Area
- 3 Stratovolcanoes
- 4 Davis Lake
- 5 Odell Creek
- 6 LaPine Basin



Davis Lake

Davis Lake is another area within the Odell Watershed that has a complex range of social expectations for use and management. Through the years, human use of the lake has changed due to the extreme fluctuations of the water level which cause the lake to range in size from 40 to 3,000 surface acres. During high water years, recreational use of the lake is high due to the productive fishery and boating opportunities. During low water years, this use decreases. Because of this fluctuation in recreational demand, the area has not been as highly developed with facilities as Odell Lake has.

Odell Creek

The social expectations for Odell Creek and the remainder of the Odell Watershed are less complex. Historically, the Odell Creek area has received minimal use by the surrounding communities. Presently, human uses include dispersed camping, fishing, and hunting. (Figure 11) Commodities in this area include dead and dying lodgepole pine that is collected as firewood, especially by people from the westside of the Cascades. Gravel is also mined from this area for road construction on National Forest lands. In 1994 the ROD recognized the regional value of this area for wildlife habitat. This document amended the Forest Plan and directed that this area be managed for those specific values.

LaPine Basin

The LaPine Basin reaches far beyond the boundaries of the Odell Watershed, but within the watershed, this area is relatively flat and dominated by lodgepole pine and to some extent ponderosa pine. The social context of this area has not changed significantly over the years. Timber harvest continues to be the expected use of this area. There are only a few recreation trails that pass through the LaPine Basin and it is not highly visible from the Cascade Lakes Scenic Byway. Currently, dead and dying lodgepole pine is being salvaged from the area in order to provide timber to the wood products industry.

Reference Conditions, Current Conditions, and Trends

What are the major historical human uses, including tribal and other cultural uses?

What are the current human conditions and trends of the human uses in the watershed?

What are the causes of change between historical and current uses? What are the influences and relationships between human uses and other ecosystem processes in the watershed?

The social context of the Odell Watershed is partially explained by the history of human settlement in and around the watershed, and how the watershed and its resources have been utilized. Each community has evolved utilizing different resources within the Odell Watershed primarily due to the differences in time and location of each settlement. Most of the different uses are still valued by the respective communities and are part of their culture. By understanding these uses and the culture of each affected community, the social context of the Odell Watershed can be better understood. Refer to Figures 19 and 20 for information on major transportation routes, recreation trails, campgrounds and other sites, and social context.

Tribal Uses/Treaty Rights

During prehistoric times before the eruption of Mount Mazama (Crater Lake), the Odell Watershed was considered to be a small part of a vast territory shared by several nomadic tribes of American Indians. A broad boundary located near the present town of Bend, Oregon, signified the southern reach of the tribes that now comprise the Confederated Tribes of the Warm Springs Reservation and the northern reach of the Klamath Tribe. Other territorial boundaries were designated from mountaintop to mountaintop and encompassed the associated valleys and water drainages. These people probably hunted, fished, and gathered roots and berries within the Odell Watershed as they traveled toward the Columbia River Gorge. Near The Dalles, they traded their products crafted from the obsidian lava beds near Tulelake, northern California (Coburn 1994).

As the early pioneers migrated to this area during the late 1800s, these vast American Indian territories were mapped to inform settlers of their location. Using compasses and straight lines, the mapped boundaries constricted the original physiographic boundaries used by the American Indians. By 1865 the United States Government had delineated a reservation for the Klamath Tribe south of the Odell Watershed. During 1958-1960, the Klamath Tribe sold this reservation to the United States Government for approximately \$120,000,000. The area is now designated as part of the Winema and Fremont National Forests (Coburn 1994).

The Klamath Tribe has remained informed and involved with the Deschutes National Forest during forest land and resource management planning. Most of this involvement is formalized through a planning process outlined in the National Environmental Policy Act (NEPA). The Forest currently employs a member of the Klamath Tribe to serve as a liaison between itself and the Warm Springs and Klamath Tribes. Consequently, forest managers are better informed of opportunities to conserve and enhance those forest resources valued by American Indians.

These resources may include the physical evidence of their ancestors from prehistoric times and a variety of berries, roots, plants, fish, and big game that were traditionally gathered and hunted throughout the Odell Watershed. The American Indians have concerns involving the retention of the integrity of special places such as Odell Lake, Davis Lake, and the high mountain tops, which may have been used as vision quest sites.

Cultural Resources

Odell Lake-Willamette Pass

Much like today, the water features within the Odell watershed have attracted human use and determined settlement patterns. The Odell Lake-Willamette Pass area is one of the most culturally rich area within the Odell Watershed. Data collected from Odell Lake prehistoric archaeological sites offers evidence of previous vegetation and climactic regimes much different than today. The data suggest a human presence and utilization of local resources up to 7,550

years ago, prior to the Mount Mazama eruption of approximately 6,700 years ago. Based on the stratigraphic profile analysis, this early occupation is probably the first human use of the area following the retreat of Pleistocene epoch (before 10,000 years ago) glaciation.

The historic cultural resources in the area reflect early Forest Service management (Hickerson 1994). Cy J. Bingham was most likely the first forest ranger in the area. During the early 1900s, Cy blazed trails through the area and carved his name and date on selected trees. One of these trees is located at the Pebble Bay Campground. An early ranger station was located near Odell Lake Resort. There are also artifacts from the early railroad years and CCC era.

Because of the intensive development and recreational use around Odell Lake, the integrity of the prehistoric and historic resources has been degraded over the years either by trampling, erosion, or theft. Currently, the Crescent District Archeologist is developing a heritage plan for the Odell Lake area with input from the Klamath Tribe and other archeologists. This pilot plan will help guide future development in the area, such as septic tank installation, to protect the integrity of prehistoric and historic resources (Hickerson 1994).

High Cascades

Currently, there is not much information available about the cultural resources within the High Cascades due to a lack of cultural surveys conducted in the wilderness and dispersed recreation areas. Cultural resource surveys are usually conducted in areas where planned ground disturbing activities, such as timber harvest and construction, will occur. The wilderness and dispersed recreation designations have prevented these ground disturbing activities from occurring, so few resource surveys have been completed. However, the majority of cultural resources in the area, except in high use areas such as lakes, should be in good condition.

Stratovolcanoes

Archaeologists and American Indians have suggested that the stratovolcanoes within the Odell Watershed such as Davis Mountain could have been used by American Indians as burial and vision quest sites. Limited physical evidence on one of the stratovolcanoes has been collected that suggests prehistoric and/or historic use of the tops of these volcanic features, making them sensitive to ground-disturbing activities. Known historic resources include the remnants of early Forest Service lookouts on Maiden Peak and Davis Mountain.

LaPine Basin and Odell Creek

Since it is a somewhat flat corridor between the high Cascade Crest and the stratovolcanoes, the LaPine Basin within the Odell Watershed served as a north/south travel route. Evidence of American Indian use of this area is scattered throughout the basin. Evidence is most abundant along Odell Creek which attracted human use and led the way to Davis Lake. Historic resources reflect this same use. During the late 1800s, Judge Waldo documents his use of this route in his diary (Williams 1985).

Davis Lake

Prehistoric use of Davis Lake is very evident along its shoreline and the lava flow. Use of the lake correlates with its creation by the lava flow about 5600 years ago. Physical evidence of prehistoric use is typically identified where some amount of existing ground disturbance has occurred. Native-surfaced roads and dispersed and developed campgrounds have high ground visibility, providing greater opportunities for the discovery of cultural resources by both archaeologists and avocational collectors. Campgrounds at Davis Lake have been developed on top of the archaeological (prehistoric) deposits and continued use and maintenance contribute substantially to the loss of integrity in the sites through erosion, soil compaction, and unauthorized collection of artifacts. Areas around the original channel of Odell Creek are probably the most sensitive if human use occurred before the eruption of the lava flow that created Davis Lake nearly 5,500 years ago (Hickerson 1994).

Historic cultural resources around Davis Lake include evidence of temporary settlements and grazing such as old irrigation ditches, bridges, and fencing (Finneran 1988). The Davis Lake Ranger Station site (Section 3 T 24 S, R 6 E), designated in 1907, was located near Ranger Butte and Ranger Creek, which was originally known as Cold Creek. The Ranger's cabin and barn were built in 1911. In the 1970s the guard station at Davis Lake was moved to Crescent, Oregon, and now serves as a private residential home.

Cultural resource surveys around Davis Lake have primarily been conducted to provide clearance for timber-related ground-disturbing activities. Complete surveys of the entire area have not occurred. Until additional surveys are completed or a cultural resource management plan is developed, the area is highly susceptible to the loss of historic and prehistoric site integrity.

European Settlement and Uses

The following is a brief history of the various European human settlements and their cultures that have influenced the Odell Watershed in some capacity over time. All of these communities continue to influence forest management within the Odell Watershed through various forums with the Forest Service, some of which are identified below.

Willamette Pass-Odell Lake Area

During the late 1800s when the means of human transportation was transformed from foot and horse to wagons, trains, and automobiles, the flat terrain around Odell Lake and the low elevation of Willamette Pass were utilized to route railroads and highways through the Cascades to the Willamette Valley. This new, direct link to the Willamette Valley opened up commercial traffic through the area, and brought visitors to recreate in the High Cascades. By the late 1920s, railroad stations, two resorts, and several summer homes were built around Odell Lake. In 1939 Willamette Pass Ski Area was developed. These developments established the foundation for the current social context of this area. The roads are kept at a high maintenance level and receive heavy commercial and interstate traffic.

West Side of the Cascades

In the early 1850s, white settlers explored the Odell Watershed for a potential route through the Cascade Mountains to the Willamette Valley. The route was to be an alternative to the Columbia River section of the Oregon Trail. The first surveyors in the area were William Macy and John Diamond. They climbed the highest peak in the Odell Watershed, 8,744 feet in elevation, and discovered a pass south of where they stood. John Diamond later named this peak "Diamond Peak" for himself (History Papers).

In 1865, another pair of surveyors, Byron J. Pengra and William G. Odell, visited the area. They discovered a large lake, which Pengra named for Odell, and a low mountain pass located near present day Willamette Pass. These early surveying trips led to the construction of the Oregon Central Military Wagon Road which crossed the Cascade summit south of the Odell Watershed (History Papers).

The first automobile crossed the military road in 1911. The car was a 1910 Buick and the trip took over a month to complete. Roads were soon built to access the east and west ends of Odell Lake with ferry service connecting the two roads. The military road remained the basic transportation route through the area until the Central Pacific Railroad was completed in 1926 (Williams 1983).

This railroad was built parallel to Odell Lake along its southwest side and tunneled under the Cascade Crest. This direct link brought people from the westside of the Cascades to the Odell Watershed for recreation. It also created a route to transport industrial products through the Cascades. By 1927 two railroad stations, two resorts, and several summer homes had been constructed around Odell Lake to accommodate the increased recreational and commercial uses (Williams 1983).

By 1940 the use of automobiles was more popular than riding the train, so State Highway 58 was constructed. The highway was also built parallel to Odell Lake, but along its northeast side. The highway eventually joined Interstate Highway 97, the California-Dalles Highway, several miles south of the Odell Watershed (Williams 1983).

Additional recreation facilities and summer homes have been constructed around Odell Lake. Several utility corridors and road maintenance facilities have been strung along Highway 58, and more and more people have been routed through the Odell Watershed.

Opportunities for recreation within the Odell Watershed remain an important asset to many residents of the Willamette Valley. A majority of the users of campgrounds within the Odell Watershed and owners of summer homes around Odell Lake are permanent residents of the Willamette Valley (Virgin 1994). Most of these users have established a long tradition of recreating within the Odell Watershed. In the last few years, the use of the Odell Watershed for wood products has also increased due to a recent decline in areas available for timber harvesting and firewood collection west of the Cascades.

Residents of the Willamette Valley remain involved and informed with current land management decisions that affect their special interests through several forums. The National Environmental Policy Act (NEPA) encourages public involvement in project scoping. Information about potential projects and current forest management decisions is mailed to a variety of people. The majority of people, however, are informed of current issues through Westside television and

newspaper reports such as the article "Dreams of Lake Going Down Drain" about Davis Lake which appeared in the *Eugene Register Guard* (*Register Guard* 1994).

Many special interest groups such as sport clubs and homeowner associations are composed of Willamette Valley residents. These associations have been involved with the Forest Service to promote their special interests within the Odell Watershed. For example, mountain bike clubs have worked with the Deschutes and Willamette National Forests to increase mountain biking opportunities in the area. Other special interest groups lobby for fishing, hiking, sno-mobiling, Nordic skiing, wildlife watching, and windsurfing within the watershed.

Rural Recreation and Residential Communities (USDA Forest Service 1990a)

Since the Odell Watershed area attracts a high volume of recreational use, service-oriented communities have established themselves around the area. The closest community of this type is Crescent Lake Junction located less than a mile from the watershed boundary. This small business community has grown along both sides of State Highway 58 near the junction with Crescent Lake access by Forest Rd. 60.

In addition to being informed and involved through the NEPA planning process, Crescent Lake Junction has developed a business type relationship with the Forest Service. Forest managers participate in meetings of the Oregon Cascade Recreation Association which is the chartered community association. These meetings provide frequent opportunities to discuss the management of resources that provide an economic base for the community. These resources include a diversity of quality recreational opportunities, permitted special uses, commercial mushroom collecting, facilities, roaded access, infrastructure, law enforcement, and scenic quality.

This community has also worked in partnership with the Deschutes National Forest and the Klamath County Economic Development Association to develop a Community Action Plan. This plan will help guide the expansion of the community within its recreational and environmental capacity by developing an integrated vision for the community's future and its use of the resources within the Odell Watershed.

This vision has helped the community to identify appropriate recreation and infrastructure improvement opportunities including a new sno-park, trails, emergency services, sewer, water, and transportation needs. The plan has developed a list of potential projects to move the community toward this new vision for the future (Community Action Team 1994). Projects completed thus far are the new sno-park and a community services center.

Another community that utilizes the Odell Watershed as a recreational resource is LaPine, 17 miles north of Crescent, Oregon, on Highway 97. LaPine is a residential community that accommodates people who enjoy the rural lifestyle and convenient access to the Deschutes National Forest and its numerous amenities. Residents in and around LaPine are involved with forest management planning through the NEPA process and special interest groups. The diversity of recreational opportunities and quality of scenery are their primary interests within the Odell Watershed. This community is not directly dependent on the use of resources within the Odell Watershed for its economic stability as is the community of Crescent Lake Junction.

Rural Industrial Communities (USDA Forest Service 1990a)

As the timber industry grew throughout the Pacific Northwest, industrial timber communities were established on the eastside of the Cascade Mountains. In 1938 the Gilchrist mill was constructed approximately 12 miles from the Odell Watershed. This operation established the community of Gilchrist and provided a new economic base for the community of Crescent, Oregon, one mile south of Gilchrist on Highway 97 (History Papers).

Prior to the Gilchrist mill, Crescent's economy was based on servicing traffic which used the California-Dalles Highway (97) and the railroad which passed through town. The headquarters for the Paulina National Forest was located at Crescent in 1906. Since that time, the Forest Service has also provided employment opportunities in the area. (History Papers).

The Odell Watershed has historically been considered as an extended "backyard" for residents of Crescent and Gilchrist. In the past, few visitors utilized the area outside of the Odell Lake-Willamette Pass area, so the remainder of the watershed was essentially theirs for hunting, fishing, mushroom collecting, and firewood gathering. These activities were done for enjoyment as well as for subsistence. Timber was also readily available to support the local industry (USDA Forest Service 1990a).

Many of the local uses such as hunting and mushroom collecting have been displaced by either new management policies or the influx of new users. As human use increases and diversifies within the Odell Watershed, the historic backyard for Gilchrist and Crescent is decreasing in size. It is a scenario similar to the one that faced American Indians, in terms of the loss of exclusive use of a geographic area.

The communities must now share the Odell Watershed with a variety of users with diverse values and needs such as commercial mushroom pickers and travelers on the Cascade Lakes Scenic Byway. Meanwhile, national issues surrounding the conservation of wildlife and riparian habitats have also changed the historic use of the watershed for timber and recreation by imposing new management strategies.

Currently, residents of Crescent and Gilchrist involve themselves in forest management planning through the NEPA process and special interest groups. Their concerns primarily reflect their declining freedom to utilize the area as they have grown accustomed to using it. A Community Action Team has been chartered. This group provides a forum for addressing issues and developing a unified vision for the community's future, through a Community Action Plan, including its future relationship with the Odell Watershed.

Central Oregon Urban Center (USDA Forest Service 1990a)

Bend, Oregon originated as a rural industrial community similar to Gilchrist but has since grown into the urban center of Central Oregon. Located about 45 miles north of Gilchrist and Crescent, Bend has attracted a population of over 25,000 people with diverse backgrounds and values. In 1994 the saw mill was sold, and is currently being modified into a riverfront development that combines both commercial and residential use (Bulletin 1994). Bend's economy is growing toward light industry, large retail franchises, and service-oriented businesses such as resorts and restaurants.

In contrast to rural industrial communities, the high quality scenery and recreational opportunities such as those found within the Odell Watershed are the highest valued resources.

The quality of life that this environment provides has attracted people to Bend from urban places all across the United States.

Recently, on "Eye on America," a national television news magazine, Bend was highlighted as a destination for people that have given up high paying urban jobs to find a better living environment and quality lifestyle. To these people, the quality of life that Central Oregon provides is more valuable than a secure income. The area is also popular for people who have earned a comfortable living and can now move to an area where they desire to live (Video 1994).

In addition to routine NEPA involvement, local newspapers and television stations keep Bend area residents informed of management issues that may concern them and their lifestyle in Central Oregon. In the context of the entire Deschutes National Forest, the Odell Watershed receives less attention and use from Bend residents than the Three Sisters area which is in Bend's backyard. Issues such as commercial mushroom harvesting and the natural draining of Davis Lake are of interest to the Bend residents and have been highlighted by local newspapers, radio, and television (The Bend Bulletin 1994).

Commodities and Commercial Uses

Commercial Use

Odell Lake-Willamette Pass

Commercial and interstate traffic support small businesses in the area of Crescent Lake Junction and a maintenance facility for the Oregon Department of Transportation. The inherent opportunities for summer and winter recreation with supportive facilities makes this area a destination for many people. This type of use provides the most stable flow of income for resorts, businesses in Crescent Lake Junction, campground concessionaires, and the Willamette Pass Ski Area. The quality of the outdoor setting including the facilities, fishery, wildlife, access, and scenery must be maintained in this area to sustain or increase its constituency.

High Cascades

The High Cascade Crest has not been developed for commercial and commodity use, but the recreational opportunities within the Diamond Peak Wilderness and the undeveloped recreation areas attract additional users to facilities and businesses at Willamette Pass and Crescent Lake Junction. Trailheads to the area are located adjacent to Shelter Cove and Odell Lake Resorts and the Willamette Pass Ski Lodge. Currently, the Shelter Cove Resort provides special services to through-hikers of the Pacific Crest Trail. Hikers can receive or buy supplies and have designated overnight accommodations.

Because the area is easily accessible from Highway 58 and the Waldo Lake Road, there are other opportunities for special uses, including specialized outfitters and trail guides. These services would probably increase use in the area and may decrease the outdoor solitude experience for some recreationists. The undeveloped recreation area provides the most flexibility for additional special uses.

Odell Creek

In the early 1900s, a fish hatchery operated in the area near Odell Lake, but it no longer exists (History Papers). In comparison to other creeks outside of the Odell Watershed, the Odell Creek area is not very popular for fishing, camping, and hunting.

Davis Lake

The current management of Davis Lake does not emphasize commodities or commercial use. The area is primarily undeveloped with no resorts or highly developed recreation facilities. The three campgrounds around the lake are currently operated by a concessionaire who maintains the facilities and collects fees.

The fishery at Davis Lake, which is excellent during high water years, is managed at its natural capacity during low water years. Water is not artificially retained in the lake to support a sport fishery like it is for Crane Prairie and Wickiup Reservoirs located just north of the Odell Watershed. The lake is also designated for fly fishing only, and most anglers catch and release their fish. Duck hunting is also popular at Davis Lake. Both hunting and fishing require state license fees.

Timber

Stratovolcanoes

Within the Odell Watershed, the stratovolcanoes are the most productive growing sites for a variety of vegetation. On the Crescent Ranger District, these buttes and mountains have provided the greatest volume of high value timber to the wood products industry over the years, including large saw timber ponderosa pine and Douglas-fir.

LaPine Basin

The LaPine Basin within the Odell Watershed consists primarily of lodgepole pine. A majority of the lodgepole stands have dead and dying trees from the mountain pine bark beetle. These trees are used by the wood products industry to manufacture wood chips, post, and poles. This lodgepole pine is also utilized for personal and commercial firewood. Some mushroom harvesting also occurs in the LaPine Basin.

The flat area between the high Cascade Crest and the stratovolcanoes is considered part of the LaPine Basin. Lodgepole pine is the dominant tree type in the basin due to the low productivity of pumice and ash which cover the area up to a meter in depth. This pumice and ash deposition resulted from the eruption of Mount Mazama (Crater Lake). Because of the low commercial value of lodgepole pine and limited recreational opportunities in the basin, the Forest Service did not manage this area for any particular use until the 1960s.

At that time, a mountain pine beetle epidemic caused a large component of the lodgepole pine to die. The timber industry created a market for the dead and dying lodgepole, which resulted in a majority of it being salvage harvested.

Most of the LaPine Basin was roaded within the last 30 years to access the dead and dying lodgepole for salvage. The flat topography of the basin has allowed people to travel basically

wherever they desire. This includes firewood collectors, timber harvest equipment, hunters, OHV operators, and mushroom pickers.

Forest Products

Stratovolcanoes

The stratovolcanoes support a variety of fungi including the matsutake mushroom. The fall mushroom collecting season coincides with the big game hunting season. Consequently, conflicts between early season big game hunters and mushroom collectors have been increasing over the last few years.

Transient Commercial Mushroom Pickers

Since 1988, commercial harvesting of the matsutake mushrooms in this area has increased exponentially. It has been a gold rush type phenomenon as mushroom collection has evolved from a subsistence, recreational, or educational activity to a multimillion-dollar industry (Molina 1992). This increase is primarily attributed to the influx of Southeast Asians who migrate to the Pacific Northwest commercially harvesting wild mushrooms.

Commercial mushroom harvesters and buyers now travel to the area during the fall collecting season. In about 40 days, commercial mushroom collectors can bring in between \$75,000-100,000 to the local economy at Crescent Lake Junction (CAT 1994).

Southeast Asians have found that mushrooms in the Pacific Northwest are similar to those in their homeland. They can pick them within the Odell Watershed and sell them to buyers at Crescent Lake Junction without having to speak fluent English or own much more than a car for transportation (Molina 1992). The majority of pickers within the Odell Watershed are transient and are only in the area during the regulated fall mushroom season. Most of the pickers stay in designated industrial campsites. Only one industrial site is located within the watershed. The fall mushroom collecting season coincides with the big game hunting season. Consequently, conflicts between early season big game hunters and mushroom collectors have been increasing over the last few years.

Concerns about managing this growing commercial use led to a planning effort involving the Deschutes, Winema, Umpqua, and Willamette National Forests. Most of the use is concentrated on the Crescent District of the Deschutes, and the Chemult District of the Winema National Forest. An Environmental Assessment has been completed (1995) with appropriate public involvement to address the social and biological effects of continued commercial mushroom harvesting in the area.

Mineral sources, Gravel, Cinder

Odell Creek

The geologic processes which created Odell Lake and Creek also created an excellent gravel source for the Forest Service. The glacial moraine which dams Odell Lake ended near McCool Butte, and glacial outwash in the form of gravels were deposited from east of McCool Butte to Davis Lake. The coarsest gravel settled first near McCool Butte with finer material moving further toward Davis Lake. The coarser gravels near McCool Butte are desirable for a variety of uses including road construction. Currently, one pit, the Odell Pit, is in operation in this area.

Land Ownership, Uses, and Forest Service Management

The history of Forest Service management within the Odell Watershed aids in documenting how humans have influenced this landscape since the late 1800s and the reasoning behind their actions. Most of the reasons are related to the unique physiographic features and the inherent ecological processes within the Odell Watershed that have influenced people's desire and ability to utilize the various resources throughout time.

Moreover, this historical overview nurtures an important perspective that there have been many land managers deciding the fate of the Odell Watershed prior to today, and the greatest number of people who will be affected by today's decisions have yet to be born.

Judge John Breckenridge Waldo from Eugene was one of the first Willamette Valley settlers to visit the Odell Watershed for recreation. Beginning in 1872, Judge Waldo and several friends spent their summers exploring the area in and around the Odell Watershed. The group would often camp and fish at Odell Lake and then follow Odell Creek from the lake's outlet for seven miles to rediscover Davis Lake (Williams 1985).

From these visits, Waldo developed a great appreciation for the beauty and wildness of the Odell Watershed. Inspired, he pleaded to Congress in 1889 that this area be designated as part of the National Forest Reserves. Due in part to Judge Waldo's efforts, President Grover Cleveland withdrew this land from the Public Domain on September 28, 1893 (History Papers).

Since that time, the Forest Service has managed the watershed for the use and benefit of all American citizens. This means that the Odell Watershed has standards for management that not only reflect the values of Oregonians and residents of the Pacific Northwest, but also the values of all Americans. Most of these values are articulated in environmental policy such as the Clean Water Act, Wilderness Act, National Environmental Policy Act, and the Endangered Species Act.

On April 13, 1994, a Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl (ROD) was signed to amend the current Deschutes National Forest Land and Resource Management Plan 1990 (LRMP). Commonly known as the Northwest Forest Plan (NWFP), this is the most recent change in forest management direction, and it will affect the use of the Odell Watershed by all communities mentioned thus far.

Odell Lake-Willamette Pass

The historic management of the Odell Lake and Willamette Pass area has centered around transportation routes through the Cascades, accommodating recreational use, and the fishery at Odell Lake. The following poem which is presumed to be written by Cy Bingham, a Forest Ranger during the early 1900s, describes Odell Lake:

"In this grand old State in which we dwell,

There's a spot called Lake Odell,
No prettier lake, was ever seen,
Where the hunters killed the spotted fawn,
And speared the dollys as they spawned." (History Papers).

In the early 1900s, a fish hatchery was established at Odell Creek near the Odell Lake outlet. Non-native fish were soon introduced to the lake and the populations thrived. Currently, the Oregon Department of Fish and Wildlife maintains a large fishery including kokanee salmon and lake trout. Odell Lake, with an average depth of 282 feet, is now considered to be one of the best deep water, recreational fisheries in the state of Oregon.

Recreational use of the area evolved along with transportation. During the 1920s resorts and summer homes were built around Odell Lake to accommodate anglers and overnight users. Today, there are sixty-six summer homes concentrated along the northeastern and northwestern shores of the lake and several campgrounds and boat ramps.

In 1939, the Willamette Pass Ski Area was developed adjacent to Odell Lake as the first operating ski area in the central Cascades. Only the Timberline Lodge on Mt. Hood has a longer operating history in the state of Oregon (Dept. of Planning 1984). This ski development initiated the establishment of Willamette Pass as a winter destination area.

In 1974, a snowmobile racetrack was built at the southern boundary of the Odell Watershed immediately north of the Crescent Lake Airstrip. The permit for the racetrack was the first issued for this type of use in Region 6. The track area, which originally operated as a solid waste disposal site for upper Klamath County, is no longer used for racing (History Papers). In 1984 the ski lodge at Willamette Pass Ski Area was constructed. Since then, accommodations for other winter activities including cross-country skiing have also been developed throughout the area.

The 1990 Deschutes National Forest Land and Resource Management Plan (LRMP) allocates the majority of the Odell Lake-Willamette Pass area for intensive summer and winter recreational use. The goal of this allocation is to provide a wide variety of quality outdoor recreation opportunities in a forested environment that range from modified to undeveloped (Figure 4).

Wildlife emphasis in this area is focused on habitat improvements for watch-able wildlife and maintaining or improving fish habitat. Two areas located around Odell Lake provide the necessary habitat for wildlife species such as the northern spotted owl and bald eagle and are designated specifically to conserve the integrity of that habitat. Within these small areas, human use is to remain subordinate to wildlife needs.

For fisheries, Trapper and Crystal Creeks and the area around their inlets to Odell Lake, provide the most critical habitat for fish spawning and rearing. The bull trout, which historically utilized these areas to spawn and rear, is now federally listed as Threatened. This will affect future management of the non-native fishery, which includes kokanee salmon and recreational use of Trapper Creek riparian area. Currently, all bull trout must be released if caught by anglers. For more information, see the Biological Domain, Aquatic Species of Concern section.

In 1994, the Record of Decision for the Northwest Forest Plan (NWFP) amended the Deschutes Forest Plan and designated this area to three allocations: Administratively Withdrawn Areas,

Late-Successional Reserves, and Riparian Reserves. This amendment shifts the priority in this area from providing recreational use sites in riparian areas to riparian protection from degradation (Figure 3).

High Cascades

The rugged, glaciated terrain of the High Cascades including Diamond Peak, Mount Yoran, and Maiden Peak discouraged roading during the late 1800s. Instead, routes were established at present day Willamette Pass which is lower in elevation. In the 1930s, the Oregon Skyline Trail was blazed along the Cascade Crest crossing the base of Diamond Peak over Willamette Pass and past Maiden Peak (History Papers).

The value of the wilderness experience that could be obtained from this trail was widely recognized. This section of trail grew in popularity and uniqueness as other areas in the Cascade Mountains were soon roaded. In 1957 the USDA Forest Service established the Diamond Peak Wilderness which was eventually added to the National Wilderness Preservation System in 1965. In 1968, the Oregon Skyline Trail became part of the Pacific Crest National Scenic Trail. (History Papers).

These acts of legislation prevented the continuation of development in the Willamette Pass area for winter recreation including the denial of building permits for two additional ski resorts. The first proposal was for a Diamond Peak resort in the 1940s. This development was envisioned to be larger than the Timberline Lodge on Mount Hood (History Display). The second proposal was made in 1970 to develop Maiden Peak for downhill skiing with a base area located near Bobby Lake (USDA Forest Service 1970).

The LRMP allocates the area south of Willamette Pass as the Diamond Peak Wilderness. The ROD classified this area as Congressionally Withdrawn, which does not change current management direction. Likewise, the area to the north, which is allocated as Dispersed Recreation in the Forest Plan, is now allocated to Administratively Withdrawn.

Stratovolcanoes

Stratovolcanoes and other similar volcanic features within the Odell Watershed include the following landmarks: Davis, Royce, and Maklaks Mountains, and Hamner, Ranger, and McCool Buttes. These volcanic features were not glaciated into scenic monuments like Diamond Peak and Mount Yoran, but are mostly vegetated, conical in shape, and stand alone as prominent landmarks. This conical shape and high vegetative productivity have influenced their history of human use.

Forest Service managers first utilized the vistas afforded by the conical landmarks by building two fire lookouts within the watershed. The first was built on Maiden Peak in 1923, was abandoned in 1942, and burned in 1955. Later, a lookout was built atop Davis Mountain which was destroyed in the 1970s. In 1971, the first official helispot on the Crescent Ranger District was built on Hamner Butte. Historical maps indicate that a majority of the Odell Watershed was accessible within several hours by foot from these lookouts, which probably kept historically frequent ground fires within the watershed suppressed to a minimal size (History Papers).

The stratovolcanoes have also served as a source for valuable timber. The combination of having highly productive growing sites for mixed conifers and ease of accessibility created

feasible timber operations. Today, a majority of the stratovolcanoes are roaded with low maintenance level roads (native surface) and have been logged in some capacity.

The LRMP has allocated these volcanic features for various uses. Because of their high visibility from the Cascade Lakes Scenic Byway and recreation sites, most of them have been allocated to Scenic Views. Other visible areas have been designated as northern spotted owl habitat. Both of these management areas emphasize the conservation of large trees to benefit either scenery or wildlife habitats. Consequently, in areas of past timber harvesting, more large trees have been retained in these management areas versus those allocated to General Forest which emphasizes timber production while providing for other uses such as commercial mushroom collection and hunting.

The Northwest Forest Plan designates a majority of the stratovolcanoes in this watershed as Late-Successional Reserves (LSRs) which greatly changes management direction from timber production (as in General Forest) to managing for the retention and growth of large trees. In 1995, the Davis Late Successional Reserve Assessment was completed. Habitat objectives and appropriate treatments were identified for the area. The NWFP has also allocated part of this area to Matrix which defers to the current Forest Plan for management standards and guidelines.

LaPine Basin

The flat area between the high Cascade Crest and the stratovolcanoes is considered part of the LaPine Basin. Lodgepole pine is the dominant tree type in the basin due to the low productivity of pumice and ash which cover the area up to a meter in depth. This pumice and ash deposition resulted from the eruption of Mount Mazama (Crater Lake). Because of the low commercial value of lodgepole pine and limited recreational opportunities in the basin, the Forest Service did not manage this area for any particular use until the 1960s.

At that time, a mountain pine beetle epidemic caused a large component of the lodgepole pine to die. The timber industry created a market for the dead and dying lodgepole, which resulted in a majority of it being salvage harvested. The accessible dead and dying lodgepole was also used for commercial and personal firewood.

The LRMP allocates most of the LaPine Basin to General Forest which emphasizes timber production and some additional uses. The ROD amends this allocation to Late-Successional Reserve which allows for firewood collection and salvage operations if those activities are intended to prevent effects on late-successional habitat, while permitting some commercial wood volume removal.

Odell Creek

Odell Creek begins at the outlet of Odell Lake and flows approximately seven miles to the inlet of Davis Lake. Throughout history, fish, wildlife, and people have used this riparian corridor to travel between the two lakes. From its outlet at Odell Lake east to McCool Butte, the glacial moraine which created Odell Lake also created a wide riparian area with a perched water table. The resulting marshy area has discouraged roading and development.

The historic road to Davis Lake, one of the few roads in this area, is a good example of a route which has avoided this wet area. The road was routed from State Highway 58 near the crossing of Odell Creek to the north of the creek along the base of Maklaks Mountain. This route was considered as an alternative route for the Cascade Lakes Scenic Byway but was not selected for

various reasons, including safety and avoiding riparian disturbance. The existing route along the base of Hamner Butte was selected for the byway instead (Putman 1994).

Under the LRMP the interior of this area was designated as Old Growth surrounded by General Forest. Timber harvesting in this area has been minimal due to the low value of lodgepole pine in the wetlands. The NWFP designates this area as Late-Successional and Riparian Reserve which varies from the management objectives set for General Forest, but does not differ from the historic 'on-the-ground' management of this area (Figures 2 and 7).

From the east of McCool Butte to Davis Lake, the soil is more porous and the riparian area is limited to the stream channel. This area is more conducive to roading, and a road currently parallels Odell Creek. The LRMP manages this lodgepole area as General Forest. Salvage and firewood operations have removed most of the dead and dying lodgepole in this area. As stated above, the Northwest Forest Plan designates the entire Odell Creek area as Late-Successional and Riparian Reserves. These designations will affect salvaging and firewood activities and possibly dispersed recreation opportunities in this eastern section of Odell Creek.

Davis Lake

Nearly 5,500 years ago, a lava flow blocked Odell Creek and flooded approximately 3,000 acres of the LaPine Basin, thereby creating Davis Lake which has a maximum depth of 26 feet. At certain times of the year the porous nature of the lava flow allows water to drain from Davis Lake at a greater rate than Odell Creek and other water sources can replenish. Consequently, the water surface of Davis Lake can fluctuate between 40 and 3,000 acres. This natural process has greatly influenced the use and management of the lake for agriculture, recreation, and wildlife.

During low water years, the Davis Lake area appears as a large prairie. In the late 1800s and early 1900s, several settlers attempted to homestead the area under the Homestead Act of June 11, 1906. To homestead the area, the government had to be convinced that the land was suitable for agriculture. Several arguments were made supporting the area for agriculture during low water years, but testimony of high water years made the idea of homesteading questionable (Settlement Papers 1908-1915).

Finally, the Secretary of Agriculture requested a formal examination of the Davis Lake area. It was named the Davis Lake Classification Project, and on September 11, 1914, the Secretary of Agriculture issued the following statement:

“It is my opinion after a complete review of the evidence, that this land has no positive value for agriculture, that it is needed for the use, utilization, protection, administration and enjoyment by the public of the resources of the surrounding forest area, and that the only higher use to which it might be put would be water storage purposes, which is also a proper National Forest use of land.” (Settlement Papers 1908-1915).

Consequently, the area was never officially homesteaded, but grazing was permitted in the area. Judge John Breckenridge Waldo noted in his diary on August 14, 1888:

“We have fared well at Davis Lake, but a band of sheep have been about the Lake since before we came, and have taken much of the charm from the place. For

taking the aroma out of the wilderness this animal can hardly be excelled by a company of 'business' men or clodhoppers." (Williams 1985).

The Stearn Cattle Company received a grazing permit for the Davis Lake area after Crane Prairie reservoir was flooded. Permitted grazing continued in the area until 1969 when it was phased out due to increased conflicts with recreation and wildlife needs. These needs were identified as part of the Charlton-Davis Lake Land Use Study which was conducted in the late 1960s when the lake's water level was high (History Papers).

During high water years, populations of fish and wildlife flourish at Davis Lake, and human use increases due to the prime hunting and fishing opportunities. The desire to maintain these opportunities has led to several attempts to artificially retain water in Davis Lake. In the 1940s there were unsuccessful attempts to plug noticeable holes in the lava. Attempts were again repeated between 1966-1967. Fishery improvements were also attempted throughout the years, including the introduction of non-native fish and the poisoning of chubs (History Papers).

During low water years, the use of Davis Lake by fish and anglers drops considerably, but high densities of wildlife and waterfowl continue to use the area. This resource has attracted people who enjoy watching wildlife, especially the impressive variety of migratory birds. This use was emphasized in the current LRMP where a majority of the area was allocated to conserve bald eagle habitat along the lakeshore. Another allocation includes proposed Special Interest Areas to preserve and provide areas of unique geological, biological, and cultural features for recreation, research, and educational opportunities.

Only two sites located near the Odell Creek inlet were designated for intensive recreation. The other campground located near the lava flow has retained its undeveloped character. In the 1970s, there were plans to develop this campground, however, the plans were abandoned during the preceding low water years which lowered the recreational demand (Vroman 1994). In 1994 the Lava Flow Campground was temporarily closed due to a pair of nesting bald eagles. This action illustrates the emphasis on wildlife management at Davis Lake in contrast to Odell Lake and several lakes along the Cascade Lakes Scenic Byway that are managed almost entirely for intensive recreation.

The Record of Decision amends the LRMP allocations to include Administratively Withdrawn Areas, Late-Successional Reserve, and Riparian Reserves. This amendment has shifted the priority from providing recreation in the riparian areas to protecting their integrity for fish and wildlife habitat.

Recreation

Odell Lake-Willamette Pass

The Odell Lake-Willamette Pass area provides a unique setting for recreation within a larger context. Odell Lake is situated in a recreation area that spans from Oakridge, Oregon located 37 miles west of Willamette Pass to Crescent Lake located 4 miles southwest of Crescent Lake

Junction. Within this area a large spectrum of outdoor experiences are possible, all easily accessible from State Highway 58 (Figure 19).

Waldo Lake, a large, high elevation lake, provides recreationists on the Willamette National Forest with an environment that is primarily undeveloped where people can canoe, hike, and bike in a quiet, serene setting. On the other end of the spectrum, Crescent Lake is warm enough to attract water skiers, jet skiers, and swimmers. During the summer, this lake is active with motorized watercraft, and the beaches are shared by several groups of recreationists.

Odell Lake provides a recreational experience between those of Waldo and Crescent Lakes. The cold, deep water and strong winds discourage swimming and water skiing. The excellent fishery attracts motorized boating, but boaters usually limit their motor use to travel between fishing spots. This creates an outdoor setting on Odell Lake that is scenic and somewhat quiet.

A range of facilities around the lake add to this outdoor experience. Anglers or other visitors can stay in summer homes, developed campgrounds, lodges, and nearby accommodations in Crescent Lake Junction. There are also campgrounds on Odell Lake accessible only by boat which offer a unique outdoor experience not available at lakes that provide access around their entire perimeter.

The Willamette Pass-Odell Lake area also provides opportunities for recreation during the winter. A combination of consistent snowfall and the winter maintenance of Highway 58 invites winter recreational use to this area. A full range of experiences are possible ranging from day and night downhill skiing to groomed and ungroomed cross-country skiing. The Willamette Pass Ski Area and the East Odell Lake Lodge rent equipment and groom a variety of ski trails. Recreational sno-mobiling is minimal around Odell Lake which enhances the quiet, winter setting for nordic skiers.

The Odell Lake-Willamette Pass area is a highly solicited area for summer and winter recreation. Within a larger context, it illustrates a balanced spectrum of outdoor experiences ranging from primitive to developed settings. The continued increase of use within this area highlights an opportunity to expand and develop new facilities to accommodate the influx of visitors. Although the area can physically support more activities, people, and development, the spectrum of outdoor experiences can quickly become imbalanced which eliminates the opportunities for undeveloped, quiet recreation and habitat for a variety of wildlife species.

The 1990 Deschutes National Forest Land and Resource Management Plan (LRMP) has continued to support this intensive recreational use and commercial traffic. Communities at local, regional, and national scales expect these uses to continue into the future. Crescent Lake Junction, a small service community, depends on these travelers and recreationists to support its businesses. The Klamath Tribe values this area for its wealth of heritage resources and advocates protecting these resources from further degradation resulting from development around Odell Lake.

High Cascades

The High Cascades within the Odell Watershed provide recreationists with a convenient, but pristine environment to enjoy solitude and wildness. From State Highway 58 and the Waldo Lake Road, high alpine lakes such as Yoran and Rosary Lakes are accessible by hiking only a few miles. From the Waldo Lake Road, most trails are flat or downhill which is attractive to

hikers and bikers that want a high elevation or downhill experience without much uphill effort. Because of this convenient access, the use of these areas will probably increase as visitor traffic rises and populations grow. As use increases, the opportunities for solitude and a pristine setting will decrease.

The Pacific Crest Trail (PCT) is also routed through this part of the Odell Watershed and is designated as a national scenic trail. This trail affords the opportunity to hike from the Mexican to Canadian borders in a mostly undeveloped, wild environment which is very unique and rare within the United States. Currently, Highway 58 is the only major development within the Odell Watershed that cannot be avoided by PCT hikers (Figure 19).

Because the area is easily accessible from Highway 58 and the Waldo Lake Road, there are other opportunities for special uses, including specialized outfitters and trail guides. These services would probably increase use in the area and may decrease the outdoor solitude experience for some recreationists. The undeveloped recreation area provides the most flexibility for additional special uses.

Stratovolcanoes

Most of the stratovolcanoes are enjoyed by recreationists from a distance. These volcanic landmarks are scenic features in the landscape as viewed from various trails, lakes, campgrounds, and the Cascade Lakes Scenic Byway. There is only one designated recreational trail on these buttes, a snowmobile route on Royce Mountain. There are many low maintenance roads that provide rough access for curious back road drivers, hunters, campers, and commercial mushroom pickers.

LaPine Basin

The flat, vegetated area within the LaPine Basin is not heavily used for recreation. Most users pass through the area on trails which extend far outside the Odell Watershed such as the Border-to-border snowmobile trail, Metolius-Windigo horse trail, and mountain bike trails. Most of these trails use existing roads which are also used by hunters and mushroom collectors.

There are a few trailheads for hikers, but none of them specifically accommodate winter or horse use. Work is currently in progress on designating and constructing the southern section of the Metolius-Windigo horse trail through this area, and assessing the need for horse camp facilities in the Davis Lake area.

Odell Creek

The recreational use of Odell Creek is minimal compared to other creeks in the vicinity of the Odell Watershed. Dispersed hunting, fishing, and camping occur at a few spots along the creek where roaded access is provided. Most of these users are repeat visitors with a tradition of using Odell Creek for recreation. Other creeks such as Crescent Creek which is a Wild and Scenic River may provide a better setting for creek-side hiking and more convenient access.

Davis Lake

The recreational setting of Davis Lake changes with the fluctuating water level. The area accommodates different recreational uses and users during high versus low water years. During high water years Davis Lake is shared by a variety of users including fly fishermen, low speed

boaters, canoeists, campers, and wildlife watchers. During low water years, use of the area by anglers, campers, and boaters declines.

This natural fluctuation of human use has helped maintain the area's undeveloped, wild condition. The low water/low use years, have allowed the campgrounds, riparian areas, and wildlife that were disturbed during the high water/high use years to restore themselves. If projects for facilities were demanded in high water years, the demand faded during low water years. Consequently, developments rarely were completed including Lava Flow Campground which has a very low level of development.

Tentatively, three areas around Davis Lake are proposed as stopping points along the Cascades Lakes Scenic Byway including the lava flow, East Davis Lake campground (for day use), and a

Odell Watershed Analysis Area

Recreation

-  Major Roads
-  Wilderness
-  Developed Campground
-  Resort
-  Ski Resort
-  Summer Homes Tracts
-  Trailhead
-  Dispersed Recreation Site
-  Summer Trail
-  Winter Trail

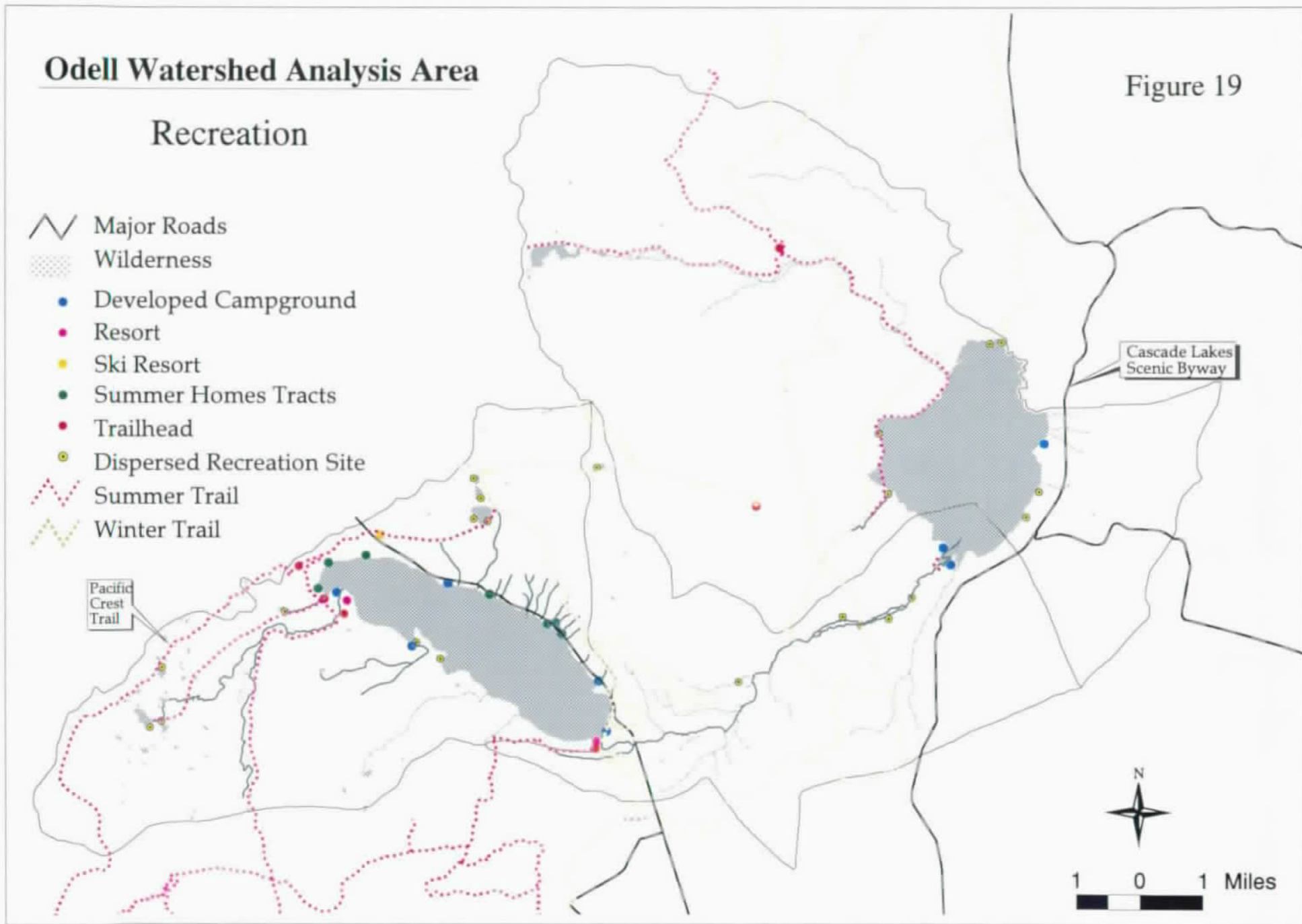
Pacific
Crest
Trail

Cascade Lakes
Scenic Byway



1 0 1 Miles

Figure 19



viewing area at the entrance road. If these stops are implemented, use of the lake area will greatly increase (Simpson 1994).

The 62 Road also directly links the Crescent/Gilchrist area to Davis Lake. Currently, three miles of this road are not paved, if this link is ever improved or solicited, the use of Davis Lake would increase substantially. As more and more use occurs at Davis Lake, the need for more development will emerge and threaten the existing undeveloped character of this lake which is unique to the southern portion of the Cascade Lakes Scenic Byway.

The current management of Davis Lake does not emphasize commodities or commercial use. The area is primarily undeveloped with no resorts or highly developed recreation facilities. The three campgrounds around the lake are currently operated by a concessionaire who maintains the facilities and collects fees.

Today, with growing populations in Central Oregon, and additional access being provided by the scenic byway, recreational use of Davis Lake is increasing. Even during low water years, people come to watch wildlife, including a wide variety of migratory birds, and enjoy the primitive character of the area. There are people in every community who value this natural fluctuation in the water level. However, there are also people who expect the water level to be retained at a minimal level to sustain populations of fish and enhance specific waterfowl habitat. Other social expectations include the national expectation to provide habitat for the bald eagle which impacts opportunities for recreation during nesting periods. The area also contains a wealth of cultural resources that are highly valued and expected to be preserved. The management of Davis Lake currently accommodates these diverse social expectations, but as human use increases, this will become more difficult to achieve.

The fishery at Davis Lake, which is excellent during high water years, is managed at its natural capacity during low water years. Water is not artificially retained in the lake to support a sport fishery like it is for Crane Prairie and Wickiup Reservoirs located just north of the Odell Watershed. The lake is also designated for fly fishing only, and most anglers catch and release their fish. Duck hunting is also popular at Davis Lake. Both hunting and fishing require state license fees.

Transportation and Access

Odell Lake-Willamette Pass

The earliest roads in the Odell Watershed were built in the Odell Lake and Willamette Pass area to provide access to the southern Willamette Valley through the High Cascades (refer to the "European Settlement and Uses" section for additional history). State Highway 58 provides an East-West link for residences and travelers between Interstate Highway 97 and Interstate 5, both major N-S routes through the entire state of Oregon. The roads are kept at a high maintenance level and receive heavy commercial and interstate traffic.

Commercial use of the Odell Lake-Willamette Pass area is centered around State Highway 58 and the Southern Pacific Railroad. Highway 58 is often used as an alternative route for

commercial truckers who want to avoid the Interstate 5 route through the Siskiyou Mountains. Trucks constitute approximately 40 percent of the traffic (Community Action Team 1994). Currently, the closest Amtrak stops near the Odell Watershed are located at Oakridge and Chemult. The Amtrak stop at Crescent Lake was discontinued in 1977, but there is interest in reestablishing this stop to draw more business to the area (Community Action Team 1994). This type of traffic plus commercial and interstate traffic, support small businesses in the area of Crescent Lake Junction and a maintenance facility for the Oregon Department of Transportation. These routes also serve as right-of-ways for utilities such as Midstate Electric.

High Cascades

Because of the rugged terrain of the High Cascades and the early establishment of travel routes at Willamette Pass, no roads have been built in the High Cascades within the Odell Watershed. Access is limited to foot and horseback within the Diamond Peak Wilderness. The adjacent dispersed recreation area north of Willamette Pass, does allow bicycle and motorized winter use such as snowmobiles on designated trails only.

State Highway 58 provides access to the Willamette Pass-Pacific Crest Trailhead which spans both the Diamond Peak Wilderness and the dispersed recreation area. From Highway 58, roads around Odell Lake access trailheads to Yoran and other high cascade lakes. The Waldo Lake Road (#5897) which spurs off of Highway 58 on the west side of the Cascade Crest, provides roaded access parallel to the Cascade Crest on the backside of Maiden Peak. This road is paved to Waldo Lake and turns to native surface near Charlton Lake.

From Charlton Lake, the 5897 Road connects to the Cascade Lakes Scenic Byway at the 42 Road junction north of the Odell Watershed. The low maintenance of this section of road has discouraged through traffic from the Cascade Lakes Highway. If the level of maintenance is improved to accommodate standard cars, the use of this road and the undeveloped recreation area would greatly increase by residents of Central Oregon and the Willamette Valley.

Stratovolcanoes

The majority of the existing roads on the stratovolcanoes are associated with timber harvesting. The conical shape of these mountains and buttes were historically more conducive to roading than the High Cascades. A single road could either be spiraled to the top or switch back up one side, from there, timber harvest equipment developed a network of skid roads and corridors which facilitated the removal of the timber.

Most of these roads were constructed with a native surface and receive low maintenance (Figure 20). Many have been closed either by road barricades, natural revegetation, or obliteration. Existing roads are still used by hunters, mushroom collectors, and curious drivers, but the trend is to eliminate roads unnecessary for resource management.

LaPine Basin

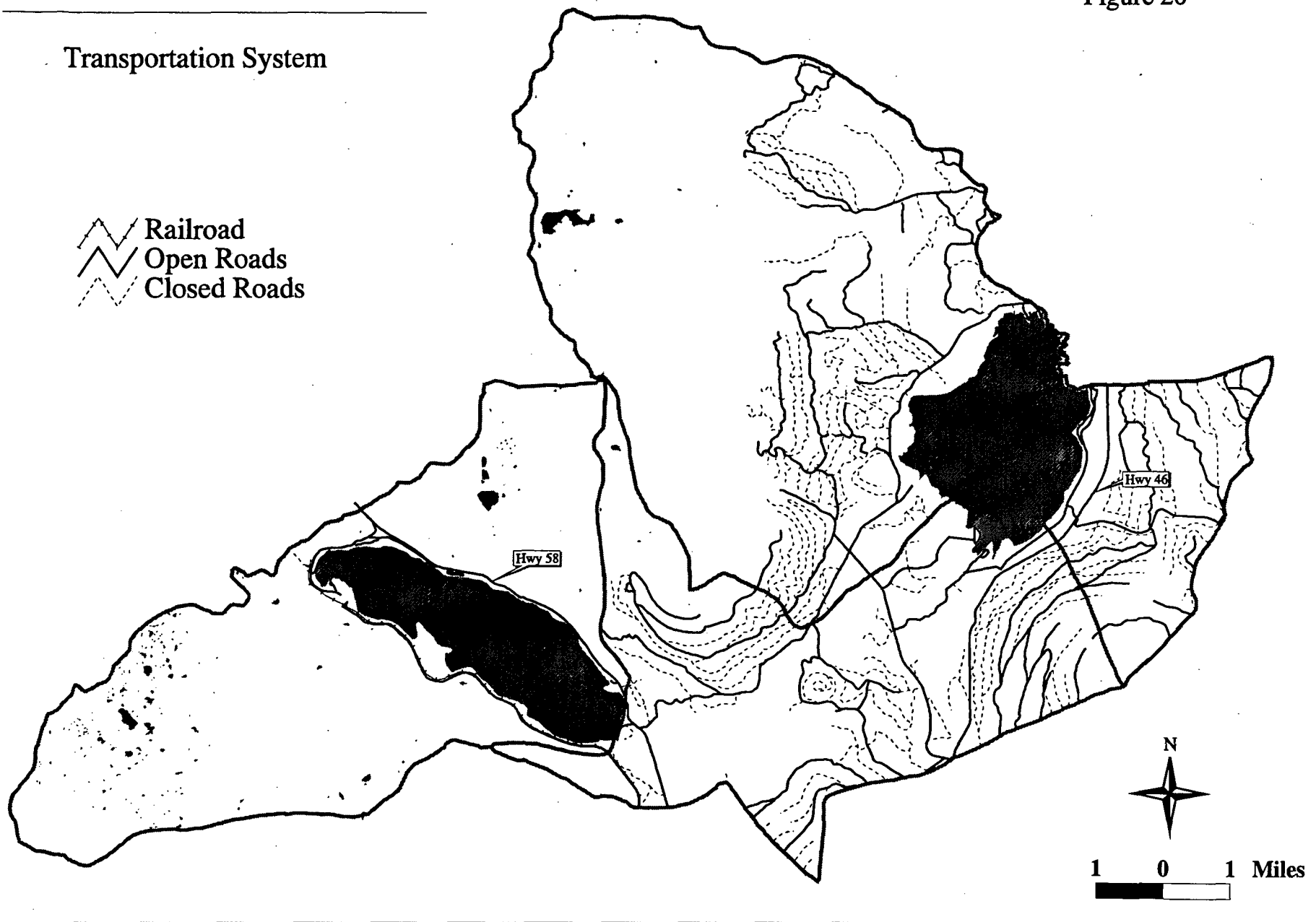
Most of the LaPine Basin was roaded within the last 30 years to access the dead and dying lodgepole for salvage. The flat topography of the basin has allowed people to travel basically wherever they desire. This includes firewood collectors, timber harvest equipment, hunters, OHV operators, and mushroom pickers. The Davis Late Successional Reserve Assessment identified much of this area as a priority for travel and access management. The area is open for motorized use, but the LSR objectives are to reduce the number of roads where unnecessary for resource management (USDA Forest Service 1994).

Odell Watershed Analysis Area

Figure 20

Transportation System

-  Railroad
-  Open Roads
-  Closed Roads



Odell Creek

The western half of Odell Creek from Odell Lake to McCool Butte has minimal roading. Most traffic, including recreation trails, is routed south around McCool Butte and away from this sensitive riparian area. The road near the Maklaks Creek inlet is identified as a mountain bike route, and is the only route in this area designated for recreational use.

An underpass for Highway 58 is proposed in this area for snowmobile traffic. If constructed, this may attract other users through the west Odell Creek area such as horseback and bike riders who want to cross Highway 58. These trails will need to be routed similar to the existing snowmobile route which crosses a bridge near McCool Butte and goes around the sensitive riparian area.

The remainder of Odell Creek, east of McCool Butte toward Davis Lake, is more accessible by road. Forest Rd. 600 was built parallel to the creek which has encouraged some dispersed camping along the creek. Extraneous entry routes into these camps have been blocked since the previous watershed analysis was completed. Three primary sites are currently receiving use on Odell Creek.

Davis Lake

Historically, access around Davis Lake was much closer to the lakeshore. People can remember many times when the historic road to Davis Lake from Highway 58 was flooded along the western lakeshore (Putman 1994). This road is no longer used by vehicles, but some people do use it as a trail. The 4660 Road now provides access nearly a half mile from the lakeshore.

Access along the eastern lakeshore used to be confined to the 850 and 855 Roads which were once part of the Cascade Lakes Scenic Byway, however, the byway was reconstructed and moved above the lakeshore about a half mile. Today, an intersection on the byway leads travelers to the 850 and 855 Roads to access Lava Flow Campground and East and West Davis Campgrounds. These roads are problematic because they pass through critical habitat for the bald eagle. Gates across the roads eliminate access between January 1 and August 31. Rock barriers were placed along the 850 and 855 Roads in 1994 to limit direct access down to the lakeshore. A project is currently underway to prepare a long-term plan for access to Davis Lake and Lava Flow Campground.

Scenic Quality and Perceptions of "Natural Appearance"

Odell Lake-Willamette Pass

The Odell Lake-Willamette Pass area has maintained most of its natural scenic character which includes a foreground dominated by large trees and picturesque scenes of Odell Lake with snow-capped Diamond Peak in the background. The uniform texture of the mixed conifers in the middleground has been modified in localized areas such as the Willamette Pass Ski area which is viewed from the southwestern lakeshore. Other areas of modification include gravel pits and highway widening.

Scenic management within this area has emphasized the retention of the large tree dominated forest and blending developments into the High Cascades setting. Most of the recreation sites

have been developed with large logs and steeply pitched roofs which are commonly associated with structures built during the CCC era.

The high visibility of this area has prevented active vegetation management including timber harvest and understory thinnings. Consequently, an understory of white and grand fir has been established under the large tree overstory. This may later threaten the health of the desired large tree dominated forest and understory vegetation including huckleberry, willow, and other shrubs.

High Cascades

The natural scenic character within the High Cascade Crest has been retained throughout the years. Management for wilderness and dispersed recreation has maintained and protected its natural scenic character. Even the suppression of wildfire has not significantly affected the character of this forest. Only root rot pockets larger than 40 acres are noticeable on the landscape. These pockets provide visual variety in an otherwise uniformly textured forest.

This area is highly visible from distances ranging from ½ to 10 miles from Highway 58, the Cascade Lakes Scenic Byway, and several recreation sites including Davis Lake. The area is most closely viewed from the Pacific Crest Trail and several other high mountain trails.

Stratovolcanoes

Timber harvest activities have caused the greatest impact to scenic quality on the stratovolcanoes. Most of these visible volcanic landmarks have partially retained their inherent scenic characteristics when viewed as middle and background or at a distance greater than a half mile. Some of the past regeneration harvest units including clearcuts, however, appear as geometric, unnatural openings. Royce, Maklaks, Davis, and Hamner Mountains display the most recent modifications. Other buttes such as Ranger and McCool are mostly impacted by visible roads and skyline corridors.

The Cascade Lakes Scenic Byway, which is routed along the base of Davis Mountain and Hamner Butte, provides travelers with the closest view of vegetative diversity growing on the stratovolcanoes. Over the years, timber harvest activities have reduced the amount of large ponderosa pine and fir trees, which historically dominated this foreground view, to the point that large trees are now considered to be unique scenic features. Currently, these views are dominated by pole-sized trees and the remaining large trees are screened behind thickets of lodgepole pine which have invaded the disturbed highway right-of-ways.

LaPine Basin

Most of the LaPine Basin cannot be viewed from travel routes within the Odell Watershed, however, a view from the top of any of the high mountains and buttes reveals a patchwork of clearcuts. A majority of the lodgepole stands were salvage harvested within the last 30 years with some form of clearcut to help control the mountain pine beetle epidemic.

From a foreground view or within a half mile, the flat topography limits scenic views. Along a single road a visitor may see one or all of the following: a foreground dominated by thickets of young lodgepole pine, a 40 acre clearing dominated by lodgepole seedlings with views of the surrounding mountains, a decadent lodgepole forest with large amounts of standing and fallen dead trees, or areas where firewood collection has left a green forest with tire tracks throughout.

Scenic management of the area has been challenging due to its susceptibility to insect epidemics and the consequent mortality.

The most scenic vegetation in the LaPine Basin within the Odell Watershed is along the forested lava flows, where old, large ponderosa pines are elevated on the lava ridges. Currently, no designated trails or recreational use occurs in this area.

Odell Creek

The riparian area surrounding Odell Creek, especially west of McCool Butte, creates a unique scenic character within the Odell Watershed. This corridor includes a variety of riparian shrubs, spruce trees, and meadows with an abundance of wildflowers. Modifications to the scenery have only occurred in localized areas where timber has been harvested within 50 feet of the creek. Dispersed campsites along the creek have changed the character in areas only where excessive access routes have been created by users. The area is highly resilient and can restore itself if given adequate protection from use.

Davis Lake

The unique scenic character around Davis Lake has been retained over the years. The lakeshore is still dominated by large open park-like stands of ponderosa pine. Areas of lodgepole appear natural with large amounts of standing and fallen dead trees. Historically, willows may have been more noticeable on the landscape before grazing. Several hundred native willows were planted in 1994 as a restoration effort.

Recreation facilities around the lake appear subordinate to the surrounding landscape. Of all the developed campgrounds, Lava Flow Campground is the most primitive in appearance with an entry road and campsites situated among large ponderosa pines. In some areas an understory of grand fir has become established, and endemic insect and disease infestations are evident, both factors may threaten the longevity of the big pines.

East and West Davis Lake Campgrounds are situated in areas dominated by lodgepole pine. The mountain pine beetles have caused tree mortality in the area resulting in the removal of numerous hazard trees. Ponderosa pine seedlings were planted in 1994 throughout the campgrounds.

The water level fluctuation of Davis Lake also changes the scenic character of the area from a wide open space, which a person can wander through by foot, to a large lake reflecting the adjacent land features and sky. During low water years there are usually tire tracks throughout the exposed lake bottom which detracts from the natural scenic quality.

SYNTHESIS AND INTERPRETATION

Key Questions

Hydrology

What are the natural and human causes of change between historical and current hydrologic conditions? What are the influences and relationships between hydrologic processes and other ecosystem processes (e.g. sediment delivery, fish migration, etc)?

Erosion Processes

What are the natural and human causes of change between historical and current erosion processes in the watershed? What are the influences and relationships between erosion processes and other ecosystem processes (e.g. vegetation, woody debris recruitment, etc)?

Stream Channel

What are the natural and human causes of change between historical and current channel conditions? What are the influences and relationships between channel conditions and other ecosystem processes (e.g. in-channel habitat for fish and other aquatic species, water quality)?

Water Quality

What are the natural and human causes of change between historical and current water quality conditions? What are the influences and relationships between water quality and other ecosystem processes (e.g. mass wasting, fish habitat, stream reach vulnerability)?

Vegetation

What are the natural and human causes of change between historical and current vegetative conditions in the watershed? What are the influences and relationships between the vegetation and seral patterns and other ecosystem processes in the watershed (e.g. hydrologic maturity, channel stability, shade, disturbance, species movements, soil and erosion processes)?

Species and habitats (plant, wildlife, aquatic)

What are the natural and human causes of change between historical and current species distribution and habitat quality for species of concern in the watershed? What are the influences and relationships of species and their habitats with other ecosystem processes in the watershed?

Social

What are the causes of change between historic and current human uses? What are the influences and relationships human uses and other ecosystem processes in the watershed?

Trends	Causes	Processes Affected	Primary Outcome or Resources Affected	Related Outcomes or Resources Affected
Reduction of large-tree dominated forest stands, with corresponding increase in pole and seedling/sapling dominated stands; moving outside the HRV (historic range of variability) for late and old structured stands; increasing fragmentation. (Applies to all PAGs that have been entered for commercial timber harvest activities).	Conifer regeneration harvest methods; exclusion of low intensity fire; insect (bark beetle) infestation; disease; high-density understory and lack of stocking control.	Vegetative succession including: structure, composition, age, health and vigor, and competition for water and nutrients; regeneration; nutrient cycling; erosion; natural disturbance regimes-fire, insects, and disease; successional time frame.	Economic benefits through jobs and products; change of standing vegetative structure; change in microclimate-increase in frost pocket effects (l. pine-dry); movement towards earlier structural stages, away from late/old; disturbance to wildlife; reduction in species favoring old structural stands; increase in species favoring earlier structural stages; decrease in species favoring contiguous habitat; increase in species favoring contrast (edge) habitat.	Reduction of large tree component (overstory and replacement ponderosa pine) which provides nesting habitat for the bald eagle; reduction of habitat for spotted owl, marten, voles, woodpeckers and related wildlife species; change in brush/forb composition; decrease in scenic quality, due to loss of visible large trees in foreground and visibility of harvest units on the stratovolcanoes in middle and background; change in fuelwood availability; change in the amount of fuel and down woody present; accelerated conversion from late and old stands to regeneration dominated stands; increased compaction and change in sustainability; changes in site productivity due to increased duff layer (p. pine); diversity in structure is at risk due to increasingly complex fuel structure; high risk of significant mortality in overstory and/or understory as a result of disturbance activities; direct loss of trees through competition; distribution of successional stages has moved outside HRV and trend may continue.
Reduction in ability of western white pine to effectively invade and establish in root rot pockets (mountain hemlock associated PAGs).	White pine blister rust - an introduced and endemic disease.	Western white pine survival and growth.	Reduction of genetic diversity of western white pine in the watershed; loss of small stands of western white pine able to invade disturbance areas and successfully grow to reproduction age; loss of biodiversity.	Wildlife species associated with western white pine; species diversity within root rot pockets is outside the HRV.

Trends	Causes	Processes Affected	Primary Outcome or Resources Affected	Related Outcomes or Resources Affected
Bull trout have been eliminated from Odell Creek and Davis Lake and their viability is questionable within Odell Lake and its tributaries.	At Odell Lake and tributaries: angling pressure; historic poaching of fish during spawning season; introduction of non-native fish; competition with non-native species for spawning (kokanee) and/or rearing (brook trout) habitats; At Odell Creek and Davis Lake: parasite <i>Ceratomyxa shasta</i> ; historic poisoning of system to remove chubs and whitefish.	Predator/prey relationship; population viability; social pressures; competition with non-natives $\frac{1}{4}$ kokanee and brook trout; predation by lake trout; natural selection.	Loss of genetic pool for only remaining natural adfluvial population in Oregon; loss of bull trout; decreasing juvenile survival; decreasing spawning success; Listed under the Endangered Species Act.	Probable amphibian loss due to poisoning; change in prey base for eagle and osprey; catch and release program implemented to facilitate bull trout population growth; social conflict.
Increase in soil compaction.	Ground based silviculture and fuels treatments including roading, skidding, etc.; transportation system; recreation facilities.	Erosion; aeration; soil strength; biological activity; nutrient cycling; water retention; infiltration rates; sustained root growth; succession.	Long-term impacts to soil productivity; reduction in soil quality; reduced resiliency.	Potential decrease in old growth sustainability; roads constitute acreage out of production; decrease in water quality; change in vegetative diversity; slowed growth; extension of stream network; compacted areas serve as ephemeral channels; disturbance to wildlife from the road network; increase in fragmentation.
Forest stands which have not been disturbed in the past few decades or more are moving towards later seral stages in their development. The mountain hemlock associated PAGs tend towards the middle of their successional cycle, and the other PAGs tend towards the end of their successional cycles.	For areas other than the mountain hemlock associated PAGs: Historical processes; natural succession; suppression of natural underburns; lack of stocking level manipulation.	Vegetative succession towards late seral species including: composition, structure, and age; fire cycles.	Risk of losing large trees from system; increase in forest structure complexity; large proportion of areas moving toward climax.	Increase in amount and distribution of fuels; increasingly complex fuel structure; increased tree density; increased mortality; increased probability of stand replacement disturbance; conversion of wildlife species from those that prefer pioneer habitat to those that prefer late climax seral; meets general public's scenic quality expectations.

Trends	Causes	Processes Affected	Primary Outcome or Resources Affected	Related Outcomes or Resources Affected
The mountain hemlock associated PAGs tend towards the middle of their successional cycle.	In mountain hemlock associated PAGs: root rot; insects; fire; human uses are highly subordinate to historic processes due to past land allocations including no roads or harvest activities.	All successional processes continue, except western white pine survival and growth.	Stand composition and structure within HRV; maintenance of primitive setting.	Provides a diversity of habitats for wildlife species including contiguous and contrast habitat in the vicinity of root rot pockets; unique transitional wildlife habitat-corridor for E-W travel over and along Cascade crest; habitat provided for small mammals and wolverines; recreational corridor between Diamond Peak and Three Sister's Wildernesses.
Human use has increased and diversified.	Increased social expectations within watershed for activities such as hunting, fishing, boating, bird watching, recreational mushroom/flower/berry picking, hiking, mountain biking, camping, driving, skiing, horseback riding, snowmobiling, OHV, etc.; increased population; area is readily accessible-Highway 58, Scenic Byway, other arterial and collector roads, National Scenic Trail, etc.; solitude. For Davis Lake OHV: Regulated and unregulated use; no posting; increased desire to recreate in area; lack of direction or conflicting management direction; enforcement; increased use from Waldo Lake area. Diversity of commercial uses including: sport fisheries, mushroom harvesting, service community, resorts, ski area, fuelwood, campground concessionaires, guides, wood chips, saw timber, post and pole, boating, summer homes, gravel pits.	Wildlife life cycles; erosion processes; hydrologic processes, mycorrhizal relationships; succession-vegetation; nutrient accumulation; compaction.	Increased economics; social benefits; change/shift in local cultural use; increased ecotourism; change in experience, i.e. more people, trash, etc. For Davis Lake OHV: Conflicts in use; conflicts with wildlife; reduced vigor of conifer species in dispersed recreation sites; impacts to riparian habitat. Human use and disturbance have increased the probability that undiscovered and known sites of cultural importance are being impacted. Inventory and protection of culturally significant sites need to continue at a more rapid pace to match growth pressures.	Increased wildlife disturbance; erosion in riparian areas; disruption of hydrologic cycles; impacts to riparian zones; water quality; impacts to riparian dependent species including amphibians; reduction of native fishery; increase in user conflicts; decrease in solitude opportunities; isolated heavy use areas; train-noise pollution. For Davis Lake OHV: disturbance to wildlife, vegetation, cultural resources; decrease in scenic quality experience (decreased recreation quality); pressure for additional facilities (boat ramp and horse camp). Compaction and erosion. Important information from cultural resources is being lost through the removal of artifacts, development on public lands, and decomposition of wood, metal, and perishable organic materials.

Trends	Causes	Processes Affected	Primary Outcome or Resources Affected	Related Outcomes or Resources Affected
Continued maintenance of non-native fish species in most water bodies (lakes and streams).	Management for non-native species including kokanee and brook trout; stocking of non-native species; fishing for non-natives is a popular recreation activity; economically viable for ODFW.	Competition; natural selection; predator/prey relationships; genetic flows.	Competition for bull trout spawning and rearing habitat; suppressed amphibian populations; zooplankton and macroinvertebrate populations selectively modified and reduced by fish predation; potential barrier to genetic interchange%amphibians and zooplankton.	Increased prey base for eagles, osprey; backcountry fishing-attraction for wilderness use; non-native species are the primary fishing attraction at Odell Lake; supports ecotourism, local economics, and local cultural use.
Meadows are moving towards late seral species composition with associated reduction in grass/forb/shrubs and increase in conifer species.	Suppression of natural fires.	Succession.	Encroachment of conifer species; reduction of open meadow habitat.	Reduction in habitat for meadow dependent species of wildlife and plants; reduction in establishment opportunities for early seral species.
General state of riparian areas is good, except in localized areas of trails, roads, and dispersed campsites as noted under causes.	Area is attractive; high human value; continuation of natural processes; vegetation generally is in good shape; minimum of human activity including recreation and timber harvest; controlled roaded access-limited number of roads and road closures; minimum development; specific management objectives to maintain riparian area.	Hydrologic cycle; erosion; succession; wildlife fitness; species viability; migration; genetic interchange.	Overall maintenance of hydrologic processes; maintenance of viable corridors for wildlife species and amphibians; localized impacts/degradation to riparian areas (vegetation and streambanks) from trails, roads, and dispersed sites; decrease in water quality-sedimentation and nutrients; area for solitude; good fishery.	Additional access to and through riparian areas; risk to degrade cultural resources; some disturbance and localized displacement of wildlife-NTMBs, amphibians, and big game reproduction; healthy populations-elk and ruffed grouse; continued high viability of wildlife populations; watchable wildlife; increased hunting opportunities; increased wildflower, camping, dispersed recreation opportunities.
	At Odell Creek: Increased dispersed camping and trail use (summer and winter); access is controlled (non-parallel to creek)	Erosion; vegetation succession; hydrologic function-channeling.	Increased erosion of streambanks-localized; decreased riparian habitat; disruption of hydrologic function.	Disturbance to wildlife from OHVs and other recreation uses; meets local expectation and needs; degraded experience at impacted sites.
	At Trapper and Crystal Creeks: Railroad crossings; campground use; increased human use. At Trapper Creek: Resort/marina; wilderness trailhead; channeling	Revegetation; LWM reduction; timing of water flow; erosion; vegetative succession.	Reduction of instream LWM - hazard tree removal, roads; stream channelization; degrading streambanks.	Recreation activities; economic resources; increased rate of water flow; degradation of water quality-phosphorus and sediment; change in fish habitat suitability.

	with gabions.			
Trends	Causes	Processes Affected	Primary Outcome or Resources Affected	Related Outcomes or Resources Affected
Water quality has declined and stabilized at a nutrient level above historic (trophic) levels in Odell Lake.	Overall human use, including summer home/campground/resort septic systems; lakeshore erosion, cinder input from Highway 58; boats docking on shore.	Eutrophication; erosion.	Lakeshore stability; increasing amounts of food for fish (zooplankton and phytoplankton); improved fisheries.	Improved recreation experience by improving fishery; aesthetics (erosion); areas to dock boats.
Use of Davis Lake fluctuates with water level.	Highly variable/fluctuating aquatic and riparian habitats at Davis Lake¾Natural fluctuations of water availability to lake; geologic formation of lake¾shallow lake with channel; outlet controlled by fractures in lava at all levels; diatomaceous soils (mud) limits the amount of recreation development possible, it is a natural barrier/deterrent to human and animal use.	Unique hydrologic regime-flow; wetting/drying processes; accumulation/decay; water temperature; food chains-availability; nutrient cycling; fish susceptibility to disease (increased temperature as the catalyst); evaporation.	Fishery population fluctuation (seasonal)-based on water availability; stability of the chub population; uniqueness of lake's hydrologic system; cultural resources affected.	Chubs provide primary prey base for fish eating birds (waterfowl, eagles, osprey, cormorants), the predator base fluctuates with the prey base; retention of natural processes (diatomaceous soil, fluctuating water levels) leads to limited desire for recreation opportunities such as fishing, hunting, and bird watching; limited development for recreation; boat access fluctuates (no low water access); human use fluctuates, but demand remains high; local desire to reduce lake level fluctuations in order to maintain fishery and waterfowl hunting opportunities; water and other habitat for wildlife species fluctuates, including waterfowl nesting habitat and habitat composition, and affects species such as dabblers, divers, and shorebirds; conflicts between humans and wildlife.

Recommendations

Landscape Strategy Areas Goals and Objectives

The Odell Watershed analysis area has been divided into six Landscape Areas based on common issues, trends, and goals. See Figure 21 for the location of these areas.

1. West Odell Creek

Goal: Reserve this area for the present and future benefit of riparian dependent species by allowing the continuation and conservation of natural processes.

Objectives:

A. Maintain the integrity of the riparian area for wildlife, including movement corridors and areas for genetic transfer, and hydrologic function. In addition, maintain the water tables and subsurface flow.

B. Maintain or enhance open meadows due to their uniqueness as a landscape feature, through the use of prescribed fire and/or manual removal of encroaching conifer trees. Natural, wet (high moisture regime) areas should be used for fire containment; in addition, low impact fire suppression techniques should be used.

C. Accelerate conversion of plantation areas to later structural stages. This may be accomplished by thinning, soil restoration, and/or fertilization.

D. Maintain or enhance habitat for wildlife species by promoting development of stands of large trees. A succession of large lodgepole pine stands should be provided. These stands will benefit species such as the goshawk, osprey, and great gray owl among others and will promote maintenance of large tree dominance, soil aeration, and the ability of roots, fungi, and microorganisms to penetrate the soil.

Promote development of trees 11" DBH and greater in size, since they provide nesting habitat for the species listed above. Over time, provide large areas (1000+ acres) of contiguous habitat for black-backed woodpeckers. This habitat will be created by fire and endemic populations of insects and disease. Areas of this size and type are not sustainable within the watershed itself, but if examined on a larger scale, this habitat type can be sustainable, and the Odell Watershed can provide an important portion of it.

Maintain dead and dying trees, since they are utilized by a variety of species including: the black-backed woodpecker, other associated woodpeckers, secondary cavity users, ruffed grouse, marten, and fisher. Within lodgepole pine maintain standing dead trees as a structural component within goshawk and great gray owl habitat until canopy cover (dead & live) falls below 50% or known birds vacate the area. Harvest access, layout, and design should consider travelways as well as additional habitat needs for goshawks and other species.

- E. Maintain or enhance the quality aquatic habitat and explore options for bull trout recovery.
- F. Reduce and obliterate roads and trails that are not compatible with the goal while maintaining adequate access. Additional roaded access should not occur, since this would cause fragmentation to increase.
- G. Funnel the north-south through-traffic around the West Odell Riparian Reserve area while meeting the Recreation Opportunity Spectrum (ROS). The ROS for the majority of the area will shift from roaded modified to semi-primitive motorized; the only area that will retain the roaded natural designation is the area around Highway 58.
- H. Complete the Odell Lake Basin Historic Preservation and Management Plan. This document is intended to guide planning for projects within the lake basin. Protect the integrity of the historic and prehistoric cultural resources.

2. East Odell Creek

***Goal:** Manage a viable lodgepole pine component in the area in order to provide a sustainable forest ecosystem. In addition, maintain or enhance the integrity and resiliency of the riparian systems and wildlife movement corridors which are used for dispersal and genetic transfer.*

Objectives:

- A. Maintain or enhance habitat for wildlife species by reducing fragmentation and promoting development of stands of large trees. A succession of large lodgepole pine stands should be provided. These stands will benefit species such as the goshawk, osprey, and great gray owl among others and will promote maintenance of large tree dominance, soil aeration, and the ability of roots, fungi, and microorganisms to penetrate the soil. Promote development of trees 11" DBH and greater in size, since they provide nesting habitat for the species listed above. Over time, provide large areas (1000+ acres) of contiguous habitat for black-backed woodpeckers. This habitat will be created by fire and endemic populations of insects and disease. Areas of this size and type are not sustainable within the watershed itself, but if examined on a larger scale, this habitat type can be sustainable, and the Odell Watershed can provide an important portion of it. Maintain dead and dying trees, since they are utilized by a variety of species including: black-backed woodpecker, other associated woodpeckers, secondary cavity users, ruffed grouse, marten, and fisher. Within lodgepole pine maintain standing dead trees as a structural component within goshawk and great gray owl habitat until canopy cover (dead & live) falls below 50% or known birds vacate the area. Harvest access, layout, and design should consider travelways as well as additional habitat needs for goshawks and other species. Maintain the down, woody component in order to provide big game security, travelways for marten, and small mammal habitat.
- B. Maintain or enhance the quality aquatic trout habitat and explore options for bull trout recovery.
- C. Prescribed fires in the area will be of an intensity to maintain nutrients and the nutrient cycling regime. They will also be utilized to provide a diversity of structural

conditions and to reduce fuel loading in order to protect large portions of the area from catastrophic fires.

D. Use management methods that will maintain soil capabilities on undisturbed sites and restore those that are degraded.

E. Manage dispersed recreation to provide healthy riparian areas and conserve features. Streambanks will be stable, bound by healthy vegetation which adds nutrients and large, woody material to the channel. Areas containing vigorous, stable, non-riparian vegetation adjacent to the riparian area will be provided for dispersed camping (recreational and hunting).

F. Commodity uses in the area for public and administrative benefit will be used to obtain or enhance stated landscape goals.

G. Complete the Odell Lake Basin Historic Preservation and Management Plan. This document is intended to guide planning for projects within the lake basin. Protect the integrity of the historic and prehistoric cultural resources.

3. Odell Lake/Willamette Pass

***Goal:** Accommodate recreational use that is both appropriate and diverse by providing a wide spectrum of quality, outdoor settings that range from primitive (pristine) to developed, while maintaining water quality, fishery productivity, critical wildlife habitat and corridors, riparian integrity, heritage resources, large tree dominance, and special uses such as summer homes, utilities, and travel routes.*

Objectives:

A. Maintain or enhance areas of healthy, large-tree dominated forests. Large ponderosa pine and Douglas-fir trees at least 30" DBH should be maintained for bald eagle nesting and roosting habitat as well as for other species.

B. Manage areas for increased resistance to insects, disease, and fire. This can be achieved, in part, by maintaining multiple stand structures and seral conditions which will also benefit wildlife species. A variety of management tools and techniques should be used across the landscape, and could include prescribed fire in appropriate locations.

C. Maintain or improve habitat for PETS species; including both plants and wildlife and maintain the integrity of wildlife and amphibian habitat and corridors.

D. Maintain the health and integrity of riparian areas.

E. Maintain or enhance the quality aquatic habitat, while promoting restoration of bull trout populations.

F. Provide interagency coordination for bull trout and water quality management.

G. Maintain or improve water quality (trophic level) of the lake.

H. Identify the desired outdoor settings which range from primitive to developed and the appropriate linkages between them. Undeveloped areas that provide opportunities for solitude should not be linked with areas of high use.

I. Maintain low human disturbance levels on south side of Odell Lake between Odell Lake Resort and Shelter Cove. Provide areas for reproductive and rearing activities of riparian dependent and associated species. The other areas surrounding the lake are heavily impacted by major transportation routes (Highway 58), campgrounds, and

summer residents which preclude areas of seclusion for wildlife. Any future facility development should be subordinate to wildlife needs.

J. Participate in community planning for Crescent Lake Junction and other areas that are directly involved in the use of Odell Lake and the Willamette Pass Area.

K. Coordinate management of the Willamette Pass Ski Area with the Willamette National Forest. Maintain or enhance water and soil quality as well as key wildlife habitat and corridors within the permit area.

I. Continue to allow commercial uses as long as they do not interfere with the maintenance of the desirable physical, biological, and social qualities inherent to the character of the area.

J. Complete the Odell Lake Basin Historic Preservation and Management Plan. This document is intended to guide planning for projects within the lake basin. Protect the integrity of the historic and prehistoric cultural resources.

4. Davis Lake

Goal: Conserve the overall ecological processes that result in maintaining this unique habitat, including the appearance and overall natural ambience of the lake area. The secondary goal is to provide dispersed recreation opportunities which focus on the uniqueness of the geology, wildlife, and scenery of the area.

Objectives:

A. Maintain the natural water fluctuation of the lake.

B. Maintain the large-tree character of the lakeshore and enhance wildlife habitat and visual quality through the use of silvicultural treatments.

C. Enhance wildlife habitat such as providing cover (edge management) for species which use the meadows around Davis Lake.

D. Maintain or enhance the aquatic habitat and explore options for bull trout recovery.

E. Appreciation of the area should be enhanced without disturbance to wildlife. The primary recreation focus within the area should be on the enjoyment of the uniqueness of the Davis Lake area from all standpoints, including wildlife, geology, fisheries, and scenery without degradation of the habitat. Maintenance of the quality fishery is subordinate to the overall setting. The fishery will fluctuate with the water level. Recreation planning is needed in the areas of access, vegetation management, fire, and cultural resources. Since use is expected to increase the resources in and around the lake warrant protection. Recreation should take a subordinate position to the ecology of the area.

F. Maintain the lake in an undeveloped condition. Maintain but do not increase overnight use. Future advertisement of the area should be discouraged. Instead, people will discover it by exploring and word-of-mouth. Recreational facilities should be visually subordinate to the landscape and should not encourage additional use.

G. Establish or maintain recreational sites; limit access. Existing and new facilities should discourage off-road vehicle and mountain bicycle use, since this is not a focal area for either activity.

H. Protect the integrity of the historic and prehistoric cultural resources. Coordinate proposed project activities with cultural resource site treatments. Address problems of

soil erosion/compaction/disturbance in developed and dispersed recreation campgrounds and sites. Loss/disturbance of surface and subsurface soils in buried archaeological sites leads to diminished integrity, significance, and information potential.

5. Mountain Hemlock Association

Goal: *Maintain the pristine quality of this area. Emphasize and enhance habitat for native and naturalized terrestrial and aquatic biota. Natural processes are the dominant features that shape the landscape and include fire and development of root rot pockets.*

Objectives:

- A. Grow resistant strains of western white pine to counteract white pine blister rust and maintain vegetative species diversity.
- B. A fire plan should be developed for this landscape area and should evaluate moving from a control to a confine and/or contain strategy that would assist in the maintenance of sustainable processes. Development of a fire plan should include discussion and analysis of managed fires regardless of ignition source.
- C. Evaluate removal of non-native fish species that become, or currently are, a hindrance to successful exchange of genetic material across the Cascade Crest for amphibians. At a minimum, two corridors should be identified and managed for amphibian exchange within this area.
- D. Maintain or enhance habitat for wildlife species such as the marten, fisher, and wolverine.
- E. Wilderness: Provide for non-motorized and non-mechanized access and enjoyment of the landscape. Follow wilderness regulations and minimize new trail development.
- F. Non-wilderness: provide for winter mechanized access on designated trails which minimize disturbance to other users and wildlife. No new trails should be constructed. Provide for summer mechanized access (mountain bikes only) on designated trails which are appropriately designed and built and will minimize disturbance to wildlife. Foot and horse travel should be allowed throughout the area. No new bike trail construction should take place and new hiking/horse trails should only be constructed if they minimize resource damage.
- G. Identify and evaluate cultural resources, especially where human use impacts exist or are increasing. Protect integrity of significant cultural resources.

6. Central Conifer Association

Goal: *Encourage vegetation to move towards historic ranges in pattern, structure, and seral stage in order to sustain late and old structure related wildlife species such as the spotted owl and bald eagle. To meet the above goals utilize methods, when possible, to obtain forest products for human economic and recreational needs.*

Objectives:

- A. Reduce fragmentation by decreasing road density while maintaining adequate access for appropriate fire management, hunting, general sightseeing and administrative use. Decreasing motorized vehicle access will also reduce disturbance to wildlife. A

reduction in fragmentation could also be achieved by vegetative manipulation activities which could help contrast areas (edges) develop similar structure more rapidly.

B. Encourage late and old size structure through the use of vegetative manipulation which will improve the foreground scenic quality and enhance the suitability of the habitat for late successional wildlife species such as the spotted owl, goshawk, great gray owl, black-backed woodpecker, and marten. Large ponderosa pine and Douglas-fir trees at least 30" DBH should be maintained for bald eagle nesting and roosting habitat as well as for other species.

C. Encourage pioneer and mixed seral stages by underburning to control understory conifer and brush species and planting for the desired mix of species where appropriate.

D. A variety of management tools and techniques should be used across the landscape. Manage areas for increased resistance to insects, disease, and fire which can be achieved, in part, by maintaining multiple stand structures and seral conditions, which will also benefit wildlife species. Prescribed fire could be used as a method to simplify fuel beds in order to effectively reduce the risk of stand replacement fires.

E. Maintain or enhance habitat for wildlife species. Over time, provide large areas (1000+ acres) of contiguous habitat for black-backed woodpeckers. This habitat will be created by endemic populations of insects and disease. Areas of this size and type are not sustainable within the watershed itself, but if examined on a larger scale, this habitat type can be sustainable, and the Odell Watershed can provide an important portion of it.

Vegetative treatments, such as salvage or firewood cutting could be designed to enhance foraging, roosting, and nesting needs of the black-backed woodpecker. Areas where wildfires have burned should not be immediately harvested, since burned stands become infested with bark beetles and provide a food source for woodpecker species for several years. Maintain dead and dying trees, since they are utilized by a variety of species including: black-backed woodpecker, other associated woodpeckers, secondary cavity users, ruffed grouse, marten, and fisher. In addition, maintain down woody material since it supports a prey base for goshawk, great gray owl, spotted owl, marten, and fisher.

Within lodgepole pine maintain standing dead trees as a structural component within goshawk and great gray owl habitat until canopy cover (dead & live) falls below 50% or known birds vacate the area. Harvest access, layout, and design should consider travelways as well as additional habitat needs for goshawks and other species. Mixed conifer wildlife movement corridors should be reestablished to benefit species such as the spotted owl and other species that utilize the canopy.

F. Utilize natural tree mortality to meet fiber and fuelwood demands, while achieving the main goals.

G. Plant resistant strains of western white pine on the upper slope of

H. Hamner Butte to counteract white pine blister rust and maintain vegetative species diversity.

I. Maintain ecological interrelationships both above and below ground to assure long-term sustainability of species such as fungi, bryophytes, and lichens.

J. Use management methods that will maintain soil capabilities on undisturbed sites and restore those that are degraded.

K. Recreational through-traffic and uses should be compatible with wildlife and other users and resources. Efforts should be made to reduce existing and potential future conflicts between dispersed uses. These uses are linked to areas outside the watershed and should also be examined at a broader scale.

L. Identify and evaluation cultural resources, especially during project planning. Protect integrity of significant cultural resources.

Landscape Area Opportunities

Restoration Actions

Since the Odell Pilot Watershed Analysis was completed in 1994, many of the restoration activities that were identified during that analysis have been completed. Some of the accomplishments include fish structures placed in Davis Lake, fish habitat was enhanced on Crystal Creek, Odell Lake has benefited from some bank stabilization projects, dispersed camp sites have been rehabilitated, and willow planting occurred at the confluence of Odell Creek and Davis Lake. Vegetation management activities addressed some of the stand issues within the Central Conifer Association area, blister rust-resistant white pine was planted in root rot pockets, and underburning has been used to reduce the risk of stand replacement fires.

Many more opportunities for watershed restoration exist or are on-going in nature. The tables below prioritize them for each landscape area. Criteria used to determine the priorities for projects are:

- Immediacy of need
- Meets intent of Northwest Forest Plan ROD
- Preventative
- Feasibility

West Odell Creek	
Activity	Objective(s)
Delineate the area as a Riparian Reserve.	A
Complete the Odell Lake Basin Historic Preservation and Management Plan.	H
Provide information and education at Odell Lodge about wetlands including their importance to wildlife and hydrologic function.	A
Timber harvest activities may be appropriate within the area as long as access through riparian areas does not occur.	A, C, D, F, H
Additional recreational use and access should not be encouraged within this riparian zone. Rehabilitation should occur on existing recreation sites or trails which have had undesirable effects on riparian features or hydrologic function.	A, D, F, G, H
Maintain the trail location at the bridge crossing near McCool Butte; guide through-traffic, including the Metolius-Windigo horse trail, south of the butte around the riparian area. Modify or restructure the bridge at McCool to accommodate multiple uses, including horses, to fit the ROS. Repair gates on either side of the bridge. Recreational uses are linked to areas outside the watershed, so should also be examined at a broader scale. Encourage summer hiking in areas outside of this watershed that are more appropriate.	A, F, G
Consider management with fire versus harvest in areas where appropriate.	B, D

Within meadows, manual or prescribed fire methods should be used to reduce conifer encroachment and to rejuvenate patches of decadent willows in order to maintain a diverse structure of age classes.	B, D
Obliterate roads in meadows that are not presently major travel corridors.	B, D, F, G
Restore soils in activity areas by subsoiling compacted areas.	C, H
Management activities can be used where they clearly enhance the goal.	B, C, D, E, F, H

East Odell Creek	
Activity	Objective(s)
Complete the Odell Lake Basin Historic Preservation and Management Plan.	H
Enhance the willow plant community present near the confluence of Odell Creek and Davis Lake to provide a forage base for summering elk populations and the beavers residing in East Odell Creek.	A
Rehabilitate areas where Odell Creek uses old road beds at high water.	E
Reduce fragmentation of lodgepole pine by consolidation of harvested areas. Vegetative treatments, such as salvage or firewood cutting could be designed to enhance foraging, roosting, and nesting needs of the black-backed woodpecker. Maintain burned areas for an adequate length of time in order to provide forage habitat for wildlife species, including woodpeckers.	A, C, D, G
Commercial uses can occur within the area and may be a by-product of restoration of the vegetation to the HRV. For instance, fuelwood cutting may be used to facilitate the return of the vegetation to within the HRV, and firewood can also be provided as the remaining stands become less suitable for the goshawk and snag-dependent species.	A, D, F
Revegetate harvested areas along Odell Creek, with diverse species if possible, to provide shade to the stream.	B, D, E
Restore soils in activity areas by subsoiling or some other appropriate means.	A, D, G
Rehabilitate the abandoned gravel pit that is located along the bank of Odell Creek.	D, G
The gravels obtained from the Odell Gravel Pit constitutes an economic resource or commodity use. The opportunity for expansion of the pit exists outside the riparian zone. The rehabilitation plan could be used for instance, to provide wildlife habitat or recreation uses.	D, F, G
Identify appropriate locations for dispersed recreation. Rehabilitate dispersed sites that are within 100 feet of water. Restore or harden dispersed sites and limit access with barriers to riparian areas, if needed.	D, E, G
Eliminate or obliterate roads and trails that are parallel to Odell Creek when they are not appropriate or necessary for access. The road to East Davis Lake Campground should be considered for obliteration if problems with camping and access to the riparian area become an issue. No new parallel trails, roads, etc. to the creek should be constructed, if access to the creek would be encouraged.	D, E

Odell Lake/Willamette Pass	
Activity	Objective(s)
Complete the Odell Lake Basin Historic Preservation and Management Plan.	H

Implement Trapper Creek Restoration for bull trout habitat based on 1999 Environmental Assessment	D, E, F, H
Remove old water control structures from Trapper and Crystal Creeks.	C, D, E
Stands containing immature and mature trees which could be managed to produce suitable replacement trees for the bald eagle and to meet the habitat needs of other wildlife species should be identified. Management of these stands could include underthinning, prescribed low intensity fires, creation of small openings for regeneration, and designated removal of some trees to reduce competition and stress.	A, B, C, M
Riparian corridors should be identified for movement of amphibians across the Cascade Crest. Lakes identified as critical to the maintenance of travel corridors for amphibians may have non-native fish stocking discontinued. A minimum of two corridors for amphibians should be identified and established. Maintain wildlife corridors north of Highway 58 and south of Odell Lake with the focal point located at the west end of Odell Lake in order to allow for genetic interchange across the Cascade Range.	A, B, C, D, E, I, K
Evaluate campsites that are < 50 feet from the water at Odell Creek campground. If area is impacted, pull back, rehabilitate, or redesign.	C, D, E, G, M
Evaluate campsites in Trapper Creek Campground that are < 100 feet from Trapper Creek. If area is impacted, consider the campsite for redesign, rehab, pull back, or moving.	C, D, E, G, J, L, M
A long-term restoration plan for Trapper Creek should be developed, which addresses bull trout habitat, riparian vegetation, and recreation including campsites and trails.	D, E, F, H
Develop a master plan for the Shelter Cove Resort which should address management of the trailheads as well as the resort, including its potential for expansion. If it is determined through the master plan that expansion is a feasible option, then the following considerations should be met: expansion of the resort should not result in the occupation or disruption of riparian zones or the impairment of ground and surface water quality. If riparian areas could not be avoided, then off-site mitigation measures including wetland development would be required.	C, D, E, G, I, J, L, M
If areas are showing impacts, remove fire rings, tables, and other unnecessary developments (not including boat docks or other anchoring systems) located on the summer home tracts that are within 50 feet of Odell Lake or any creeks.	C, D, E, G, J, L
During the next routine inspection of the summer homes, information should be gathered, including a map and verbal description of the plumbing or on-site waste disposal system as well as a discussion on how the permit holder disposes of solid and liquid waste. This information will be kept in the files and reported to the Klamath County Department of Health (KCDH). All summer homes that are identified during the routine inspection to meet one or more of the following criteria: have an on-site sewage disposal system that is less than 100 feet horizontal distance from the lake or a creek; have the disposal system located within 7 vertical feet of the lake level; or the seasonal groundwater is within 7 feet of the surface, are suspect of being a source of pollution (conditions vary slightly dependent upon the on-site sewage disposal system). A joint evaluation will be made within six months of identification of the suspect facility jointly by the Forest Service and KCDH as to whether the on-site waste disposal system is a source of pollution (the permit holder may hire a licensed engineer to do the evaluation). If any system is identified as a source of pollution, an alteration permit with subsequent modifications should be required and approved by KCDH. As ownership changes for the summer homes or resorts, on-site sewage disposal systems should be inspected by Klamath County Department of Health. Issuance of a permit should be contingent upon the required modification and/or repairs to the system as required by KCDH.	D, E, F, G, J, L
Restore riparian areas along lakeshore and tributary streams where surface runoff causes the delivery of fine sediments to the lake.	D, E, F, G
Coordinate with ODOT to explore ways to reduce the entry of cinders into the water bodies and stream channels.	D, E, F, G

Coordinate with Amtrak Railroad to remove litter along the railroad tracks and to seek ways to reduce the dumping of waste along the Odell Lake area	D, E, F, G
Provide interpretive services and/or facilities (including signing) to enhance heritage resources; increase public awareness and appreciation of wetlands, wildlife, and fish species; and raise public sensitivity and awareness of the fragile nature of these resources.	A, B, C, D, E, J, M

Davis Lake	
Activity	Objective(s)
Assess dispersed recreation around Davis Lake. Close user created trails and roads when warranted.	E, F, G
Several stands of aspen near Davis Lake may provide opportunities to maintain and enhance these unique areas for wildlife habitat. Activities could include fencing enclosures to allow aspen suckering and/or felling aspen trees that are declining in health to promote the development of a replacement stand.	C
Vegetative treatments should be designed to promote development of large-tree dominated stands, late successional forests, and bald eagle habitat and may include prescribed fire and thinning. These treatments should concentrate on those trees infected with bark beetles and/or at risk from mistletoe.	B, C
Continue to reintroduce prescribed fire in meadows, lakeside vegetation, and adjacent timber. Reduce conifer encroachment into meadows. Use other methods to reduce high fuel loads before using fire, where necessary.	B, C
Improve the fishery within Davis Lake without manipulating the water level. Maintain or enhance LWM in Davis Lake at the confluence with Odell Creek. Manage for bull trout recovery including evaluating the potential to stock the species in Ranger Creek. Request that ODFW move the Odell Creek deadline (fishing closure to protect spawning fish) approximately 300-400 yards downstream from current location.	A, D, E
Improve the habitat for wildlife in and around Davis Lake, including introducing cavity snags into lake; creating waterfowl nest islands; placing nest structures for birds, bats, and squirrels to supplement habitat; enhancing lakeshore vegetation for wildlife species; and maintaining beaver habitat near inlet at Ranger Creek.	A, C, E
Resolve or mitigate the conflicts between campground users and eagles, or allow the interaction of eagles and humans to take place with monitoring if the impacts favor the eagle.	E
Establish a site capacity for dispersed sites. Rehabilitate recreational facilities and dispersed campsites. They should be redesigned to reduce conflicts with wildlife. Restore and/or perform erosion control in areas where humans have impacted the lakeshore and streambanks. Decompact campgrounds and harden designated travelways and campsites only if these activities can be completed without detrimentally impacting cultural resources.	F, G, H
Consider alternatives for access to East and West Davis campgrounds. Roads not identified as necessary for transportation should be obliterated and rehabilitated to consolidate access to the Davis Lake Area.	F, G, H
Assess appropriateness of constructing a boat ramp for low water access. The current boat ramp should be signed during low water periods to restrict wheeled access onto the lakeshore.	A, E, F, H
Sign area in regards to OHV restrictions; consider barriers to control access. Design through-trail traffic to avoid impacting the ecology or aesthetics of the area; this includes bike traffic originating from Waldo Lake, snowmobile traffic, the Metolius-Windigo	E, F, G, H

horse trail, and potential horse camp. Bike traffic should be routed around the lava flow.	
Develop a cultural resources plan.	H
Relocate the Metolius-Windigo Horse Trail between Moore and Ranger Creeks to drier ground.	E

Mountain Hemlock Association

Activity	Objective(s)
Monitor the condition of blister rust-resistant white pine that was planted.	A
Maintain meadows from encroachment as needed.	B
Surveys should be conducted on lakes stocked with non-native fish species and surrounding lakes and potholes to determine amphibian presence and the importance of the stocked lakes as a corridor link for genetic transfer. Surveys should also be conducted on adjacent watersheds both on Deschutes and other National Forests to determine linkage corridors between watersheds in accessing the non-native stocked lakes. Where stocked lakes are found to be a barrier for amphibian linkage, agreements should be made with the Oregon Department of Fish and Wildlife as to where future fish stocking should and should not occur.	C
Identify and designate wildlife corridors and manage them for conservation of species.	D
Establish capacity levels and monitor use at back country sites, in particular, those located at Bobby, Rosary, and the High Cascade Lakes. Relocate inappropriate dispersed campsites and obliterate sites.	E, F
Restore and/or perform erosion control on trails, dispersed sites, and riparian areas.	E, F
Develop a recreation management plan for area (winter/summer). Include a Willamette Pass comprehensive plan which addresses the primitiveness of the Waldo Lake Area and OCRA.	F
Evaluate bike trails by conducting a suitability study with soils and ROS, if unsuitable, redesign trails for bike use, ie. Maiden Peak and Moore Creek Trails.	F

Central Conifer Association

Activity	Objective(s)
Stands containing immature and mature trees which could be managed to produce suitable replacement trees for bald eagle and other wildlife species needs should be identified. Management of these stands could include underthinning, prescribed low intensity fires, creation of small openings for regeneration, and designated removal of some trees to reduce competition and stress.	B, C, D
Vegetative manipulation within this area could include thinning or removal of the understory trees, precommercial thinning of regenerated areas to reduce competition and facilitate more rapid growth of the remaining trees, thinning individual species to enhance a particular seral stage, and/or underburning to control understory conifer and brush species. Most regeneration cuttings would probably not enhance the desired characteristics for the area, unless the purpose of the cut is to respond to a disturbance agent which has already had major impacts on stand structure or composition.	A, B, D, E, F, G, H, I
Fragmentation reduction by means of vegetative manipulation activities could include thinning of regeneration areas to enhance height and diameter growth, treatment of small patches between existing regeneration areas to more closely match the regenerated stands, and/or entering large contiguous areas with future harvest activities in ways which will allow development of viable patch sizes to meet relevant wildlife management objectives.	A, B, C, D, E, I

Reintroduction of fire in the ponderosa pine and mixed conifer dry plant associations could be used as a vegetative manipulation tool and as a method to simplify fuel beds in order to effectively reduce the risk of stand replacement fires. Underburning can be used to meet the management objectives for this area, while jackpot burning and/or broadcast burning are possible methods to use in previously harvested regeneration units. Pre-treatment of underburn areas may be needed to minimize stand replacement events. Such treatments could include understory thinning, mechanical piling, crushing, or similar activities which would effectively reduce the risk of destroying the overstory by underburning. Create fuel reduction breaks which will aid in high intensity fire suppression. Within these areas intensive thinning, removal of limbs, and reduction of the large fuel component should take place.	B, C, D, E, G, H, I
Enhance sugar pine regeneration on the buttes and in other suitable locations by thinning existing areas and/or underplanting.	C, D, H
Maintain or enhance large, woody material (LWM) in Moore Creek which may be achieved by thinning stands to promote development of future LWM.	D, H
Identify and mitigate cold air drainage areas when planning vegetation manipulation.	D, H, I
The exact distribution, quantity, types, and sustainability of fungi within this area are unknown. Baseline surveys should be conducted to determine the density and diversity of fungi species present, and monitoring studies should be used to determine the effects of extensive mushroom harvesting on the sustainability of the mushroom species and ecosystems. (Tie to Chemult study in progress). In addition, information needs to be obtained on the mycorrhizal relationship between fungi and tree species, the effects of mushroom harvesting on the tree species, and the effects of tree harvesting on the mushrooms. Mushrooms and their relationship to wildlife as a food source should also be explored. Information should be obtained on the amount, type, and location of mushrooms that are commercially harvested. The impacts on aesthetics and pristine areas from mushroom harvesting and associated uses (industrial camp sites) should be quantified.	D, E, H, I
Assess the appropriateness of installing guzzlers.	B, E
Rehabilitate soils in harvest areas with excess compaction.	D, H, J
Decrease motorized vehicle access throughout the Central Conifer Association to reduce disturbance to wildlife, and rehabilitate suitable roads to reduce fragmentation and as well as the opportunity for wildlife poaching. Close or obliterate roads based on slope and skid trail/road density maps, the need to reduce fragmentation, and overall access plans. Assess the impacts to areas where trails and/or roads extend the stream/runoff network. Establish priorities for rehabilitation and standards for maintenance.	A, D, I
Evaluate trails by conducting a suitability study with soils and ROS, if unsuitable, redesign trails for appropriate use. Evaluate multiple-use trails and appropriateness of mountain bike trails. Design trails and links for appropriate uses including a bike trail from Davis Lake/BEMA around the wetlands to the underpass. Where feasible, convert roads to trails. As appropriate, relocate the Metolius-Windigo horse trail out of the wet area along the west side of Davis Lake. Evaluate the appropriateness of and establish the Ranger Butte horse camp.	A, B, D, I, J
Identify, designate, and harden dispersed camp sites. Consider development of dispersed camp sites at trail heads.	D, I, J
Consider potential future conflicts between users, i.e. mushroom hunters/bow hunters, horseback riders/hikers/mountain bikers, snowmobilers/skiers, etc., and prepare educational programs to reduce conflicts.	J
Assess cultural aspects on buttes.	L
Repair erosion problems from skid trails along road into Maiden Lake trailhead where they are eroding onto the 4664100 Rd.	J

Recommendations Common to All

- In Firewood cutting areas, control should be exercised over users creating roads.
- Noxious weed reduction should be emphasized in all areas.
- Use native or desirable non-native species when revegetating.

Roads and Access

- Along the open road system, determine the need to restore unauthorized and/or undesigned user developed accesses through such methods as entrance management or complete restoration.
- Where closed roads have been breached by ATV and/or 4-wheel vehicle use, reclose the roads as soon as possible before a pattern of motorized use is reestablished.
- Access is a highly sensitive issue to the public. The decision to temporarily close or obliterate an established access needs to consider not only the physical and biological but the social implications as well. The Deschutes National Forest Travel Management Guide (Chapter 2-8 and 2-13) identifies questions to consider in the decision to close a road or trail. Once a decision has been made to close or obliterate a road or trail, the method chosen will be the most economical, while also meeting the intent of the decision, and consistency of management objectives.
- Roads to be used for winter use (i.e., winter haul, snowmobiling) need to have sufficient drainage designed for compacted snow conditions.
- In riparian areas with high recreational use, consider “directing” use rather than “restricting” or “prohibiting”, particularly if the current use is not causing undesirable impacts. *Allowing* use on designated routes signed on the ground may be a more successful way to redirect use patterns.
- When constructing or reconstructing accesses, minimize sidecasting to reduce the potential for sedimentation.
- Reconstruct roads and associated drainage features that pose a substantial risk to water quality and fisheries.
- Prioritize reconstruction based on current and potential impacts to riparian resources and the ecological value of riparian resources affected.
- Before looking at closing or obliterating new accesses, look at the effectiveness of existing obliterations. How well does the obliteration meet the intent of the following definition? *Obliteration: The reclamation and/or restoration of land to*

resource production from that of a transportation facility (FSM 7709.54-90-1); (A travelway) over which travel has been and will continue to be denied, the entrance obscured, and the wheel tracks or pathway is no longer continuous and suitable for travel. It includes travelways obliterated by natural processes such as revegetation or other natural occurrences, and for which the drainage is not in need of further attention (FSM 770-90-2).

If the decision is to “re-obliterate” the access, be certain that this action will not result in a greater potential for sedimentation. The entire road or trail prism needs to be restored for drainage concerns.

After looking at the effectiveness of existing obliterations, consider temporarily closed travelways as candidates for obliterations (Maintenance Level 1 roads).

Typically these travelways have been closed and reduced to a Level 1 status because they will not be needed in the near future (3 to 5 years).

- The majority of the existing road system was planned and designed for tractor logging methods. If other logging methods are used in the future, a reduction in road densities may be appropriate. However, landing sites along the open roads may need to be enlarged and the increased likelihood for impacts in these locations will need to be evaluated.
- Perform road maintenance work on open roads.

Inventory and Surveys

Late successional species:

- Use current direction for Northwest Forest Plan to conduct wildlife surveys.
- Partnerships with the National Audubon Society, High Desert Museum, and other birding groups may be utilized to conduct bird surveys in a timely manner.
- Specific species to survey include spotted owl, great gray owl, flammulated owl, northern goshawk, black-backed woodpecker, white-headed woodpecker, three-toed woodpecker, pileated woodpecker, and Northwest Forest Plan Survey & Manage species.
- As funding and partnerships allow, conduct surveys to obtain baseline data, then monitor populations and distribution trends every decade.

Survey and Manage species:

- Continue to conduct annual surveys for Canada lynx to determine the presence and distribution of this species on the Crescent Ranger District.
- Conduct the mollusk surveys as specified in the Northwest Forest Plan and build a database of known sites, acres surveyed, and results.

Amphibians:

- As funding and partnerships allow, conduct surveys to obtain baseline data, then monitor population and distribution trends every decade. Plots would be located in water bodies containing appropriate habitat for the various species.

Non-native species:

- As funding and partnerships allow, conduct inventories to obtain baseline data on the presence and distribution of non-native species.
- Plant surveys may need to be conducted annually if treatment is being administered.
- For non-native wildlife species conduct 3-5 years of surveys to obtain baseline data, then every ten years conduct two years of surveys to determine the trend or invasion potential. Plots will be set up in appropriate habitats.

Birds:

- Continue the Breeding Bird Survey route within the watershed.

Mammals:

- Continue track surveys for marten, fisher, and wolverine, and other species.
- As funding/partnerships allow, continue to inventory and/or survey for the presence of forest carnivores (marten, fisher, and wolverine) with emphasis placed on fisher and wolverine.

Ecological Units:

- Update vegetation inventories and soil surveys in wilderness and dispersed recreation areas where traditional surveys were cursory.

Recreation:

- Participate in community planning in those areas that are influenced by or cause influences to the Odell Watershed, in order to determine appropriate uses of the watershed resources, i.e. Odell Lake, Davis Lake, etc.

Cultural Resources:

- Identify and evaluate cultural resources. Complete or develop management plans for resources that are being damaged. A prioritized list of cultural resources based on significance will aid in developing management plans, protecting significant sites, and aid in implementing other activities in the watershed.
- Individual site management plans outline the level of knowledge about site data potential for depth (i.e. buried cultural deposits), and a strategy for recovering said data. An important component of the management plan is the particular research questions that site investigations would address.

Stream Data:

- Develop reference stream reaches and gather baseline data within the watershed. This will provide data for future restoration projects, as well as providing monitoring data.

Monitoring

Strategies

The Forest Service and Oregon Department of Fish and Wildlife (ODFW) have planned an extensive monitoring program for the bull trout in 1994 in Odell Lake and its tributaries. Water temperature, trap netting, and stream, spawning, and angler surveys will be accomplished.

Macroinvertebrates are good indicators of watershed health, and have been used for the last three years as the primary monitoring tool in Odell Creek for sediment and water quality concerns. Stream surveys have been conducted on Odell, Trapper, and Crystal Creeks, and a few small streams on the west side of Odell Lake. These stream surveys will be repeated at regular intervals in order to monitor watershed health.

Items to consider for monitoring:

- Bull trout
- Water quality/quantity
- Forest Plan items
- Priorities based on watershed trends
- Human/riparian interface
- Fungus/mycorrhizae relationships
- Insect and Disease—impact/extent/potential
- Noxious weeds

Cumulative Effects -- Items to Consider During NEPA:

- Recreation opportunities
- Reduction of habitat for sensitive species
- Fragmentation
- Soil Quality
- Riparian condition and sensitive riparian areas
- Ecological processes
- Water quality
- Movement corridors
- Roads
- Vegetation management in context of HRV
- Historic fire patterns
- Disturbance regimes
- Overall social context
- Fish management information
- Continued loss of integrity of significant cultural resources due to erosion, ongoing recreation use in developed/dispersed sites.

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. The Northwest Forest Plan identified nine 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.

The Northwest Forest Plan identified Odell Creek as a Key Watershed (Tier 1). This watershed is to provide refugia for management and recovery of at-risk fish species (i.e. bull trout) and to provide high quality water. Watershed Analysis is a planning tool that ensures the above objectives are considered and incorporated in all management decisions. Implementation occurs through watershed restoration and the following special standards, guidelines, and recommended riparian reserves.

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 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 down slope.

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.

Riparian areas provide a moist zone for amphibians and other wildlife species to travel and reside in. Ungulates use the riparian areas disproportionately more than terrestrial areas for fawning and calving, and 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.

Riparian Reserves provide important wildlife habitat, which justifies the heavy loading of LWM in the creeks and the floodplains. Refer to the Biological Domain section for additional information on riparian habitats. In the Riparian Reserves (particularly in the

Lodgepole Pine 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, water quality, and stand health should dictate stand treatment needs within the Riparian Reserves. It is recognized that the 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 human intervention. Agee (1990) reports that by far the greatest disturbance factor for riparian zones is flood events, not fire.

Riparian Reserve Widths and Management Requirements

The Riparian Reserves, as described below and in the Northwest Forest Plan Record of Decision (USDA, USDI, 1994), have been adapted for the Odell 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-level Environmental Assessments (EAs). Refer to Figure 22 for a map of the recommended Riparian Reserve areas in the watershed.

Vegetation

In the Eastern Cascades it is recognized that fire played an important role in shaping the vegetative pattern across the landscape. A combination of salvage, thinning, and fire can be used as tools to create small openings in the riparian zone. No large trees that have the potential to provide shade (within the distance equal to the height of two site-potential trees) or LWM to the creek will be disturbed. Wildlife needs will dictate the remaining condition of the patches to be created. The fuel loading in the Reserves will be greater than that in the surrounding uplands except within established facilities (campgrounds, summer home tracts, etc). Operations within the Reserves will result in less than 2% compaction spatially over the length of a mile.

Roads, Grazing and Minerals Management

As per the ROD, site-specific conditions and mitigation will be developed in the project EA. In the Odell Creek subwatershed, no net increase in roads will occur from levels that existed at the time the Odell Key Watershed was established. In Odell Lake and Moore Creek subwatersheds, road levels should also remain at or below those in existence in 1994. Increased roads may be necessary, but only if justified to meet watershed goals and objectives.

Recreation Management

No new campgrounds will be developed within the distance equal to the height of two site-potential trees of any water body. It is recognized that picnic areas can be developed within that zone if the soils are coarse and riparian vegetation is not trampled or destroyed such that sediment has the potential to wash into the waterbody. Use vegetative buffers to contain any sediment in the uplands. Techniques that are desirable to use are designated trails, hardening sites or creating causeways across sensitive areas. Any existing campsites that are closer than 50 feet to the water (fire ring or picnic bench) will be relocated at a greater distance from the water.

Fire/Fuels Management

Develop a fire management strategy for the Riparian Reserves within five 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.

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 the project EA.

Riparian Reserves Within Landscape Areas

West Odell Creek

Lodgepole pine occupies the flats and slight depressions (cold air sinks) among the moraine landform; mixed conifer occupies the slopes and top of the moraines; and mixed conifer is present on the upper terrace and along the creek. This area is dominated by riparian/wetland habitat and few human impacts have occurred on the landscape. Due to the desire to maintain the integrity of this segment of the creek and riparian associations, the entire West Odell Landscape Area is recommended for designation as a Riparian Reserve. This zone is dominated by riparian vegetation in conjunction with the creek and the numerous intermittent streams. The source of water for this zone is the groundwater that moves through the moraine, which holds Odell Lake. Few roads or trails penetrate this zone and vegetative manipulations have been minimal. The lodgepole pine is showing signs of bark beetle infestation, which will result in the creation of pockets of dead and dying lodgepole.

In order to maintain water quality and floodplain integrity, minimal activities should occur within the zone outlined by the top of the outermost stream terrace. The recommended riparian widths are wide enough to maintain floodplain water quality. These widths ensure that when floods occur there is enough room for the anticipated water to pass, allow for sediment deposition to occur, and there is adequate vegetation to provide long-term large, woody material recruitment. Wildlife species will benefit from the corridors created by this riparian reserve.

A diversity of vegetative structure is desired. Flexibility in management of this zone will allow for vegetative manipulation to maintain or achieve this diversity. The emphasis is for management of later structural stages of vegetation in the conifer zone and a mix of seral stages in the riparian/wetlands. Opportunities exist to use management techniques such as horse logging, a small tractor over frozen ground, and fire to maintain or manipulate this zone. The emphasis within this area is to limit compaction, thin overstocked stands, provide for diversity, and manage for no net increase in road or trail densities.

Riparian Reserve Widths

West Odell Creek Landscape Area has a broad floodplain/water influence zone and the outer terrace defining the vegetation break is approximately a quarter mile from the creek in most segments. The recommendation is for the entire landscape area to be managed as a Riparian Reserve, where any activities conducted within this zone are to be complimentary to riparian goals.

Fire

Develop a fire management plan that allows for fire to burn to and through the water influence zone. Fire management strategies should include the three 'Cs': confine, contain, and control. No fire lines constructed with mechanized equipment should be allowed within or across riparian areas. Manage fire commensurate with the surrounding vegetation zone, providing for structural diversity.

Recreation

Future recreation development will not occur in this zone with the exception of through way non-motorized summer use trails and snowmobile trails.

East Odell Creek

Lodgepole pine occupies the upper terrace and mixed conifer is present between the terrace and the creek (the floodplain). Outside the riparian zone lodgepole pine is the dominant tree species with minimum diversity of other vegetative species. The zone is gently sloping with high water infiltration.

In order to maintain water quality, at a minimum the Riparian Reserve buffer width needs to be located at the top of the outermost stream terrace which nearly defines the 100+ year floodplain. The recommended riparian widths are wide enough to maintain floodplain water quality. These widths ensure that when floods occur there is enough room for the anticipated water to pass, allow for sediment deposition to occur, and there is adequate vegetation to provide long-term large, woody material recruitment. Corridors needed for wildlife extend beyond the readily recognizable riparian/wetland vegetation.

Emphasis for vegetation management in the adjacent conifer zone is LSR. The resulting later structural stage will assure a continual supply of LWM in the floodplain for shade purposes, wood to the creek, and downed wood and snags for wildlife. A diversity of vegetative structure is desired. Flexibility in management of riparian areas is needed to allow for vegetative manipulation to maintain or achieve this diversity. Small openings to create early seral stages are desirable. Opportunities exist to use management techniques such as horse logging, a small tractor over frozen ground, and fire management techniques. The emphasis in this area is to limit compaction and have no net increase in road densities.

Riparian Reserve Widths

East Odell Creek floodplain zone has a broad water influence zone and the outer terrace defines the vegetation break; being approximately a quarter mile wide in most segments. Any activities within this zone are to be complimentary to riparian goals. A large diversity of wildlife species use this habitat (within the terrace) as compared to non-

riparian lodgepole. For these reasons, the riparian reserve will be a minimum of the 300 feet on either side of Odell Creek, and will extend beyond where the vegetation zone break is defined by the outer terrace. This will capture all of the floodplain, water influence zone. The intermittent channels in this zone will adapt the riparian zone width as outlined in the Northwest Forest Plan.

Fire

Develop a fire management plan that allows for fire to burn to and through the water influence zone. Fire management strategies should include the three 'Cs': confine, contain, and control. The down logs within this riparian area contain a great deal of moisture. Because of this moisture the logs will not burn thoroughly. These down logs in turn will help to protect the soil so that it will be minimally impacted by fire. No fire lines built with mechanized equipment should be allowed within or across riparian areas. Manage fire commensurate with the surrounding vegetation zone, providing for structural diversity along the stream.

Recreation

Future recreation development sites are to be located outside of the primary terraces or 300+ feet from the stream.

Odell Lake/Willamette Pass

Mixed conifer occupies the terraces, the floodplains, and the zone along the lake and creeks. There are numerous intermittent and small perennial streams, and many high water table areas occupied by riparian/wetland vegetation. Nearly 20% of these areas are occupied by or are in close proximity to the railroad right of way, summer home tracts, campgrounds, and resorts. This zone is designated as a recreation emphasis area in the LRMP and the ROD. Recreation facilities directly occupy and adversely impact small portions of riparian zones. Mitigation measures and restoration opportunities have been identified in the management goals and opportunities segment of this report to address the most critical conflict areas.

In order to maintain water quality and floodplain integrity, at a minimum the riparian reserve buffer width needs to be located at the top of the outermost stream or lake terrace. The recommended riparian widths are wide enough to maintain floodplain water quality. These widths ensure that when floods occur there is enough room for the anticipated water to pass, allow for sediment deposition to occur, and 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 vegetative emphasis in this zone is to manage for later structural conditions. A diversity of vegetative structure is desired. Flexibility in management of riparian areas is needed to allow for vegetative manipulation to maintain or achieve some diversity. The primary goals of vegetative treatments should be to limit compaction, thin overstocked stands, reduce road and trail densities, and provide for maximum standing and down wood.

Riparian Reserve Widths

The Odell Lake riparian area has a small floodplain but large water influence zone. The outer terrace along the creek channels defining the vegetation break is very close to the edge of the active channel. Most channels are perennial in nature but do not contain fish. It is important that vegetation along the lakeshore is maintained in good health such that it can resist wave action and protect the lakeshore from erosion. Water quality, wildlife corridors, and vegetative integrity are key components controlling the management needs of the Riparian Reserves. The riparian reserve widths recommended in the Northwest Forest Plan are to be used in this zone. All management activities are commensurate with riparian goals for existing facilities and complimentary to riparian goals in the undeveloped areas.

Fire

Develop a fire management plan for the area that allows for fire to burn to and through the water influence zone. Fire management strategies should include the three 'C's': confine, contain, and control. The down logs within this riparian area contain a great deal of moisture. Because of this moisture, these logs will not burn thoroughly. These down logs in turn will help to protect the soil. No fire lines constructed with mechanized equipment should be allowed within or across riparian areas. Manage fire commensurate with the surrounding vegetation zone. Avoid machinery operations through the stream channel, and provide for structural diversity along the stream. Fire suppression efforts will be used to protect life and structural improvements.

Recreation

Future recreation development sites are to be located outside of the primary stream terraces, the floodplain, and 150+ feet from stream channels and lakeshore.

Davis Lake

Lodgepole and ponderosa pine occupy the zone along the lake while herbaceous vegetation, shrubs, and coniferous species occupy the floodplain. Less than 2% of the shoreline area is occupied by, or in close proximity to, campgrounds. This zone is designated as a wildlife emphasis area in the LRMP and ROD. Recreation facilities directly occupy and adversely impact a very small portion of the floodplain/riparian zone.

In order to maintain water quality, the Riparian Reserve width needs to be located beyond the floodplain. These widths ensure that when floods occur there is enough room for the anticipated water to pass, allow for sediment deposition to occur, and there is adequate vegetation to provide long-term large, woody material recruitment. It is important to maintain the health of vegetation along the lakeshore to ensure that it can resist wave action and protect the lakeshore from erosion. Wildlife use the zone beyond the readily recognizable riparian/wetland vegetation.

The conifer stands adjacent to the lake fall into one of three categories for land allocation: BEMA, LSR, and Intensive Recreation. The emphasis is for later vegetative structural stages to be maintained, but this requires some diversity of vegetative structure. Flexibility in management of riparian areas is needed to allow for vegetative manipulation to maintain or achieve this diversity. When vegetative treatments occur the

emphasis is to limit compaction, thin overstocked stands, reduce road densities, and provide for wildlife habitat.

Riparian Reserve Widths

The Davis Lake Landscape Area has a large floodplain/water influence zone. The Riparian Reserve for the lake is 300 feet and 150 feet for the associated wetlands adjacent to the lake. The resultant reserve will be the larger of the two conditions applied to the situation. Odell, Ranger, and Moore Creeks occupy a small portion of this zone. The two perennial streams (Odell and Ranger) have been assigned 300-foot reserve widths and the intermittent stream (Moore) is assigned a 150-foot reserve width. Water quality, wildlife corridors, and vegetative integrity are key components controlling the management needs of these riparian reserves. Any activities are performed in a manner, which is complementary to riparian goals.

Fire

Develop a fire management plan that allows for fire to burn to and through the water influence zone. Fire management strategies should include the three 'Cs': confine, contain, and control. No fire lines constructed with mechanized equipment should be allowed within or across riparian areas. Manage fire commensurate with the surrounding vegetation zone. Avoid machinery operations through the stream channel and provide for structural diversity along the stream.

Recreation

Future recreation development sites are to be located outside of the floodplain and 300+ feet from the stream channel or floodplain.

Mountain Hemlock Association

Mountain hemlock and lodgepole pine occupy the upper terrace, while mixed conifer is present between the terrace and the creek (floodplain). This zone is comprised of both wilderness and roadless areas. Natural processes have prevailed across this landscape.

In order to maintain water quality and floodplain integrity, at a minimum the riparian reserve width needs to be located at the top of the outermost stream terrace. The recommended riparian widths are wide enough to maintain floodplain water quality. These widths ensure that when floods occur there is enough room for the anticipated water to pass, allow for sediment deposition to occur, and there is adequate vegetation to provide long-term large, woody material recruitment. Corridors needed for wildlife extend beyond the readily recognizable riparian/wetland vegetation.

The Northwest Forest Plan has identified this area as LSR, roadless, and wilderness. Late structural stages of vegetation are emphasized, however, a diversity of vegetative structure is desired. Flexibility in management of riparian areas is needed to allow for vegetative manipulation to maintain or achieve healthy stands. Few vegetative treatments will occur since the emphasis is to allow natural processes to occur, 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.

Riparian Reserve Widths

The mountain hemlock association landscape area has a narrow floodplain/water influence zone (except upper Moore and Trapper Creeks) and the outer terrace defining the vegetation break is very close to the edge of the active channel. Most channels are intermittent or ephemeral in nature. Some of the channels in the wilderness area contain flowing water for several months each year, particularly during the snowmelt and early summer season. Since this landscape area has had minimum impacts from human activities, little to none of the hydrologic function has been compromised. The riparian reserve widths to be used in this segment of the watershed are equivalent to what is reported in the Northwest Forest Plan. Water quality, wildlife corridors, and vegetative integrity are key components controlling the management needs of this Riparian Reserve. Any activities within this zone are conducted in a manner that is complimentary to riparian goals.

Moore Creek is an amphibian corridor when the water is running. Wood (LWM) recruitment is important for shade, habitat and channel stability. Maintain healthy, green stands, with a reserve width set at 150 feet. Vegetation management should occur for stand health only. Heavy loading of snags and down woody material will be left in the buffer (>6 snags per acre). Clumps should be left to provide for future snag development.

Fire

Develop a fire management plan that allows for fire to burn to and through the water influence zone. Fire management strategies should include the three 'C's: confine, contain, and control. The down logs within this riparian area contain a great deal of moisture and because of this, they will not burn thoroughly. These down logs will then help to protect the soil so that it will be minimally impacted by a fire. No fire lines built with mechanized equipment should be allowed within or across riparian areas. Manage fire commensurate with the surrounding vegetation zone, providing for structural diversity along the stream.

Recreation

Future recreation development sites are to be located outside of the floodplain and primary terraces of the stream channel.

Central Conifer Association

Mixed conifer stands are located on the upper terrace as well as between the terrace and the creek (floodplain). This zone has moderate to steep terrain but has a high water infiltration capacity. There are few stream channels in this zone, and they are nearly all intermittent or ephemeral.

In order to maintain water quality and floodplain integrity, at a minimum the riparian reserve width needs to be located at the top of the outermost stream terrace. Corridors needed for wildlife extend beyond the readily recognizable riparian/wetland vegetation.

The majority of this zone has been assigned LSR status in the Northwest Forest Plan. A diversity of vegetative structure is desired but emphasis is on later structural stages. Flexibility in management of riparian areas is needed to allow for vegetative manipulation to maintain or enhance the later structural stages. When any vegetative treatments occur, the emphasis is to limit compaction, thin overstocked stands, reduce roads, restore soil productivity, and restore water infiltration.

Riparian Reserve Widths

The central conifer zone has a narrow floodplain/water influence zone (except Moore Creek) and the outer terrace defining the vegetation break is very close to the edge of the active channel. Most channels are intermittent or ephemeral in nature, with running water rarely occurring on the surface. A few of these ephemeral 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. It is recommended that the riparian reserves identified in the Northwest Forest Plan be adapted. Water quality, wildlife corridors, and vegetative integrity are key components controlling the management needs of the riparian reserve. Any activities occurring in this zone will be complimentary to riparian goals.

Moore Creek constitutes an amphibian corridor when the water is running. Wood (LWM) recruitment is important for shade, habitat, and channel stability. Maintain healthy, green stands with a buffer width set at 150 feet. Vegetative manipulation (sanitation entry) should occur only for stand health reasons. Heavy loading of snags and down woody material will be left in the buffer (>6 snags per acre). Clumps should be left to provide for future snag development.

Fire

Develop a fire management plan that allows for fire to burn to and through the water influence zone. Fire management strategies should include the three 'C's: confine, contain, and control. The down logs within this riparian area contain a great deal of moisture and because of this will not burn thoroughly. These down logs, in turn, will help to protect the soil so that it will be minimally impacted by a fire. No fire lines constructed with mechanized equipment should be allowed within or across riparian areas. Manage fire commensurate with the surrounding vegetation zone, providing for structural diversity along the stream.

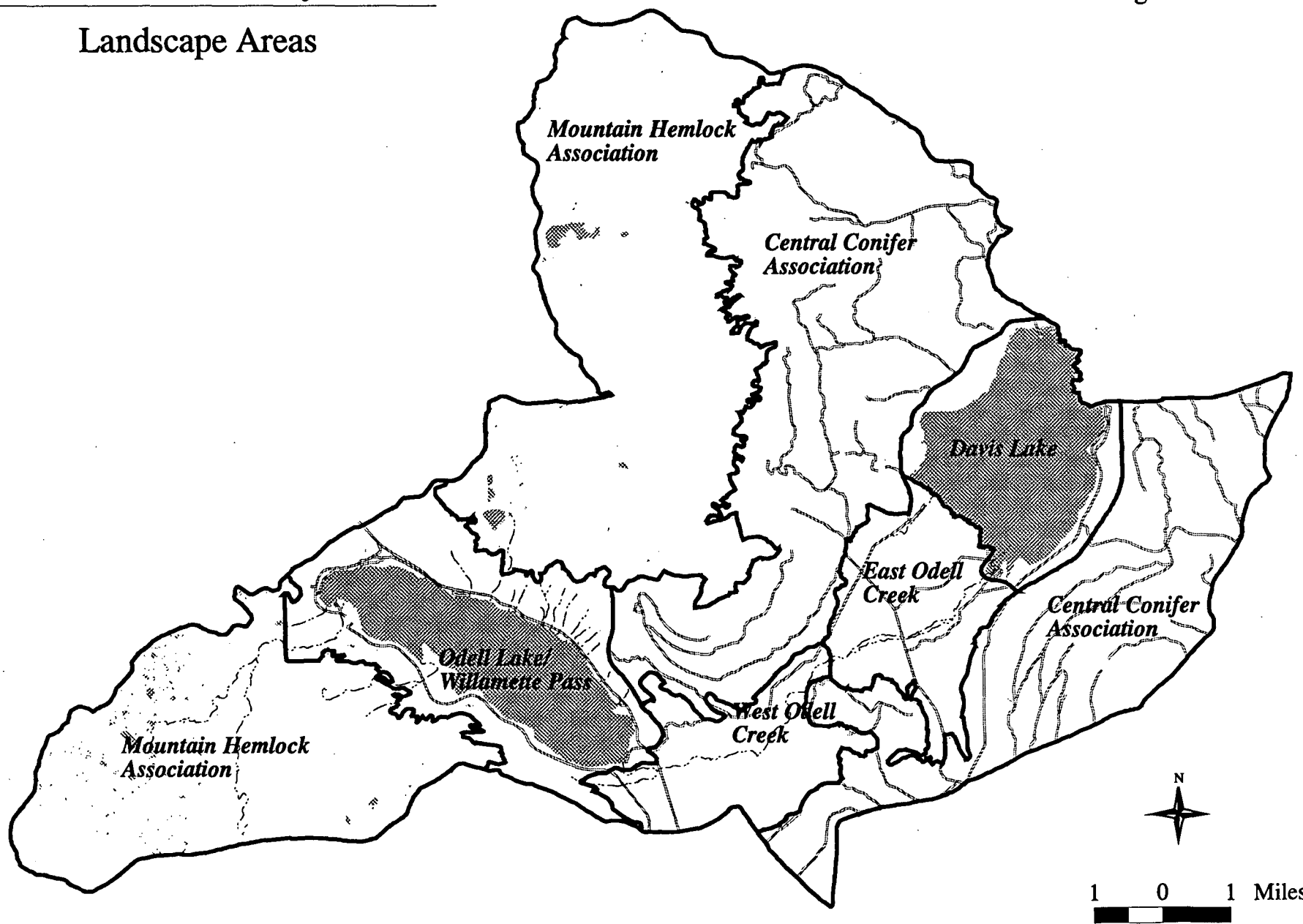
Recreation

Future recreation development sites are to be located outside of the primary terraces or 150+ feet from the stream channel.

Odell Watershed Analysis Area

Figure 21

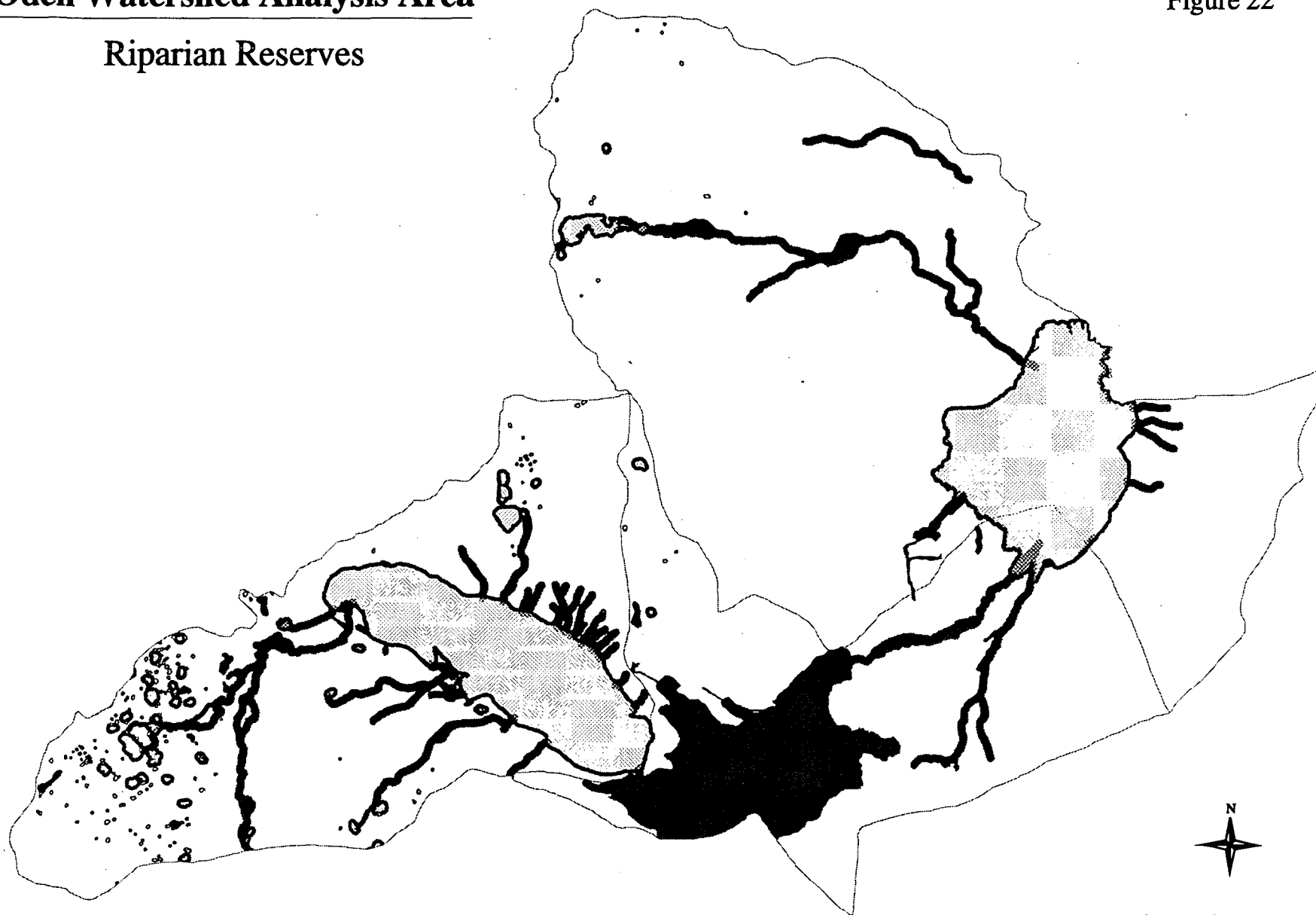
Landscape Areas



Odell Watershed Analysis Area

Riparian Reserves

Figure 22



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GLOSSARY

Abiotic -- Referring to the absence of living organisms.

Activity center -- (Spotted Owl activity center) An area of concentrated activity of either a pair of spotted owls or a territorial single owl.

Adfluvial -- Refers to fish which spend their adult life stages in a lake, but spawn and are reared in streams.

Administratively withdrawn areas -- Areas removed from the suitable timber base through agency direction and land management plans.

Air quality related values -- Values within Class I areas, such as visibility, biological diversity, and water quality, that under the Clean Air Act, should be protected from the adverse impacts of air pollution.

Alluvial -- Originated through the transport by and deposition from running water.

Amphibian -- A cold blooded, smooth skinned vertebrate organism including frogs, salamanders and toads.

Anadromous fish -- Fish that are born and reared in freshwater, move to the ocean to grow and mature, and return to freshwater to reproduce. Salmon, steelhead, and shad are examples.

Andesite -- Extrusive igneous rock of diorite composition; occurs as lava.

Aquatic ecosystem -- Any body of water, such as a stream, lake or estuary, and all organisms and non-living components within it, which function as a natural system.

Aspect -- The direction a slope faces.

Bark beetles -- Beetles (Coleoptera/Scolytidae) that attach to tree stems and produce their young in galleries located between the outer wood and inner bark.

Basalt -- Extrusive igneous rock of gabbro composition; occurs as lava.

Basin (River Drainage Area; Catchment) -- The area of land that drains water, sediment and dissolved materials to a common point along a stream channel.

Biodiversity -- See Biological Diversity

Biological diversity -- (Biodiversity, Diversity) (1) The distribution and abundance of plant and animal communities. (2) The variety of life forms and processes, including a complexity of species, communities, gene pools, and ecological functions.

Biota -- The animal and plant life in an area.

Candidate species -- Those plants and animals included in Federal Register "Notices of Review" that are being considered by the Fish and Wildlife Service for listing as threatened or endangered. Two categories that are of primary concern: Category 1 (C1) - Taxa for which there is substantial information to support proposing the species for listing as threatened or endangered. Listing proposals are either being prepared or have been delayed by higher priority listing work. Category 2 (C2) - Taxa information indicates that listing may be appropriate. Additional information is being collected.

Canopy -- The part of any stand of trees represented by the tree crowns; canopies may occur in layers.

Canopy closure -- The degree to which the canopy (forest layers above one's head) blocks sunlight or obscures the sky. It can only be accurately determined from measurements taken under the canopy as openings in the branches and crowns must be accounted for.

Cavity nester -- Wildlife species, most frequently birds, that require cavities (holes) in trees for nesting and reproduction.

Cirque -- A steep hollow, often containing a small lake, at the upper end of a mountain valley.

Class I areas -- National Parks or Wildernesses that receive the greatest air quality protection under the Clean Air Act's Prevention of Significant Deterioration (PSD) Program.

Clearcut -- An area of forest from which all merchantable trees have been removed by harvesting.

Clearcutting -- A regeneration harvest method whereby all trees (with the exception of advanced regeneration) are removed from an area of the forest.

Climatic climax -- A climax condition that is maintained by climatic factors such as temperature and precipitation regimes and length of growing season; compare with edaphic climax.

Climax -- The terminal, theoretically stable, self-perpetuating condition in a series of plant communities that culminates plant succession on any given site in the absence of any major disturbance.

Climax species (or series) -- The tree species predominating on a site at climax, especially in the absence of major disturbances. Sites are often described in terms of the major forest series they belong to. For example, grand fir climax series includes plant associations where grand fir is the dominant overstory species at climax.

Climax vegetation -- The pattern or complex of climax plant communities on a landscape corresponding to the pattern of environmental gradients or habitats.

Coarse woody debris -- Portion of a tree that has fallen or been cut and left in the woods. Usually refers to pieces at least 20 inches in diameter.

Congressionally Withdrawn Area -- Areas that require congressional enactment for their establishment such as National Parks, Wild and Scenic Rivers, National Recreation Areas, National Monuments, and Wilderness.

Connectivity of habitats -- The linkage of similar but spatially separated vegetative stands (such as mature forests) by patches, corridors, or "stepping stones" of the same vegetation across the landscape; also, the degree to which similar habitats are so linked.

Contrast -- The degree to which two adjacent ecosystems (edge) are different from one another.

Cover -- Any feature that provides concealment for fish and wildlife. Cover may consist of live or dead vegetation and geomorphic features such as boulders and undercut banks. Cover may be used for the purposes of escape from predators, feeding, or resting.

Critical habitat -- Under the Endangered Species Act, critical habitat is defined as (1) the specific areas within the geographic area occupied by a federally listed species on which are found physical and biological features essential to the conservation of the species, and that may require special management considerations or protection; and (2) specific areas outside the geographic area occupied by a listed species, when it is determined that such areas are essential for the conservation of the species.

Crown -- The part of any tree containing live foliage.

Crustacean -- A class of aquatic invertebrates having a hard exoskeleton, includes species such as shrimp.

Cryic -- A description of soil temperature regime. The soils have a mean annual temperature higher than 0o\$ C (32o\$ F) but lower than 8o\$ C (47o\$ F) with an O horizon (litter layer).

Cumulative effects -- Those effects on the environment that result from the incremental effect of the action when added to the past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-federal) or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions that take place over a period of time.

Defoliating insects -- Insects which feed on leaves or needles of living trees.

Demography -- The quantitative analysis of population structure and trends; population dynamics.

Desired Condition -- (Desired Future Condition, Desired Ecological Condition)

(a) A portrayal of the land or resource conditions which are expected to result if goals and objectives are fully achieved. (219 REGS)

(b) A description of the landscape as it could reasonably be expected to appear at the end of the planning period: that is, if the plan goals, objectives, standards and guidelines for that landscape are fully achieved.

Diatom -- A minute unicellular or colonial algae.

Dispersal habitat -- Habitat that supports the life needs of an individual animal during dispersal. Generally satisfies needs for foraging, roosting, and protection from predators.

Disturbance -- An event that causes significant change in structure, function, or composition through natural events such as fire, flood, wind, earthquake, mortality caused by insect or disease outbreaks, or by human-caused events, e.g., the harvest of forest products.

Domain -- A sphere of common activities, knowledge, and processes. For convenience, analytical modules of the WEAVE process have been grouped into three domains: physical, biological, and social.

Dominance -- An index related to diversity indices that measures the relative dominance of vegetation types across the landscape. High dominance values indicate a landscape area dominated by few vegetation types; whereas, low values occur in landscapes having diverse vegetation. Dominance does not measure the pattern of distribution.

Dominant -- A group of plants that by their collective size, mass, or number exert a primary influence on other ecosystem components.

Drainage -- An area (basin) mostly bounded by ridges or other similar topographic features, encompassing part, most, or all of a watershed and enclosing some 5,000 acres (see Subdrainage and Forest Watershed).

Duff layer -- As specifically defined in the FEMAT Report, the layer of loosely compacted debris underlying the litter layer on the forest floor.

Early successional forest -- Forest seral stages younger than mature and old-growth age classes.

Eastside -- Generally, east of the crest of the Cascade Range.

Ecological Classification -- A hierarchical approach to delineating, at different levels of resolution, areas of land having similar capabilities and potentials for management. These areas of land are characterized by unique combinations of the physical environment (such as climate, geomorphic processes, geology, soil, hydrologic function, and potential natural community), biological communities (such as plants, animals, and bacteria), and the human dimension (such as social, economic, cultural and infrastructure).

Ecological process -- The major actions or events that regulate or influence the function, structure, composition and pattern of ecosystems and that link organisms and their environment, including energy flows, trophic levels (food chains), predation, mutualism, successional

development, nutrient cycling, carbon sequestration, primary productivity, decay, hydrologic cycles, and weathering.

Ecoregion -- Regions of relative homogeneity in ecological systems or in relationships between organisms and environments based on patterns of terrestrial vegetation and environment.

Eco-subregion -- A geographic area over which the combination of climate, geomorphic process, and topography are sufficiently uniform to permit development of similar ecosystems on sites with similar properties. There are 13 eco-subregions classified on the Deschutes National Forest.

Ecosystem -- (a) A community of living plants and animals interacting with each other and with their physical environment. A geographic area where it is meaningful to address the interrelationships with human social systems, sources of energy, and the ecological processes that shape change over time.

(b) The complex of a community of organisms and its environment functioning as an ecological unit in nature. (219 REGS/DRAFT)

Ecosystem Health -- (Forest Health) The state of an ecosystem in which structure and functions are sufficiently resilient to allow the maintenance of biological diversity over time and through a range of disturbances.

Ecosystem management -- The use of an ecological approach in land management to sustain diverse, healthy, and productive ecosystems. Ecosystem management is applied at various scales to blend long-term societal and environmental values in a dynamic manner that may be adapted as more knowledge is gained through research and experience.

Ecotone -- A zone of intergradation between ecological communities.

Edge -- See Habitat Edge.

Edge effect -- The effect of adjoining vegetative communities on the population structure along the margin, which often provides for greater numbers of species and higher population densities than either adjoining community. Edge may result in negative effects as well; habitat along an edge is different than in the patch of habitat, thus reducing the effective area of the habitat patch.

Effects -- Effects, impacts, and consequences are synonymous. Effects may be direct, indirect or cumulative and may fall in one of these categories: aesthetic, historic, cultural, economic, social, health or ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems).

Endangered species -- Any species of plant or animal defined through the Endangered Species Act as being in danger of extinction throughout all or a significant portion of its range, and published in the Federal Register.

Endemic -- A species that is unique to a specific locality.

Environmental analysis (EA) -- A systematic analysis of site-specific activities used to determine whether such activities have a significant effect on the quality of the human environment and whether a formal environmental impact statement is required; and to aid an agency's compliance with the National Environmental Policy Act when no environmental impact statement is necessary.

Ephemeral streams -- Streams that contain running water only sporadically, such as during and following storm events.

Eutrophic -- A term applied to a body of water with high nutrient content and high productivity.

Evapotranspiration -- The loss of water through evaporation and transpiration.

Even-aged management -- A silvicultural system which creates forest stands that are primarily of a single age or limited range of ages. Creation of even-aged stands may be accomplished through the clearcut, seed tree or shelterwood harvest methods.

Extirpation -- The elimination of a species from a particular area.

Fauna -- The animal life of a region or geological period.

Federal agencies -- The Federal Ecosystem Management Assessment Team was composed of representatives from the USDA-Forest Service, USDI-BLM, the US EPA, the National Marine Fisheries Service and the US Fish and Wildlife Service.

FEMAT -- Federal Ecosystem Management Assessment Team. This is the title of the group of interagency scientists formed by President Clinton to develop a policy analysis of alternatives for implementation of ecosystem management on federal lands within the range of the northern spotted owl.

Final Environmental Impact Statement (FEIS) -- The final report of environmental effects of proposed action on an area of land. This is required for major federal actions under Section 102 of the National Environmental Policy Act. It is a revision of the draft environmental impact statement to include public and agency responses to the draft.

Fire cycle -- The average time between fires in a given area.

Fire frequency -- The return interval of fire.

Fire regime -- The frequency, predictability, intensity, seasonality, and extent characteristics of fires in an ecosystem.

Fire severity -- The effect of fire on plant communities. For trees, it is often measured as the percentage of basal area killed by fire.

Fish-bearing streams -- A stream that contains any species of fish for any period of time.

Floodplain -- Level lowland bordering a stream or river onto which the flow spreads at flood stage.

Flora -- The plant life of a region or geological period.

Fluvial -- Refers to fish which spend their entire life cycles in streams.

Food web -- A modified food chain that expresses feeding relationships at various changing trophic levels.

Forb -- An herbaceous plant that is not a sedge, grass, or other plant with grass-like foliage.

Forest health -- A measure of the robustness of forests in terms of their biological diversity; soil, air, and water productivity; disturbance ecology; and capacity to supply a sustainable flow of goods and services for humans.

Forest land -- Land that is now, or is capable of becoming, at least 10 percent stocked with forest trees and that has not been developed for nontimber use.

Forest types -- A classification of forest land based on the tree species presently forming a plurality of basal area stocking or crown cover of live tree.

Forest watershed -- The forested drainage area contributing water, organic matter, dissolved nutrients, and sediments to a lake or stream.

Fragmentation -- The process of reducing size and connectivity of stands that compose a forest. See Habitat Fragmentation.

Fuel -- Dry, dead tree parts which can readily burn.

Fuelbreak -- An area of land on which the native vegetation has been removed or modified so that fires burning into it can be controlled more readily. Some fuelbreaks contain firelines which can be quickly widened with hand tools or by burning.

Fuel loading -- The weight of fuel present at a given site; usually expressed in tons per acre. This value generally refers to the fuel that would typically be available for consumption by fire. Fuel loading varies as a result of disturbance (including human activities), the magnitude of that disturbance, the successional stage of the vegetation, and other conditions of the site.

Geomorphic -- Pertaining to the form or shape of those processes that affect the surface of the earth.

Glide -- A portion of a river where the water is relatively slow and has an unbroken surface, a gentle gradient where the substrate consists of fines to boulders.

Graben -- A trenchlike depression representing the surface of a fault block dropped down between two opposed, infacing normal faults.

Granitic -- Any light-colored, coarse-grained rock formed at a considerable depth by crystallization of molten rock.

Green tree retention -- A stand management practice in which live trees as well as snags and large down wood are left as biological legacies within harvest units to provide habitat components over the next management cycle. There are two levels: High level - A regeneration harvest designed to retain the highest level of trees possible while still providing enough disturbance to allow regeneration and growth of the naturally occurring mixture of tree species. Such harvest should allow for the regeneration of intolerant and tolerant species. Harvest design would also retain cover and structural features necessary to provide foraging and dispersal habitat for mature and old-growth dependant species. Low level - A regeneration harvest designed to retain only enough green trees and other structural components (snag, coarse woody debris, etc.) to result in the development of stands that meet old growth definitions within 100 to 120 years after harvest entry, considering overstory mortality.

Habitat -- The area where a plant or animal lives and grows under natural conditions. Habitat consists of living and non-living attributes, and provides all requirements for food and shelter.

Habitat capability -- The estimated number of pairs of spotted owls that can be supported by the kind, amount, and distribution of suitable habitat in the area. As used in the Final Draft Recovery Plan for the Northern Spotted Owl, this means the same as the capability to support spotted owl pairs.

Habitat edge -- The margin where two or more vegetation patches meet, such as the boundary of a clearcut next to a mature forest stand; also see Habitat Fragmentation.

Habitat fragmentation -- The splitting or isolating of patches of similar habitat, typically forest cover (but could also apply to grass fields, shrub patches, and other habitats); habitat can be fragmented from natural conditions, such as thin or variable soils, or from forest management activities, such as clearcut logging.

Habitat interior species -- See Unitype Species.

Habitat type -- The land area capable of supporting a single plant association.

Harvest -- Felling and removal of tree stems from the forest for the manufacture of forest products.

Harvest systems -- Patterns of tree removal that mimic aspects of partial or complete stand-replacing disturbances.

Healthy ecosystem -- An ecosystem in which structure and functions allow the maintenance of biological diversity, biotic integrity, and ecological processes over time.

Herb -- Non-woody vegetation that includes both grasses and broad-leaf plants of low profile, known as forbs.

High intensity fire -- A fire with the capability to be stand replacing or to cause excessive damage to late successional forest characteristics.

High severity fire -- A wildfire event with acute ecological impacts; usually, but not always of high intensity.

Human dimension -- The aspect of ecosystem management which reflects the integration of people, and recognizes that people's past, present, and future values and desires (including perceptions, beliefs, attitudes, behaviors, and needs) influence ecosystems, and that ecosystems in turn affect people's physical, mental, spiritual, social and economic well-being.

Hybridization -- The crossing or mating of two different varieties of plants or animals.

Hydrolic -- Pertaining to the movement, exchange, and storage of water.

Impact -- An environmental change that negatively affects a beneficial use or value. The value judgement of "negative" is generally construed to mean that conditions or processes are moving away from desired states.

Ingrowth -- The period after successional growth of a forest stand when it reaches a specified age or structure class. For instance, spotted owl forage habitat.

Insectivores -- Plants or animals which feed on insects.

Interdisciplinary team -- A group of individuals with varying areas of specialty assembled to solve a problem or perform a task. The team is assembled out of recognition that no one scientific discipline is sufficiently broad enough to adequately analyze the problem and propose action.

Intermittent stream -- Any non-permanent flowing drainage feature having a definable channel and evidence of annual scour or deposition. This includes what are sometimes referred to as ephemeral streams if they meet these two criteria.

Issue -- An issue refers to a topic, a subject, a category, or a value which is registered by a person as something in which they have a high level of interest. The term "issue" is used synonymously with the term "concern." Identification of aquatic and fisheries issues can occur through formal solicitation, content analysis of publications and periodicals, or informal communications.

Key Watershed -- As defined by FEMAT a watershed containing (1) habitat for potentially threatened species or stocks of anadromous salmonids or other potentially threatened fish, or (2) greater than six square miles with high-quality water and fish habitat.

Landscape -- A heterogenous land area with interacting ecosystems that are repeated in a similar form throughout.

Landscape ecology -- (1) A study of the principles concerning structure, function and change of landscapes, and the use of these principles in the formulation and solving of problems. (2) The body of knowledge pertaining to the structure, function, and change of spatial patterns in ecosystems.

Large-scale fire -- A very large-sized fire compared to the natural range of fire sizes of the fire regime in the geographic area considered. Fires that greatly exceed the typical fire size are often of high intensity and may cause profound fire effects.

Late-successional forests -- Forest seral stages which include mature and old-growth age classes.

Late-successional reserve -- A forest in its mature and/or old-growth stages that has been reserved under The ROD.

Lava flow -- A congealed stream of lava.

Lichen -- A plant consisting of a fungus in close combination with a green or blue-green algae.

LIIT -- Local Interagency Interdisciplinary Team.

Litter layer -- The loose, relatively undecomposed organic debris on the surface of the forest floor made up typically of leaves, bark, small branches, and other fallen material.

Littoral Zone -- The shallow water zone of a lake in which light penetrates to the bottom permitting vegetative growth.

Long-term soil productivity -- The capability of soil to sustain inherent, natural growth potential of plants and plant communities over time.

Macroinvertebrates -- Large aquatic insects.

Macrophytes -- Aquatic plants.

Management activity -- An activity undertaken for the purpose of harvesting, traversing, transporting, protecting, changing, replenishing, or otherwise using resources.

Matrix -- Federal lands outside of reserves, withdrawn areas, and Managed Late-Successional areas.

Mesic -- Pertaining to or adapted to an area that has a balanced supply of water; neither wet nor dry.

Mesotrophic -- A term applied to a body of water with moderate nutrient content and moderate productivity.

Microhabitats -- A restricted set of distinctive environmental conditions that constitute a small habitat, such as the area under a log.

Mid-seral forest -- See Seral Stage.

Mitigation measures -- Modifications of actions that (1) avoid impacts by not taking a certain action or parts of an action; (2) minimize impacts by limiting the degree of magnitude of the action and its implementation; (3) rectify impacts by repairing, rehabilitating, or restoring the affected environment; (4) reduce or eliminate impacts over time by preservation and maintenance operations during the life of the actions; or (5) compensate for impacts by replacing or providing substitute resources or environments.

Mixed stand -- A stand consisting of two or more tree species.

Monitoring -- A process of collecting information to evaluate if the objectives and anticipated or assumed results of a management plan are being realized or if implementation is proceeding as planned.

Moraines -- An accumulation of rock debris carried by an alpine glacier or an ice sheet and deposited by the ice to become a depositional land form. The following are several examples of types of moraines:

Terminal moraine - a moraine deposited as an embankment at the terminus of an alpine glacier or at the leading edge of an ice sheet.

Lateral moraine - a moraine formed by an embankment between the ice of an alpine glacier and adjacent valley wall.

Recessional moraine - moraine produced at the ice margin during a temporary halt in the recessional phase of glaciation.

Ground moraine - moraine distributed beneath a large expanse of land surface covered at one time by an ice sheet.

Multistoried -- Forest stands that contain trees of various heights and diameter classes and therefore support foliage at various heights in the vertical profile of the stand.

Mycorrhizae -- An association between a fungus and the roots of a higher plant which improves the plants' uptake of nutrients from the soil.

Mycotrophic -- Feeding on or otherwise being nourished by fungi.

National Environmental Policy Act (NEPA) -- An Act passed in 1969 to declare a national policy that encourages productive and enjoyable harmony between humankind and the environment, promotes efforts that prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of humanity, enriches the understanding of the ecological systems and natural resources important to the nation, and establishes a Council on

Environmental Quality (The Principal Laws Relating to Forest Service Activities, Agric. Handb. 453 USDA Forest Service, 359 p.).

National Forest Management Act (NFMA) -- A law passed in 1976 as an amendment to the Forest and Rangeland Renewable Resources Planning Act, requiring the preparation of Forest Plans and the preparation of regulations to guide that development.

Natural fire rotation -- A fire return interval calculated as the quotient of a time period and the proportion of a study area burned in that time period.

Nesting, roosting, and foraging habitat -- The forest vegetation with the age class, species of trees, structure, sufficient area, and adequate food source to meet some or all of the life needs of the northern spotted owl.

Neotropical -- Relating to or constituting the biogeographic realm that includes South America, the Indies, Central America and tropical Mexico.

Non-forest land -- Land developed for nontimber uses or land incapable of supporting 10 percent stocking with forest trees.

Old growth -- Old forest often containing several canopy layers, variety in tree sizes and species, decadent old trees, standing and down dead woody material.

Old-growth associated species -- Plant and animal species that exhibit a strong association with old-growth forests.

Old-growth forest -- A forest stand usually at least 180-220 years old with moderate to high canopy closure; a multilayered, multispecies canopy dominated by large overstory trees; high incidence of large trees, some with broken tops and other indications of old and decaying wood (decadence); numerous large snags; and heavy accumulations of wood, including large logs on the ground.

Oligotrophic -- A term applied to a body of water low in nutrients and low in productivity.

Outwash -- Accumulation of layers of sand and gravel deposited by meltwater streams near the margin of a stagnant ice sheet or alpine glacier.

Overstory -- Trees that provide the uppermost layer of foliage in a forest with more than one roughly horizontal layer of foliage.

Park-like stands -- Stands having scattered, large, seral overstory trees and open growing conditions usually maintained by frequent ground fires.

Partial cutting -- Removal of selected trees from a forest stand.

Passerine -- Pertaining to an order (Passeriformes) of small or medium-sized, chiefly perching songbirds having grasping feet with the first toe directed backwards.

Patch -- An area of vegetation with homogeneous composition and structure as viewed from aerial photography.

Pathogen -- An entity such as a fungus, bacterium, or virus that has the capacity to incite disease in another organism (host).

Pattern -- The arrangement of vegetation types or other features across landscapes.

Perched water table -- Ground water layer occupying a position above the main water table.

Perennial stream -- A stream that typically has running water on a year-round basis.

Phalarope -- A wading bird of the family Phalaropodidae, having lobed toes to facilitate swimming.

Physical process -- The rate and timing of the interaction of biotic and abiotic ecosystem components.

Phytoplankton -- A microscopic floating aquatic animal.

Plant Association -- The distinctive combination of trees, shrubs, grasses, and herbs occurring in a theoretical terminal or climax community or a series of communities.

Plant series -- Aggregations of plant associations having the same dominant overstory.

Polygon -- The map representation of a vegetation patch. The delineation of vegetation patches by computer with geographic information systems results in a polygon formed by lines that define the boundaries of the patch. The term polygon is generally synonymous with patch; polygon generally is used when describing data analysis procedures that involve manipulation of patch data.

Population viability -- Probability that a population will persist for a specified period across its range despite normal fluctuations in population and environmental conditions.

Precommercial thinning -- The practice of removing some of the trees less than merchantable size from a stand so that remaining trees will grow faster.

Prescribed fire -- A fire burning within an approved, predefined and planned prescription. The fire may result from either a planned or natural ignition. When a prescribed fire exceeds the prescription and/or planned perimeter, it may be declared a wildfire.

Productivity -- (1) Yielding useful or favorable results or involved in the creation of goods and services to produce value. (adapted from Webster)

(2) The growth rate of biomass per unit area, usually expressed in terms of weight or energy.

Project planning -- A site specific application of information gained from watershed analysis to obtain management objectives. Applied watershed analysis.

Range of the northern spotted owl -- The range of the northern spotted owl in the United States is generally comprised of land in western Washington and Oregon, and northern California.

Rate of spread (ROS) -- The rate at which a fire moves across a landscape, usually measured in meters/second.

Record of Decision -- A document separate from but associated with an environmental impact statement that states the management decision, identifies all alternatives including both the environmentally preferable and selected alternatives, states whether all practicable means to avoid environmental harm from the selected alternative have been adopted, and if not, why not.

Recovery plan -- A plan for the conservation and survival of an endangered species or a threatened species listed under the Endangered Species Act, to improve the status of the species to justify delisting in accordance with the Endangered Species Act.

Redd -- A fish spawning area usually found in gravels.

Reforestation -- The natural or artificial restocking of an area with forest trees; most commonly used in reference to artificial stocking.

Refugia -- Locations and habitats that support populations of organisms that are limited to small fragments of their previous geographic range (i.e., endemic populations).

Region -- A Forest Service administrative unit. The two Regions affected are the Pacific Northwest Region (Region 6) which includes National Forests in Oregon and Washington, and the Pacific Southwest Region (Region 5) which includes National Forests in California.

Resilience -- The ability of an ecosystem to return to a predicted, desired, or earlier state after disturbance.

Restoration -- Actions taken to return an ecosystem in whole or in part to a desired condition.

Riffle -- A portion of a river where gravel, cobble or small boulders constitute the substrate, and the water moves fast and is well oxygenated by white water.

Riparian -- Pertaining to land that is next to water, where plants dependent on a perpetual source of water reside.

Riparian area -- As specifically defined in the FEMAT Report, a geographic area containing an aquatic ecosystem and adjacent upland areas that directly affect it. This includes floodplain, woodlands, and all areas within a horizontal distance of approximately 100 feet from the normal line of high water of a stream channel or from the shoreline of a standing body of water.

Riparian reserves -- The area adjacent to streams, lakes and wetlands which is designed to protect aquatic and riparian functions and values.

Riparian zone -- As specifically defined in the FEMAT Report, those terrestrial areas where the vegetation complex and microclimate conditions are products of the combined presence and influence of perennial and/or intermittent water, associated high water tables, and soils that exhibit some wetness characteristics. Normally used to refer to the zone within which plants grow rooted in the water table of these rivers, streams, lakes, ponds, reservoirs, springs, marshes, seeps, bogs and wet meadows.

Ripping -- The process of breaking up or loosening compacted soil (e.g., skid trails or spur roads) to better assure penetration of roots of young tree seedlings.

River basin analysis -- The collection and organization of issues and process or condition knowledge on large river basins that contain many analysis watersheds. These analyses will identify regional and downstream concerns that will need to be addressed in Watershed Analyses.

Roadless area -- Areas typically exceeding 5,000 acres that were inventoried during the Forest Service's Roadless Area Review and Evaluation (RARE II) process and remain in a roadless condition.

Roost -- The resting behavior of an animal.

Root disease center -- An infection center in the forest having infected, dead, and dying trees, where the causative agent is a pathogenic root-infecting fungus. Root diseases typically spread underground via fungal growth from diseased to healthy host roots.

Salmonid -- Refers to fish of the family Salmonidae. Within the range of the northern spotted owl these include all salmon, trout, and whitefish.

Scale -- The degree of resolution at which ecological processes, structures, and changes across space and time are observed and measured. For the purpose of this document, watershed-scale is an area ranging from 20 to 200 square miles. Smaller-scale generally refers to something smaller than a watershed (project-level) and larger-scale is bigger than a watershed (river-basin or provincial). **Note:** this "scale" terminology is opposite of traditional map-scale; that is the ratio of map distance to actual distance. (A map scale of 1:24,000 is a larger-scale map with more detail than on at 1:100,000).

Scree -- See talus.

Scrubland -- A land area consisting of shrubs and having a canopy coverage of about 50%.

Second growth -- Relatively young forests that have developed following a disturbance (e.g., wholesale cutting, serious fire, or insect attack) of the previous old-growth forest.

Seeps -- Places where water oozes from the ground to form a pool

Selection cutting -- A method of uneven-aged management involving the harvesting of single trees from stands (single-tree selection) or in groups (group selection) without harvesting the entire stand at any one time.

Sensitive species -- Those species that (1) have appeared in the Federal Register as proposed for classification and are under consideration for official listing as endangered or threatened species or (2) are on an official state list or (3) are recognized by the U.S. Forest Service or other management agency as needing special management to prevent their being placed on Federal or state lists.

Seral -- (1) Successional; (2) A species or a community which will be replaced by another in succession.

Seral stages -- The series of relatively transitory planned communities that develop during ecological succession from bare ground to climax stage.

Series -- An aggregation of taxonomically related associations that takes the name of the climax species that dominates the principal layer. A taxonomic unit in a classification.

Shelterwood -- A regeneration method under an even-aged silvicultural system. A portion of the mature stand is retained as a source of seed and/or protection during the period of regeneration. The mature stand is removed in two or more cuttings.

Silvicultural prescription -- A professional plan for controlling the establishment, composition, constitution and growth of forests.

Silvicultural system -- A planned sequence of treatments or prescriptions over the entire life of a forest stand needed to meet management objectives.

Site-potential tree -- A tree that has attained the average maximum height possible given site conditions where it occurs.

Snag -- A standing dead tree.

Soil productivity -- Capacity or suitability of a soil, for establishment and growth of a specified crop or plant species, primarily through nutrient availability.

Staging area -- Temporary locations near wildfires or other emergency events where fire suppression resources (e.g., firefighting personnel and heavy equipment) are available to respond at very short notice.

Stand -- Vegetation occupying a specific area that is sufficiently uniform in composition, size, arrangement, structure, and condition as to be distinguished from the vegetation in adjoining areas.

Stand (tree stand) -- An aggregation of trees occupying a specific area and sufficiently uniform in composition, age, arrangement, and condition so that it is distinguishable from the forest in adjoining areas.

Standard deviation -- A statistic used as a measure of dispersion in a distribution, the square root of the arithmetic average of the squares of the deviations from the mean.

Standards and guidelines -- The rules and limits governing actions, and the principles specifying the environmental conditions or levels to be achieved and maintained.

Stocked/stocking -- The degree an area of land is occupied by trees as measured by basal area or number of trees.

Structure -- The physical organization and arrangement of vegetation; the size and arrangement (both vertical and horizontal) of trees and tree parts.

Structural diversity -- The diversity of forest structure, both vertical and horizontal, that provides for a variety of forest habitats for plants and animals. The variety results from layering or tiering of the canopy and the die-back, death and ultimate decay of trees. In aquatic habitats, the presence of a variety of structural features such as logs and boulders create a variety of habitat.

Substrate -- Any object or material upon which an organism grows or is attached.

Succession -- A series of dynamic changes by which one group of organisms succeeds another through stages leading to potential natural community or climax. An example is the development of a series of plant communities (called seral stages) following a major disturbance.

Surface fire -- A fire burning along the surface without significant movement into the understory or overstory, usually flame lengths are less than one meter in size.

Sustainability -- The ability of an ecosystem to maintain its organization and autonomy over time including but not limited to maintenance of ecological processes, biological diversity and productivity.

Talus -- Accumulation of loose rock fragments derived by rockfall from a cliff.

Territory -- The area that an animal defends, usually during breeding season, against intruders of its own species.

The President's Plan -- Alternative 9 and the preferred alternative of the FSEIS. Sometimes referred to as the Forest Plan, (not to be confused with the National Forest Management Act of 1976 (NFMA) definition of a Forest Plan). The other part of the President's Plan includes local community economic revitalization.

Thermal stratification -- The layering of a water body based upon water temperature.

Threatened species -- Those plant or animal species likely to become endangered throughout all or a significant portion of their range within the foreseeable future. A plant or animal identified and defined in accordance with the 1973 Endangered Species Act and published in the Federal Register.

Till -- A heterogeneous mixture of rock fragments ranging in size from clay to boulders, deposited beneath moving glacial ice or directly from melting in place of stagnant glacial ice.

Timber management -- A general term for the directing, managing or controlling of forest crops and stands of trees.

Timber production -- The purposeful growing, tending, harvesting, and regeneration of regulated crops of trees to be cut into logs, bolts, or other round sections for industrial or consumer use other than for fuelwood.

Transpiration -- The loss of water vapor by land plants.

Ultramafic -- Dark-colored igneous rocks composed of minerals which are rich in iron and magnesium.

Underburn -- Burn by surface fire.

Underburning -- Prescribed burning of the forest floor or understory for botanical or wildlife habitat objectives, hazard reduction, or silvicultural objectives.

Understory -- The trees and other woody species growing under the canopies of larger adjacent trees and other woody growth.

Understory fire -- A fire that burns in the understory, more intense than a surface fire with flame lengths of 1-3 meters.

Uneven-aged management -- A combination of actions that simultaneously maintains continuous tall forest cover, recurring regeneration of desirable species, and the orderly growth and development of trees through a range of diameter or age classes. Cutting methods that develop and maintain uneven-aged stands are single-tree selection and group selection.

Ungulate -- A hoofed mammal.

Unitype species -- A wildlife species that presumably requires one kind of habitat or successional stage. Unitype species typically prefer interior, more secluded, portions of their habitat.

Ustic -- Refers to the soil moisture regime. The soil moisture control section is dry for 90 or more cumulative days but is moist in some part for more than 180 cumulative days. Soil moisture is limited, but available when conditions are suited for plant growth.

Variability -- (Natural Variability, Historic Variability, Range of Variability) The observed limits of change in composition, structure, and function of an ecosystem over time as influenced by frequency, magnitude, and pattern of disturbances.

Vegetative composition -- The plant species present in a plant community.

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Viability -- The ability of a wildlife or plant population to maintain sufficient size so that it persists over time in spite of normal fluctuations in numbers; usually expressed as a probability of maintaining a certain population for a specified period.

Viable population -- A wildlife or plant population that contains an adequate number of reproductive individuals appropriately distributed on the planning area to ensure the long-term existence of the species.

Water quality -- The chemical, physical, and biological characteristics of water.

Watershed -- The drainage basin contributing water, organic matter, dissolved nutrients and sediments to a stream or lake.

Watershed analysis -- A systematic procedure for characterizing watershed and ecological processes to meet specific management and social objectives. Watershed analysis is a stratum of ecosystem management planning applied to watersheds of approximately 20 to 200 square miles.

WEAVE -- Acronym for the Watershed Analysis process developed by the Deschutes National Forest - [Watershed Evaluation and Analysis for Viable Ecosystems]. It incorporates our ultimate purpose for doing watershed ecosystem analysis...to sustain viable ecosystems. It evokes visions of an intricate tapestry of many colors and textures, each thread having an important function in creating a viable, interconnected whole. It also symbolizes that the work of many others is inextricably woven into the Deschutes process, and that each past and future thoughtful addition will add functionality and strength to the whole effort.

Westside -- Generally, west of the crest of the Cascade Range.

Wetlands -- Areas that are inundated by surface water or ground water with a frequency sufficient to support, and under normal circumstances do or would support, a prevalence of vegetative or aquatic life that require saturated or seasonally saturated soil conditions for growth and reproduction (Executive Order 11990). Wetlands generally include, but are not limited to, swamps, marshes, bogs and similar areas.

Wilderness -- Areas designated by congressional action under the 1964 Wilderness Act. Wilderness is defined as undeveloped Federal land retaining its primeval character and influence without permanent improvements or human habitation. Wilderness areas are protected and managed to preserve their natural conditions, which generally appear to have been affected primarily by the forces of nature with the imprint of human activity substantially unnoticeable; have outstanding opportunities for solitude or for a primitive and confined type of recreation; include at least 5,000 acres or are of sufficient size to make practical their preservation,

enjoyment, and use in an unimpaired condition; and may contain features of scientific, education, scenic or historical value as well as ecologic and geologic interest.

Wildfire -- Any wildland fire that does not meet management objectives, thus requiring a fire suppression response. Once declared a wildfire, the fire can no longer be declared a prescribed fire.

Windthrow -- A tree or trees uprooted or felled by the wind.

Woody debris -- See Coarse woody debris.

Xeric -- Very dry.

Young-seral forest -- See Seral Stage.

Zooplankton -- A floating, often microscopic aquatic animal.