PORCUPINE WATERSHED ANALYSIS

June 2003

Preface

This Watershed Analysis is presented as part of the Aquatic Conservation Strategy adopted for the President's Plan (Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl, including Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Related Species (ROD)).

This document follows the format provided in Part 2 of *Ecosystem Analysis at the Watershed Scale: Federal Guide for Watershed Analysis - Version 2.2* (August 1995). This format consists of six steps:

- Characterization of the watershed
- Identification of issues and key questions
- Description of current conditions
- Description of reference conditions
- Synthesis and interpretation of information
- Recommendations

This document is guided by two levels of analysis:

- **core topics** - provide a broad, comprehensive understanding of the watershed.
  Core topics are provided in the Federal Guide for Watershed Analysis (8/95) to address basic ecological conditions, processes, and interactions at work in the watershed.
- **issues** - focus the analysis on the main management questions to be addressed.
  Issues are those resource problems, concerns, or other factors upon which the analysis will be focused. Some of these issues prompted initiation of the analysis. Other issues were developed from public input in response to scoping or were identified by the team during the analysis process.

Key analysis questions are developed for each issue. These questions are organized by analysis step to help focus the analysis and to provide organization to the document while addressing the issues.

Public scoping for this analysis was conducted in June of 2002. A notice requesting public input printed in the Mt. Shasta Herald on May 29, 2002. A letter, also requesting public participation, was sent to 45 individuals and organizations known to be interested in management of the National Forests. As a result of public scoping, no comments were received.

The U. S. Fish and Wildlife Service, Red Bluff Officer, was invited and chose not to participate in this analysis process.

Porcupine Watershed Analysis

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Chapter 1

Characterization of the Watershed

The purpose of this chapter is to identify the dominant physical, biological, and human processes or features of the watershed that affect ecosystem functions or conditions. The relationship between these ecosystem elements and those occurring in the river basin or province is established. This chapter provides the watershed context for identifying elements that should be addressed in the analysis.

The major topics covered in this chapter are:

- Location
- Watershed Setting
- Relationship to Larger Scale Settings
- Physical Features
- Biological Features
- Human Uses
- Land Allocations and Management Direction

1.1 Location

The Porcupine Watershed is located in the northeast corner of the McCloud Ranger District of the Shasta-Trinity National Forests. The watershed is located about 70 miles northeast of Redding, California and lies within Siskiyou County (see Map 1 - Vicinity Map).

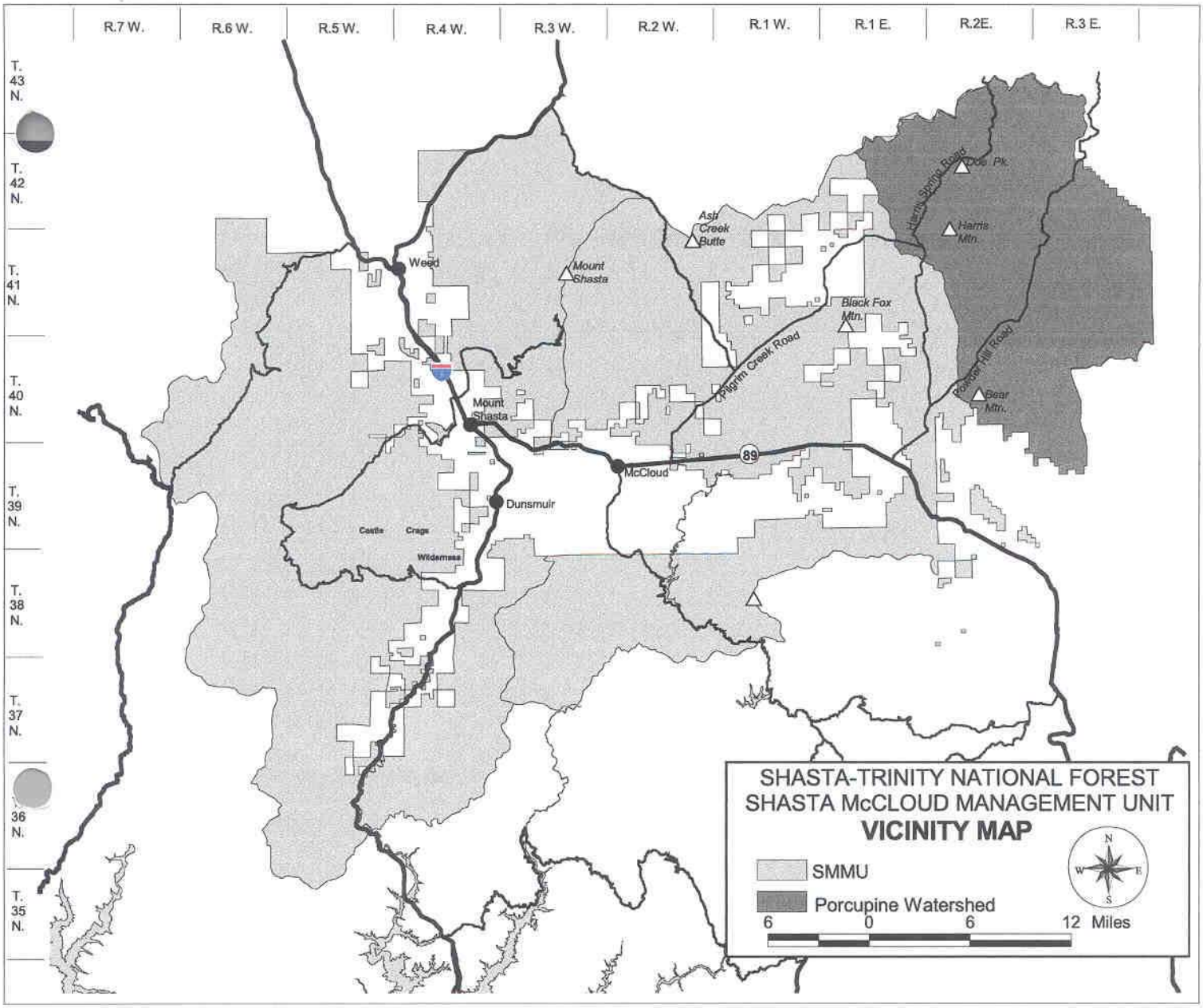
1.2 Watershed Setting

The Porcupine Watershed is about 150,000 acres in size, of which 140,000 acres are National Forest. The watershed drains to the southeast towards the Fall River drainage. There are no named streams within the watershed.

The northern and western boundaries follow prominent ridges that clearly separate the Porcupine Watershed from adjacent watersheds. The southern and eastern boundaries of the watershed are often poorly defined due to the generally flat terrain and lack of prominent ridges. For purposes of this analysis, the Forest boundary is used to define the southern and eastern extent of the watershed.

The Porcupine Watershed, as presented in this analysis, includes a narrow strip of land in the Bear Creek Watershed (see Map 1 - Vicinity Map). This area consists of approximately 2,000 acres between the actual Porcupine Watershed and the National Forest boundary. This area was included in the Porcupine Watershed Analysis because it was too small to analyze by itself.

Ownership in the watershed is mostly composed of National Forest lands that are occasionally broken by smaller blocks of private ownership. The largest single block of private land is the Harris Tract near the center of the watershed. Four sections of private land form an area of checkerboard ownership in the northwest corner of the watershed on Fisk Ridge. The south half of the watershed contains three small isolated blocks of private land, all less than 140 acres. The McCloud Railway Company owns sections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Black Fox Mtn.
Pilgrim Creek Road
Powder Hill Road
Bear Mtn.
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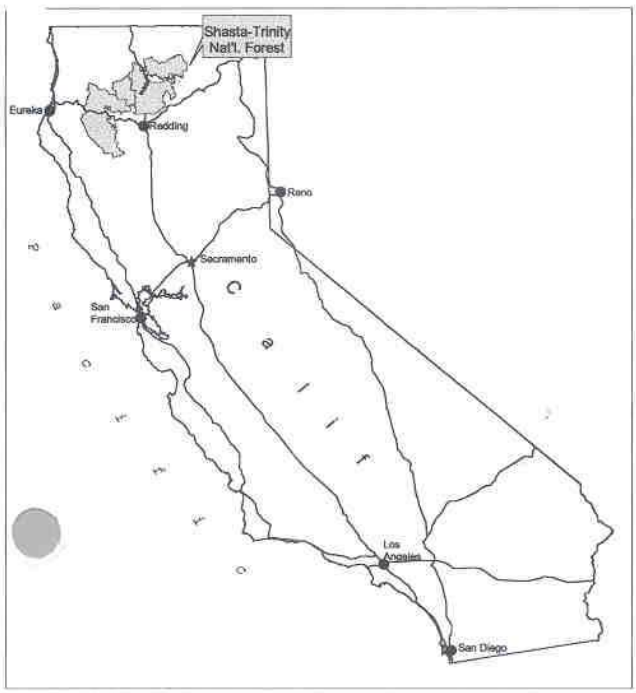
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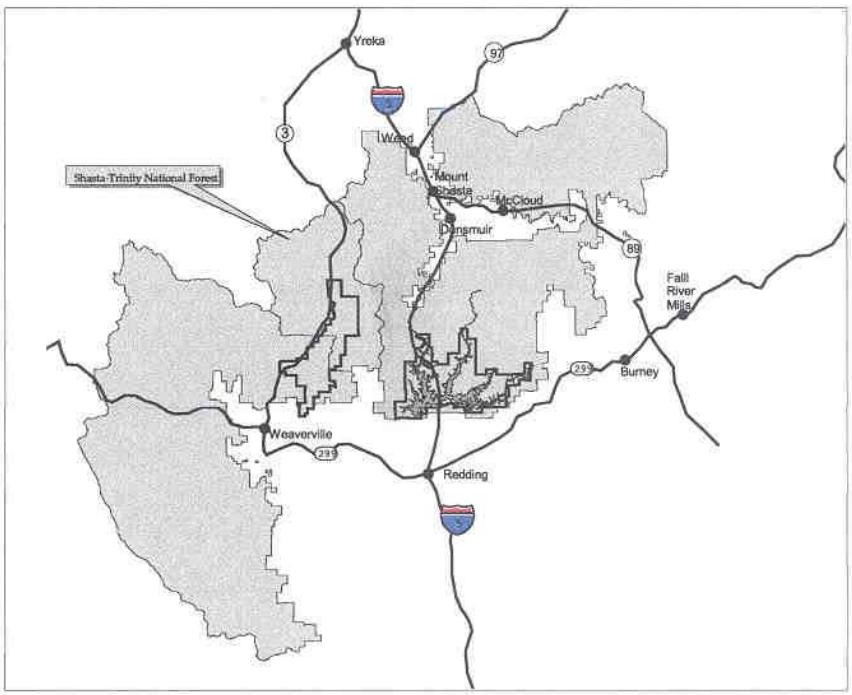
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Fall River Mills
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Burney
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Redding
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of right-of-way along the railroad track from Hunters Hill southwest to the watershed boundary. This right-of-way generally extends for 100 feet from centerline on each side of the track. The land ownership pattern for the watershed is displayed on Map 2 - Land Ownership.

Other agencies and private companies managing lands adjacent to the Porcupine Watershed include:

- North - Klamath National Forest
- Northeast - Modoc National Forest
- Southeast - Shasta-Trinity National Forest Land administered by the Lassen National Forest
- South - private timberland
- West - Shasta-Trinity National Forest

1.3 Relationship to Larger Scale Settings

Many physical, biological, and human processes or features span areas much larger than a watershed. The purpose of this section is to place the Porcupine Watershed in its logical setting with respect to these larger scales.

Two larger scale settings need to be considered when addressing the Porcupine Watershed:

- The Pit River Basin
- Late-Successional Reserves

The Pit River Basin

The Pit River Basin drains an extensive area of roughly 4,952 square miles. Its headwaters are in the Warner Mountains east of Alturas. The river flows southwesterly for approximately 110 miles to its terminus at Shasta Lake.

Climate in the Pit River Basin is characterized as dry. Annual precipitation in the basin is generally below 20 inches and averages about 12 inches per year.

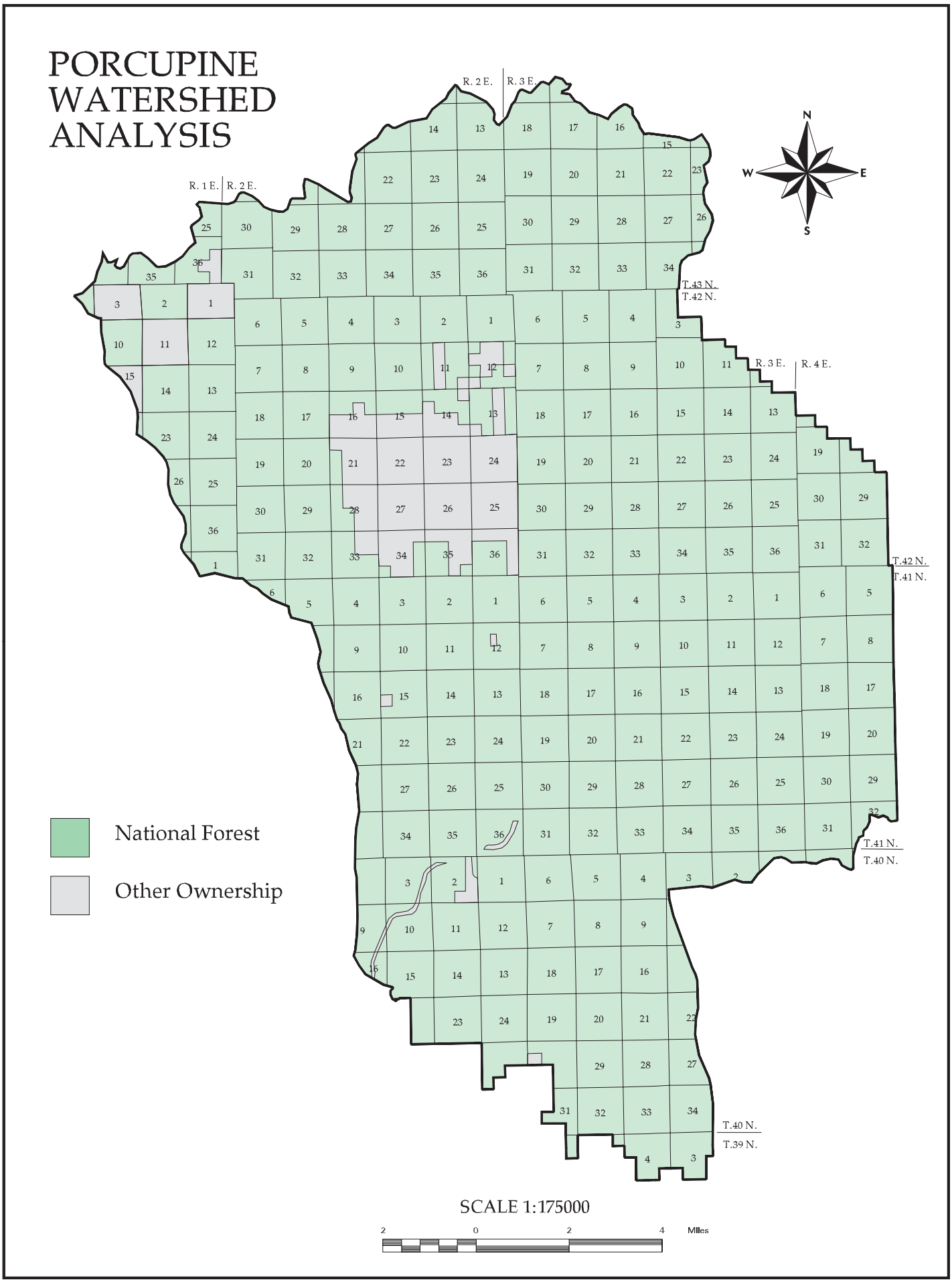
Dry eastside pine forests and western juniper typify vegetation in the river basin. Forest vegetation changes towards a more mixed conifer forest type in the western parts of the basin where annual precipitation is higher. Several broad valleys within the river basin are dominated by grasses and have mostly been converted to agricultural uses. Volcanic features such as lava flows are common and support only sparse brush.

Timber management and grazing are the predominant land uses in the Pit River Basin. Recreational use is concentrated near Lassen National Park and around lakes and rivers. Pacific Gas & Electric's Pit River Hydroelectric Project is located along the lower portions of the Pit River between Fall River Mills and Shasta Lake.

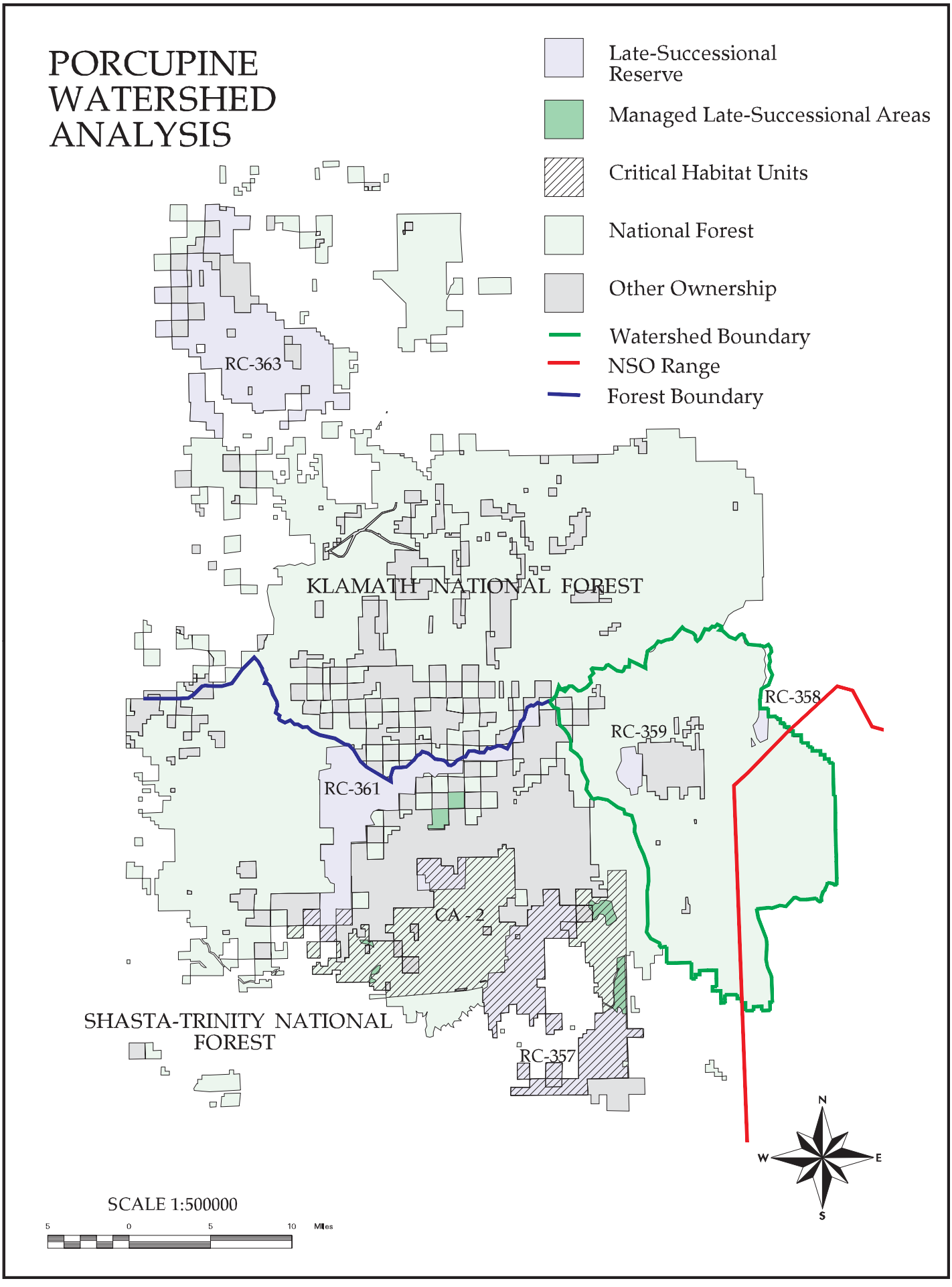
There are no surface flow tributaries from the Porcupine Watershed into the Pit River. It is assumed that subsurface movement of water from the Porcupine Watershed enters the Pit River system in the Fall River Valley.

Late-Successional Reserves

The Porcupine Watershed contains two Late-Successional Reserves (LSRs) at Harris Mountain (RC-359) and Saddle Hills (RC-358). Map 3 – Adjacent Late-Successional Reserves displays the LSRs within and closest to the watershed. LSRs need to be considered in relationship to adjacent LSRs in order to assess habitat connectivity on a landscape scale.



Map 2. Land Ownership



Map 3. Adjacent Late-Successional Reserves

1.4 Physical Features

Dominant Physical Features

The terrain of the Porcupine Watershed is generally gentle with a predominantly south aspect. Scattered buttes and hills rise above the surrounding landscape. Volcanic features, including craters and lava flows cover large areas in the eastern part of watershed. Elevations range from 3,800 feet at the south end of the watershed to 7,580 feet on Medicine Mountain. Dominant features in the watershed are shown on Map 4 - Dominant Physical Features.

Climate

The Porcupine Watershed receives less rainfall than most of the Shasta-Trinity National Forest. Mean annual precipitation is less than 40 inches throughout the watershed and drops below 25 inches in the southeast portion of the watershed (Map 5 – Average Annual Precipitation). Most of the precipitation is from winter storms of several days' duration and moderate intensity. Approximately 90% of annual precipitation occurs from October through April. Convective storms produce occasional precipitation during the summer. Summers in the watershed are characterized as hot and dry.

Geology and Geomorphology

The Porcupine Watershed is located on the Medicine Lake Lava Flows that are considered to be part of the Cascade Range Geological Province. The southern-most part of the watershed is the western edge of the Modoc Plateau Province. Both provinces are volcanic and are mostly made up of lava flows and outwash desposits. The northern half of the watershed contains many volcanic features including lava flows, obsidian flows, lava tubes, spatter cones and craters (see Map 6 - Geologic Features of Interest). The watershed is shaped by north-northwestern trending faults that create a landscape of fault scarps and grabens. The fault scarps may be hundreds of feet high in the southern part of the watershed and may be completely buried by recent lava flows and outwash deposits.

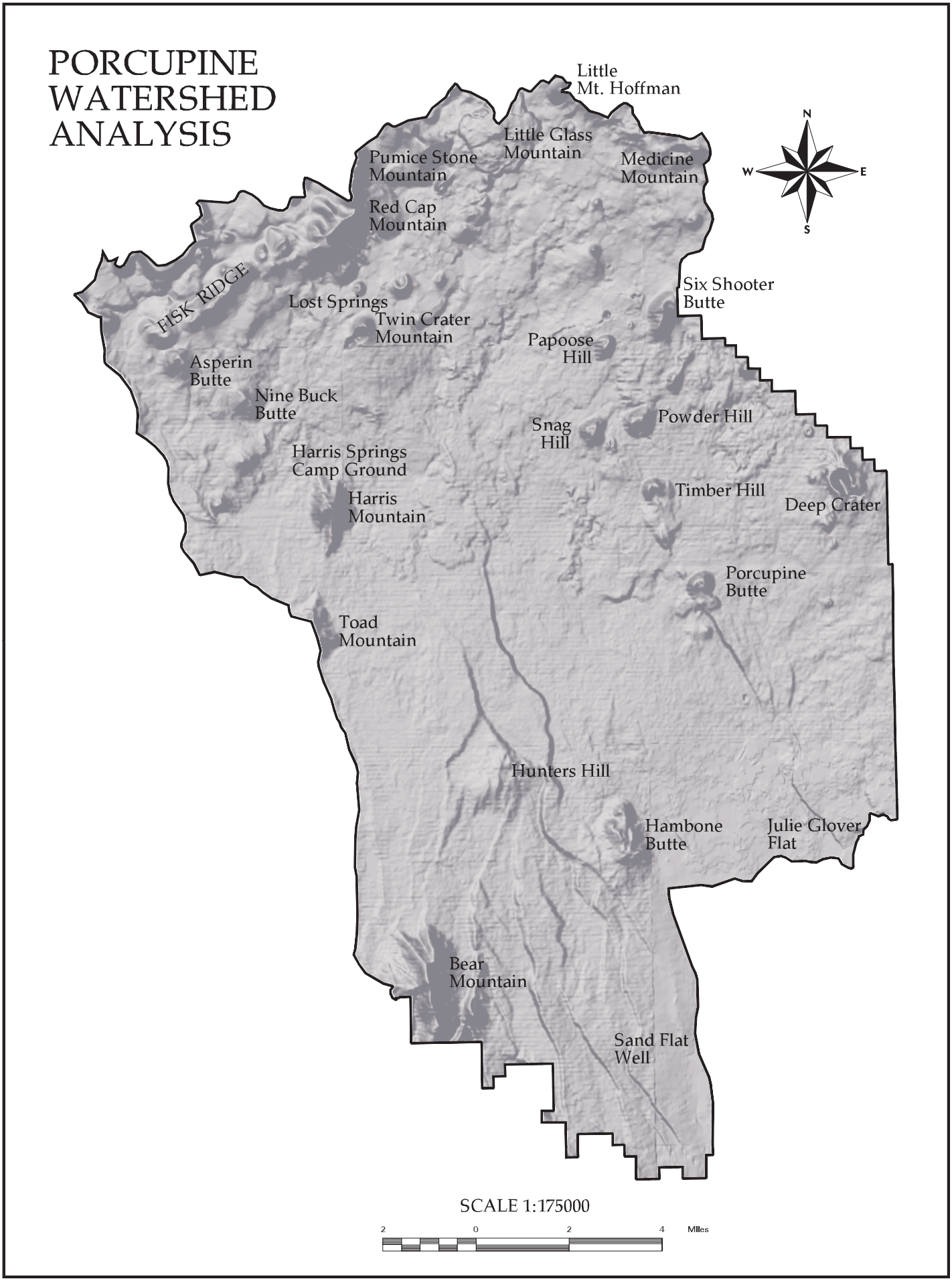
The Medicine Lake Volcano has been very active in the last 10,000 years. In the post-glacial period the watershed was inundated by glacial outwash. At about the same time a series of eruptions and lava flows created the Giant Crater Lava Flow, which covers approximately 20,000 acres (Map 7a). Since that time the watershed has seen eruptions and lava flows at Paint Pot Crater and Little Glass Mountain about 1000 years before present. The Little Glass Mountain event was a pumice eruption that spread rhyolite pumice over an area 50 km long and 10 km wide with pumice depths up to 20 feet near the source and decreasing with distance form the vent (Map 7b). Subsequently obsidian flowed from the vent and created the obsidian flow known as Little Glass Mountain.

Erosion Processes

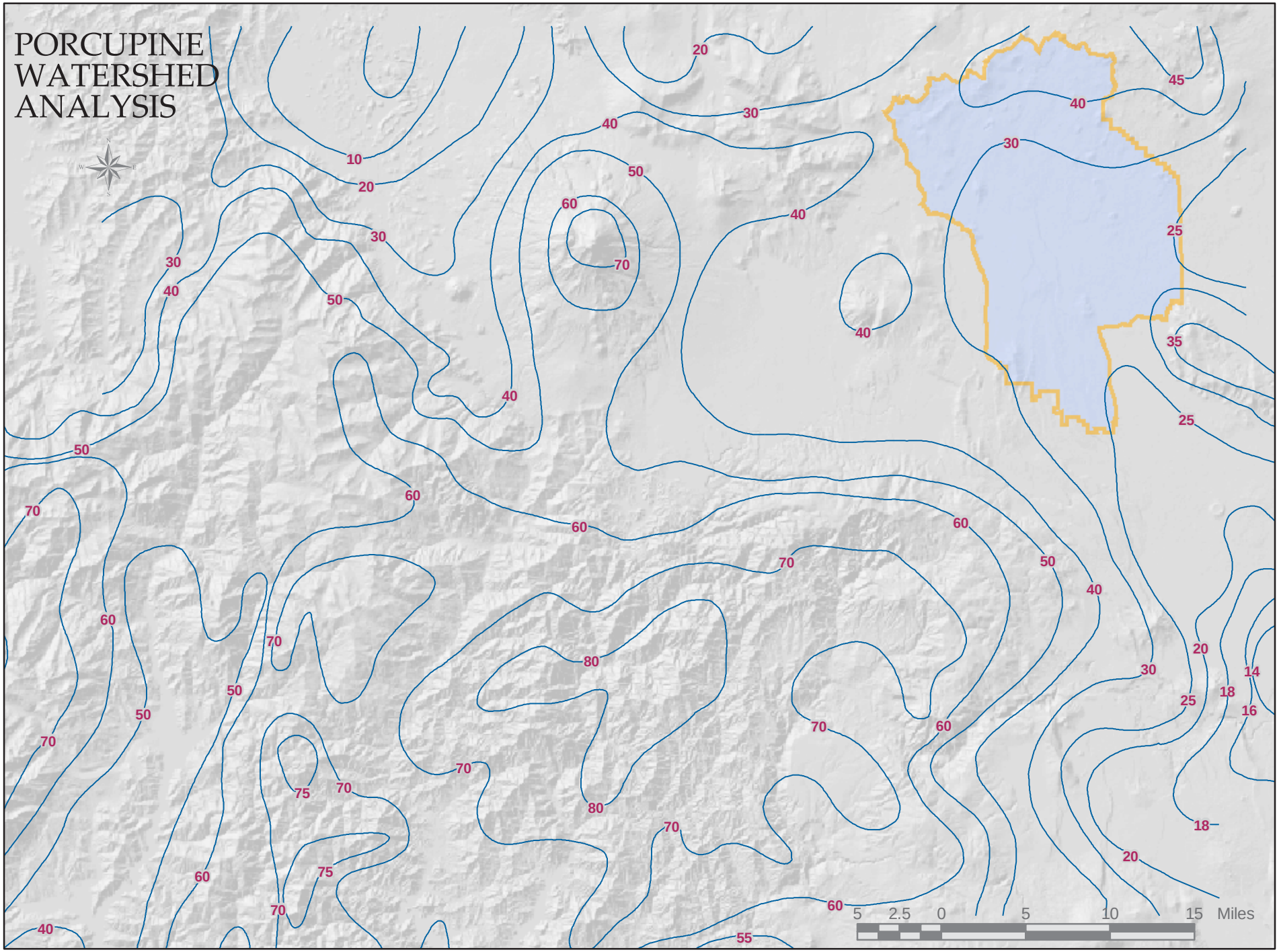
Hillslope erosion is very limited in the watershed due to the flat terrain, volcanic soil and lack of surface runoff. Erosion concerns exist only in areas of steep topography such as steep buttes and on pumice soils.

Hydrology

The Porcupine Watershed is almost completely devoid of surface hydrologic features. Surface runoff is scarce to nonexistent. Hydrologic features are limited to springs, disappearing stream channels fed by springs, wet meadows, small vernal lakes and some caves. Wet meadow systems also occur in the southern third of the watershed. All precipitation infiltrates into the ground feeding aquifers that supply water to Bear Creek and the Fall River. The watershed has no surface flow outlet and there is no surface

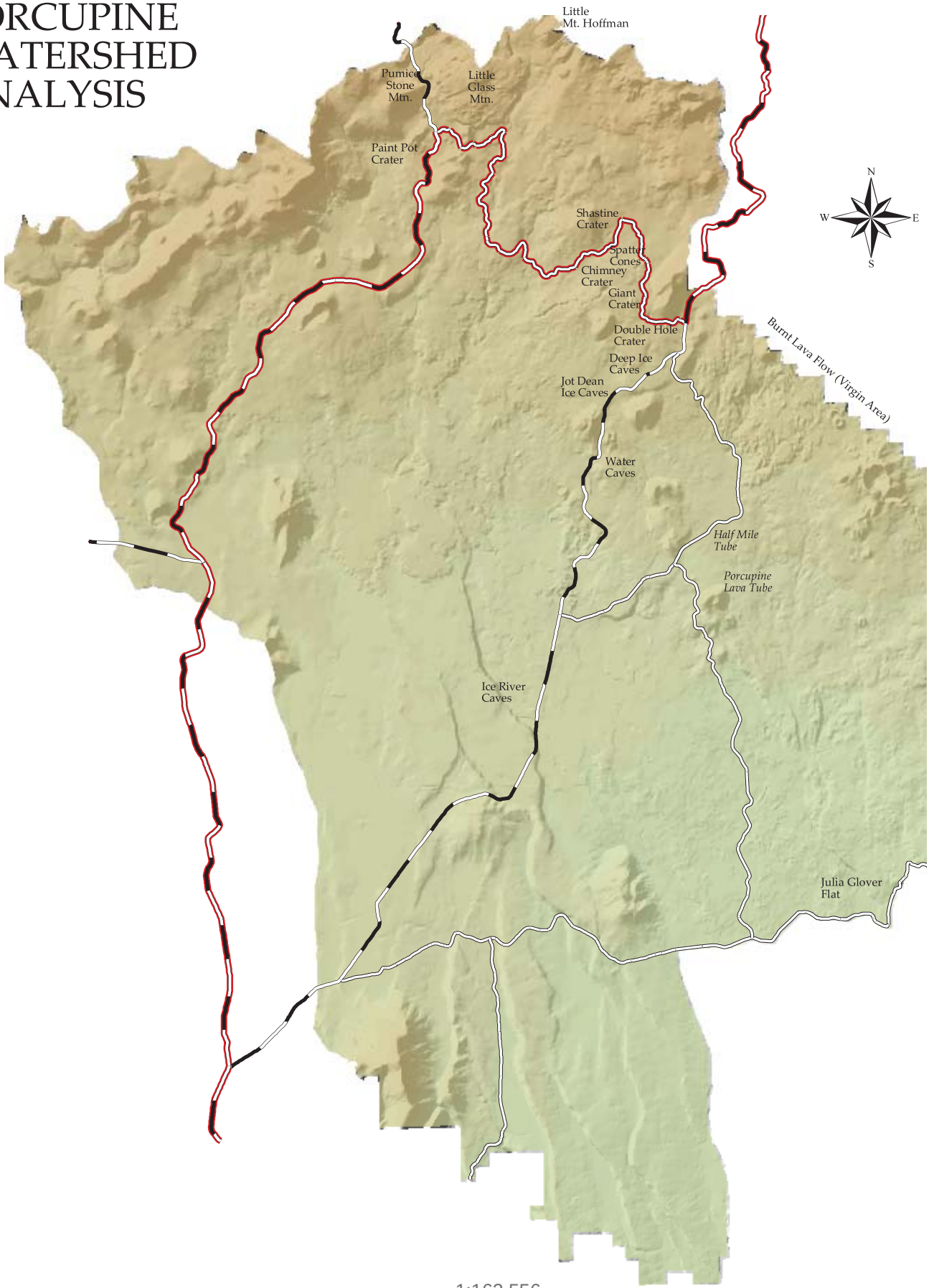


Map 4. Dominant Physical Features



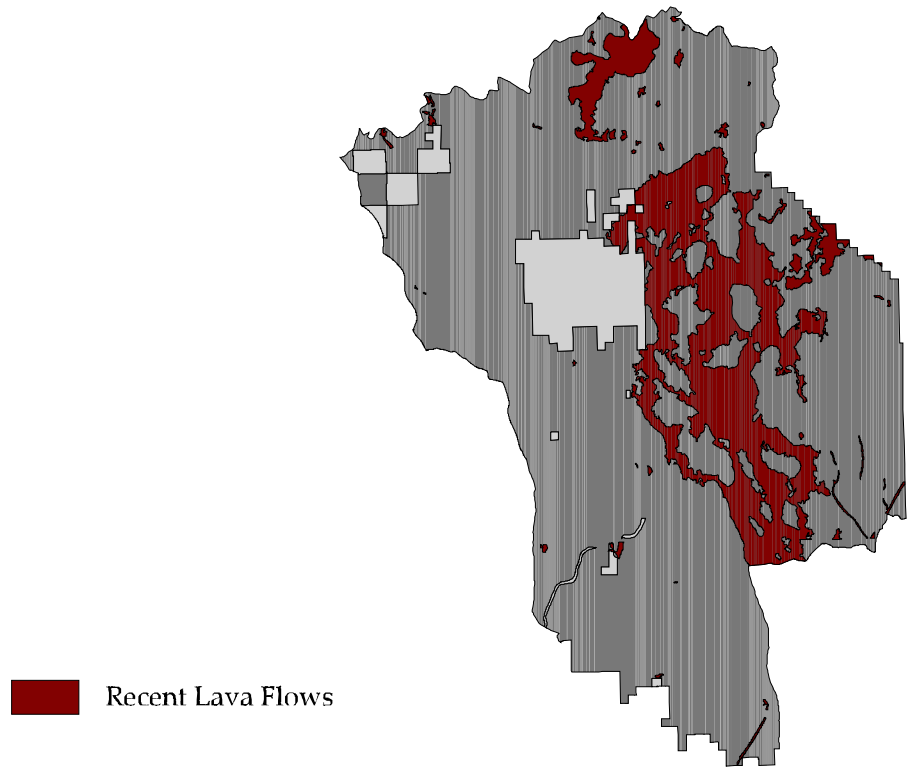
Map 5. Average Annual Precipitation

PORCUPINE WATERSHED ANALYSIS

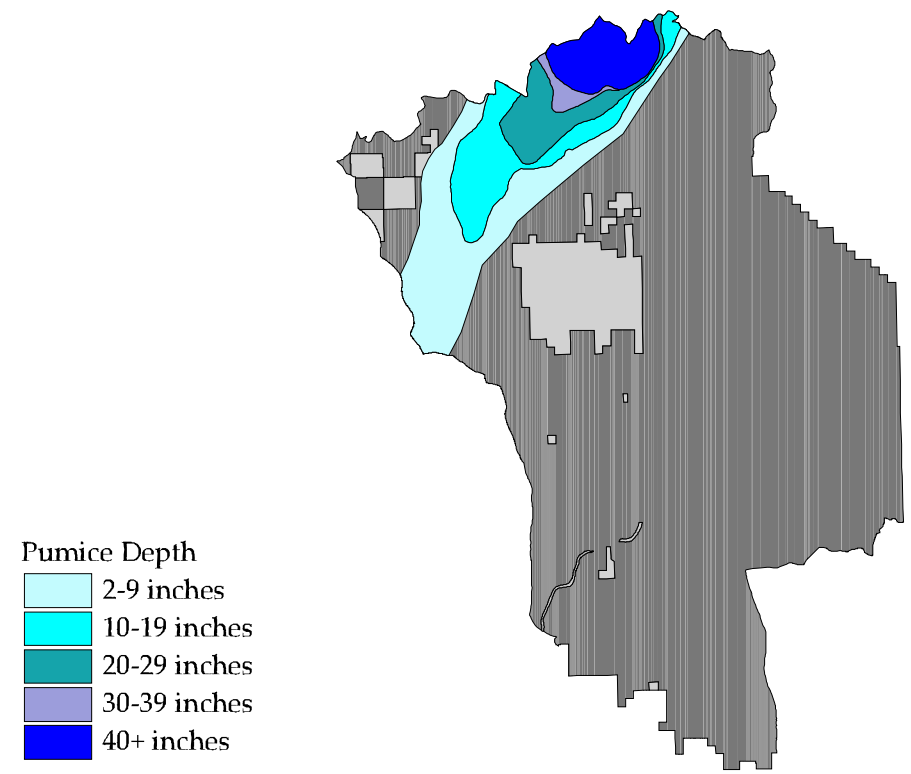


Map 6. Geologic Features of Interest

Geology and Geomorphology



Map 7a. Recent Lava Flows in Porcupine Watershed



Map 7b. The Little Glass Mt. Pumice Plume

flow connectivity between the watershed and the Fall or Pit Rivers.

Stream Channels

Stream channels are almost completely absent in the northern two-thirds of the watershed. The density of stream channels in the watershed is among the lowest in Northern California. Stream channels are confined to small intermittent streams flowing only a short distance from springs. No perennial stream channels occur within the entire watershed. Intermittent stream channels are more abundant in the southern third of the watershed.

Water Quality

Due to the lack of surface hydrologic features any discussion of water quality in the Porcupine Watershed is restricted to groundwater quality. Very little data is available to address this topic, however the quality of groundwater is believed to be very good due to the lack of human developments in the watershed.

1.5 Biological Features

Vegetation

The current array and pattern of vegetation is the result of several factors, including climate, soils, fire, timber harvest, grazing and volcanic activity. The dominant conifer vegetation types in the analysis area are mixed conifer, ponderosa pine, and true fir. Species composition tends to follow elevation, temperature, and moisture gradients ranging from predominantly ponderosa pine in the lowest, hottest, and driest sites in the southeastern parts of the watershed to white fir/red fir forests at the highest, coldest areas in the north end of the watershed.

Lodgepole pine stands are found in low-lying areas with moist soils and high water tables, often to the exclusion of all other species. Pumice soils in the vicinity of Little Glass Mountain and Paint Pot Crater also support stands of pure lodgepole pine, often in a stunted form. On more productive sites, lodgepole pine often occurs as a minor component of other conifer forest types.

Pure knobcone pine stands frequently develop following fire. Decadent knobcone pine stands are often a fuels management concern due to heavy fuel loads and the density of the trees.

Black oak is a major component of mixed conifer stands in the southern part of the watershed but is rarely found in pure stands. Quaking aspen is occasionally found as both pure stands and as individual trees within conifer stands.

Much of the Porcupine Watershed is characterized by lava flows and pumice soils. Vegetation conditions on lava flows range from barren areas to sparse brush and conifers. Vegetation in these areas is considered to be in a climax condition. Aerial photography from 1944 confirms that few vegetation changes have occurred on lava flows in the past 50 years. Deep pumice soils also limit conifer development in much of the watershed. Even areas where pumice depth is less than a foot can often present problems for reforestation.

Historical large fire history as well as fire exclusion has played a significant role in vegetation successional patterns throughout the watershed. Successional shifts from sun to shade tolerant species have occurred as a result of fire exclusion. Catastrophic fires have resulted in conversions from mixed conifer and pine forests to brush, knobcone and lodgepole pine stands.

Species and Habitats

Management prescriptions that emphasize wildlife habitat account for 15% of National Forest land in the watershed, including:

- Prescription VI - Wildlife Habitat Management (LMP 4-66)
- Prescription VII - Late-successional Reserves (LMP 4-43)
- Prescription IX - Riparian Management (LMP 4-59)

The northern goshawk (a Forest Service Sensitive species) is common throughout the watershed. A pair of northern spotted owls (a Federally Listed Threatened species) is located within the watershed on Harris Mountain. These species and other wildlife species of special concern are addressed in Chapter 3.

Two Late-Successional Reserves (LSRs) are located within the Porcupine Watershed at Harris Mountain (RC-359) and Saddle Hills (RC-358). There is no Critical Habitat Unit designation within the Porcupine Butte Watershed.

The watershed straddles the eastern boundary of the range of the northern spotted owl (FEMAT, 1993) with approximately 28% of the watershed actually occurring outside the range. Due to soil conditions and low precipitation, the area is limited in its capability to support suitable habitat for the spotted owl. These same conditions also limit the dispersal of the spotted owl to the east.

The Porcupine Watershed lies within one of the most popular deer hunting areas in Northern California. A small elk herd inhabits the southeast portion of the watershed during the summers. The LMP provides supplemental management direction to maintain and enhance big game species and to manage selected areas in the watershed for browse species and early seral stage vegetation.

Several rare plant species of special concern occur within the watershed but tend to grow on talus slopes or Riparian Reserves and away from areas that are intensively managed.

With the exception of some planted fish in two artificial ponds in the southeastern corner of the watershed there are no fish present in the watershed and there is little opportunity for the migration of fish into the watershed.

1.6 Human Uses

A wide variety of land-use activities occur within the Porcupine Watershed. Timber management is the dominant land-use activity in the watershed. The watershed is also heavily used for personal use firewood cutting, especially in lodgepole pine stands near Dry Lake (outside watershed) and White Deer Lake. Commercial and personal use mushroom picking is also common in the spring and fall. There are portions of two range allotments totaling approximately 70,000 acres within the watershed. There are no permanent, year-round residences within the watershed and only one summer cabin located on private property at Hambone.

Recreation use is dispersed and varied throughout the watershed. Harris Spring Campground is the only developed campground in the watershed. The area is heavily used for dispersed camping during hunting season. The Harris Spring and Powder Hill Roads are heavily used travel routes for recreational traffic going to Medicine Lake. The Modoc Volcanic Scenic Byway crosses the north part of the

watershed and emphasizes the volcanic features in the area. Volcanic features such as lava tubes, Little Glass Mountain, and the Giant Crater Lava Flow attract visitors. The fire lookout at Little Mount Hoffman has been restored and is rented to the public by the Forest Service for overnight visits.

An extensive transportation system has been developed in the watershed to support timber management activities. The transportation system in the watershed totals approximately 775 miles (private and National Forest). Current road density is approximately 3.3 miles of road per square mile of land. The northeast portion of the watershed is located within the East McCloud Road Management Unit.

Several utilities cross the southern half of the watershed including:

- California Oregon Transmission Project (COPT) high voltage powerline
- Western Inter-tie high voltage powerline
- PG&E gas pipeline
- McCloud and Burlington Northern Railways

The Medicine Lake Volcano, located on the watershed's northern boundary, has long been considered a potential site for development of geothermal energy. The United States Geological Survey, after reviewing the geologic data from limited seismic testing done in the late 1970's, designated an area surrounding the caldera as a Known Geothermal Resource Area (KGRA). This designation meant that federal lands could be offered for competitive leasing within the KGRA. The initial KGRA designation included 15,371 acres. After additional seismic and temperature gradient data was gathered the KGRA was expanded in 1983 to encompass 134,254 acres. The KGRA designation comprises a total area of 5,221 acres on the Shasta-Trinity National Forest within the Porcupine Watershed.

More than 100 heritage resource sites are scattered throughout the watershed, most of which have not been evaluated for National Register of Historic Places eligibility. Significant sites include: Railroad grades and logging camps associated with the McCloud River Lumber Company such as Hambone and Chippy Spur, Grasshopper Flat (prehistoric obsidian quarry) and a number of obsidian "workshop" sites in and around the Medicine Lake Highlands.

Native Americans, particularly those from the Pit River and Modoc tribes, continue to use their traditional sites in the Medicine Lake Highlands for cultural and spiritual purposes. In 1999, the Medicine Lake Highlands Traditional Cultural Places District was determined eligible for the National Register of Historic Places as a Traditional Cultural Property (TCP). The District comprises approximately 23,650 acres across three national Forest boundaries (Shasta-Trinity, Modoc and Klamath NF's). It includes much of the SE corner of the McCloud Ranger District in Townships 42 and 43 North, Ranges 2 East and 3 East (see District map) and is within the Porcupine Watershed Analysis area. The TCP District is centered at the Medicine Lake shield volcano's caldera. The TCP District is eligible to the National Register because it is associated with events that have made a significant contribution to the broad patterns of our history. The TCP District holds both past and present importance for Indian peoples from the Modoc and Pit River Tribes as a cultural/spiritual landscape with mythical associations, a place for obsidian and other resource procurement, a camping area, and a place to collect medicines.

1.7 Land Allocations and Management Direction

Management direction for the Porcupine Watershed is found in *the Shasta-Trinity National Forests Land and Resource Management Plan* (LMP) which incorporates direction from the *Record of Decision*

(ROD) *for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl.*

Land Allocation

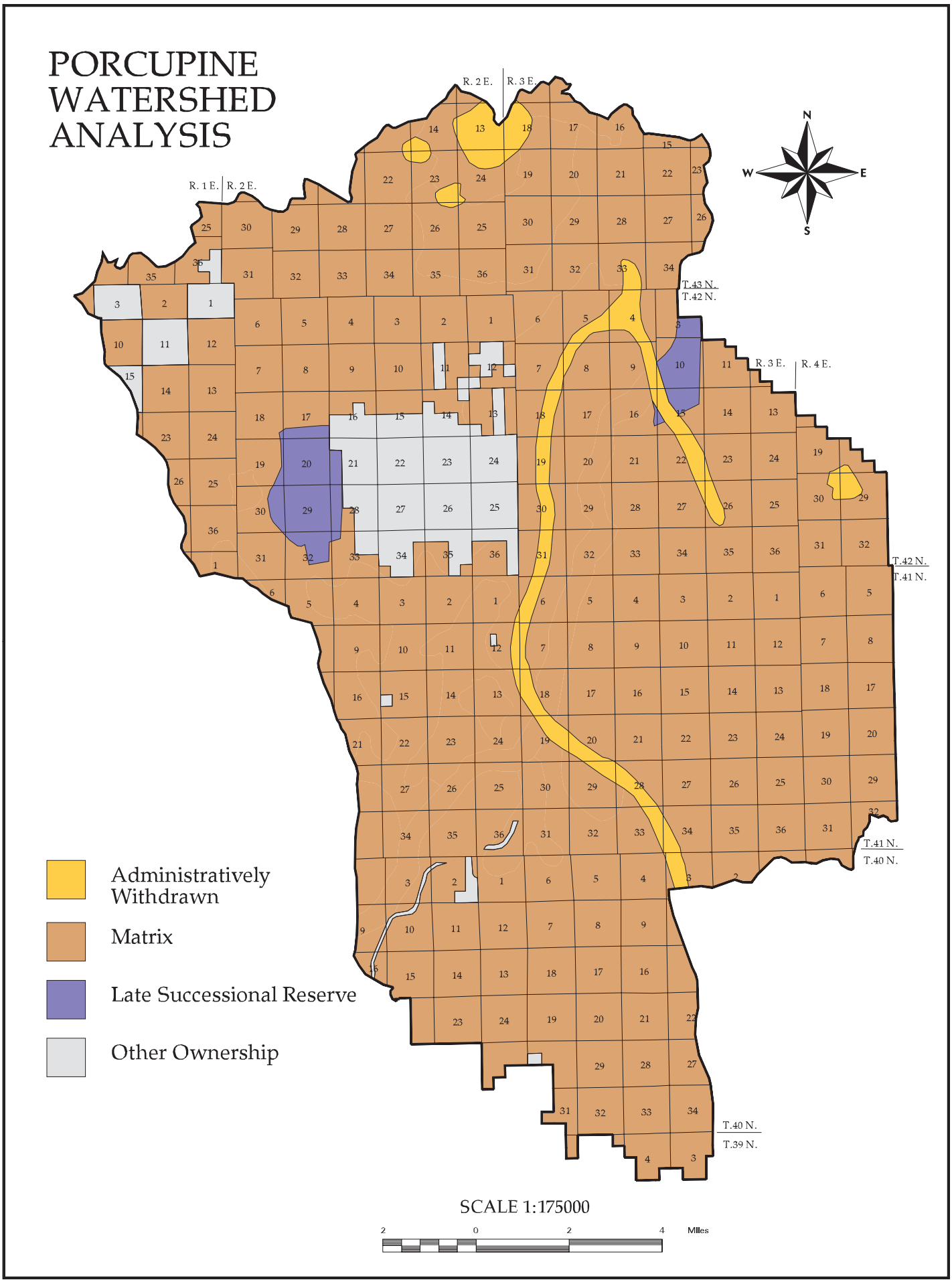
The ROD identifies four land allocations within the Porcupine analysis area (see Map 8 - Land Allocations):

- Late-Successional Reserves (LSR)
  Late-Successional Reserves are areas that have been established to protect and enhance conditions of late-successional and old-growth forest ecosystems and to insure the support of related species, including the northern spotted owl (LMP 4-37).
- Riparian Reserves
  Riparian Reserves provide an area along streams, wetlands, ponds, lakes, and unstable and potentially unstable areas where riparian-dependent resources receive primary emphasis. Riparian Reserves are important to the terrestrial ecosystems as well, serving, for example, as dispersal habitat for certain terrestrial species (ROD A-5).
- Administratively Withdrawn Areas
  Administratively Withdrawn Areas are identified in current Forest and District Plans or draft plan preferred alternatives and include recreation and visual areas, back country, and other areas where management emphasis precludes scheduled timber harvest (ROD A-4).
- Matrix
  The Matrix consists of those federal lands outside the three categories of designated areas listed above (ROD A-5). The Matrix are lands on which most timber harvest will occur and where standards and guidelines are in place to assure for appropriate conservation of ecosystems as well as provide habitat for rare and lesser known species (ROD B-10).

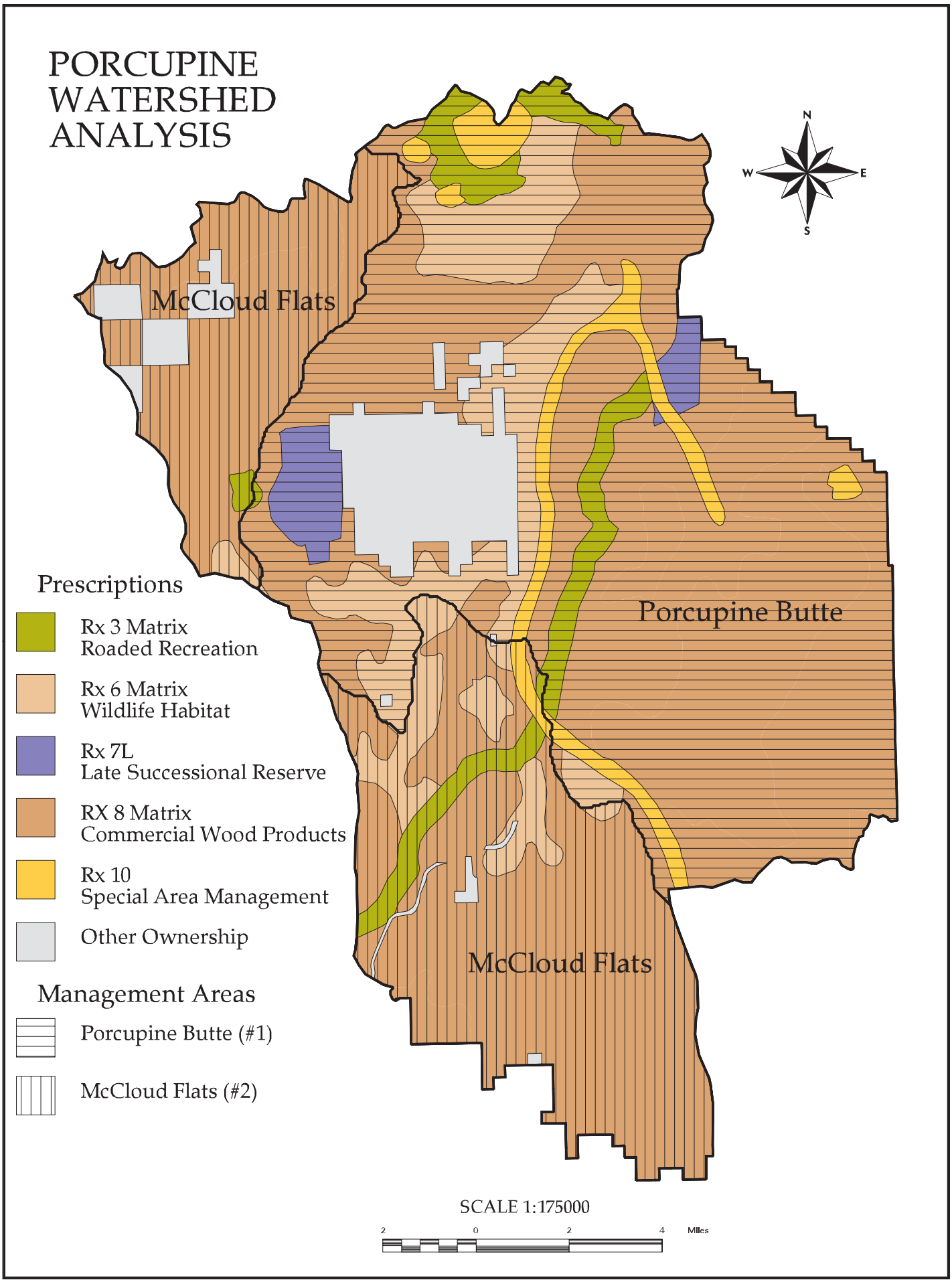
Table 1-1: Acreage summary by land allocation and management prescription within the Porcupine Watershed. Except for Riparian Reserves, acres represent the area outside Riparian Reserves.

Land Allocation or Management Prescription	**Area**	
	Acres	**%**
Late-Successional Reserves		
VII. Late Successional Reserves	3,179	2.12
Total Late Successional Reserves	3,179	2.12
Riparian Reserves		
IX. Riparian Reserves		
Total Riparian Reserves	1,792	1.19
Administratively Withdrawn Areas		
X. Special Area Management	5,866	3.91
XI. Heritage Resource Management	*	*
Total Administratively Withdrawn Areas	5,866	3.91
Matrix		
III. Roaded Recreation	6,743	4.49
VI. Wildlife Habitat Emphasis	17,094	11.38
VIII. Commercial Wood Products	105,209	70.05
Total Matrix	129,046	85.92
Total - All National Forest Land	139,883	93.14
Total - All Private Land	10,313	6.86
Total - Watershed Area	150,196	100.00

* The Heritage Resource Management prescription occurs as minor unmapped inclusions within other prescriptions.



Map 8. Land Allocations



Map 9. Management Areas and Prescriptions

Management Prescriptions

In addition to the four land allocations identified in the ROD, the LMP identifies seven Management Prescriptions in the Porcupine analysis area (see Map 9 - Management Areas and Prescriptions and Table 1-1). These are:

- III - Roaded Recreation (LMP 4-64)
- VI - Wildlife Habitat Management (LMP 4-66)
- VII - Late-Successional Reserves (LMP 4-43)
- VIII - Commercial Wood Products Emphasis (LMP 4-67)
- IX - Riparian Management (LMP 4-59) *
- X - Special Area Management (LMP 4-49)
- XI - Heritage Resource Management (LMP 4-50) **

* Mapped separately due to complexity. See Map 10 - Riparian Reserves.

** Unmapped - occurs as minor inclusions within other prescriptions

Management Areas

Supplemental management direction for specific units of land is provided in the LMP under Management Area Direction (LMP - Chapter 4 - Section G). The LMP identifies two Management Areas in the Porcupine Watershed (see Map 7 - Management Areas and Prescriptions). These are:

- Porcupine Butte (#1) (LMP 4-75)
- McCloud Flats (#2) (LMP 4-79)

Northeastern Siskiyou Coordinated Road Management Plan

Road use in a portion of the Porcupine Watershed is managed according to the Northeastern Siskiyou Coordinated Road Management Plan (1991) (see Map 10 - East McCloud Road Closure Area). The Porcupine Watershed encompasses the East McCloud Road Management Unit, which is one of five units within the Plan. Only certain roads designated in the Unit are open to motorized vehicles from three days prior to the opening of X-1 archery deer season (late August) to the end of X-1 general deer season (late October). Motorized vehicle travel is prohibited on all other roads and trails during this period.

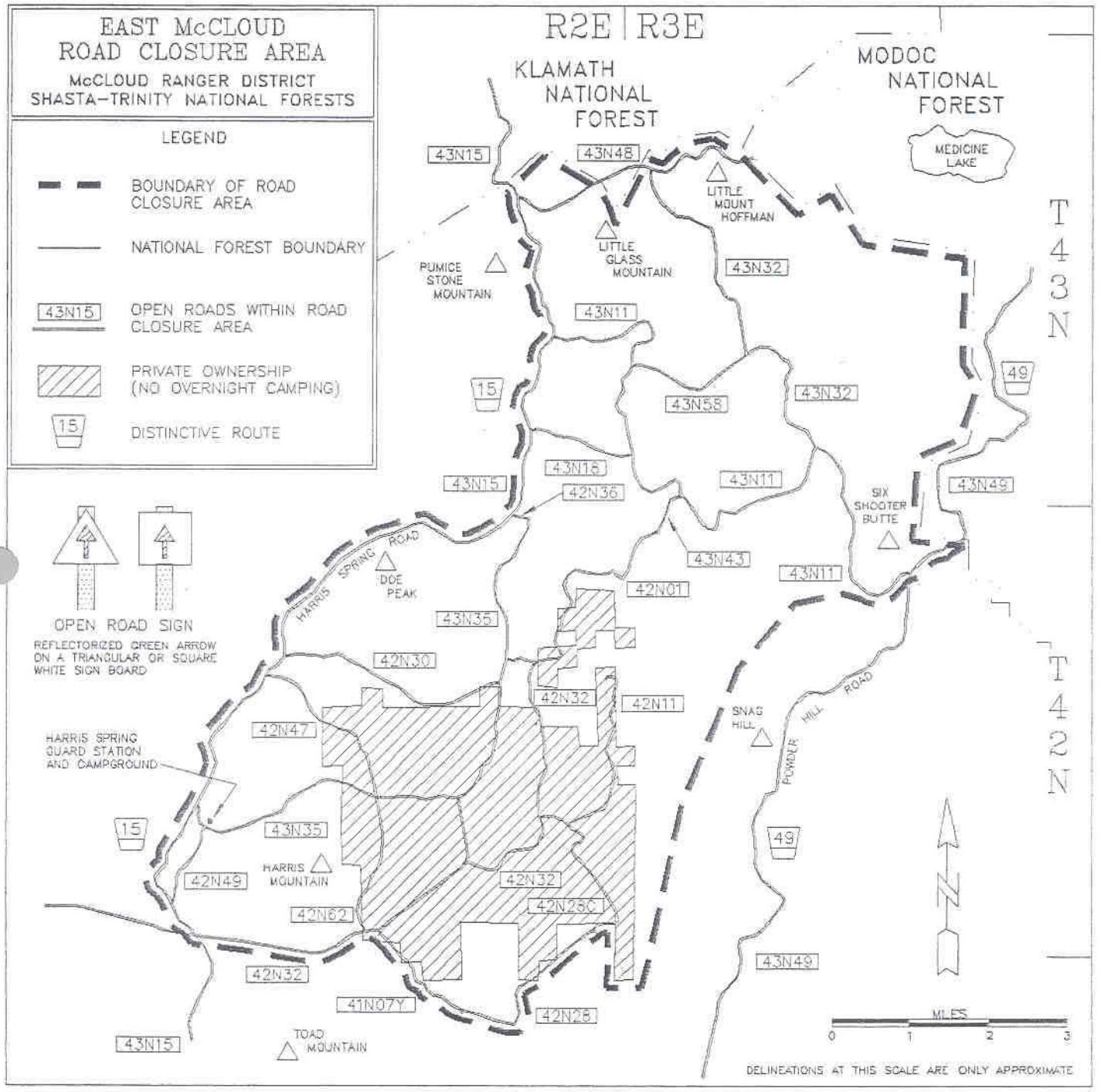
Shasta-Trinity Fire Management Plan

The Shasta-Trinity Fire Management Plan was adopted in 2002 to provide fire management direction concerning placement and priorities of fuels management projects based on hazard, risk, and value. The plan includes several strategic management objectives, two of which apply to the Porcupine watershed:

1. Protection of late successional habitat that occurs inside and outside the LSR.
2. To incorporate prescribed fire as an alternative to natural fire processes in all applicable watershed analyses. The plan designated fire management areas and provided forest direction.

Management Area 1-Porcupine:

- Allow fire to play its natural role thru natural ignitions. Allow for prescribed natural fire where values at risk confine suppression strategies and consumption of fuels (biomass) meets future resource needs.
- Maintain the existing and planned fuelbreak system to a level that will result in wildfires generally not exceeding 40 acres in size. (Note: There are a total of 77 miles, 1925 acres, of fuelbreaks within the watershed that were constructed through timber sale activity and COTP agreements).
- Maintain fuel management investments and suppression resources capable of eliminating a single outage of the powerline system (Calif/Oregon Transmission, TANC project).



Map 10. East McCloud Road Closure Area

Geologic Special Interest Areas in the Porcupine Watershed

The Final Environmental Impact Statement for the Shasta-Trinity National Forest Land and Resources Management Plan (1994) (FEIS) identified specific areas that were recommended and established as Geologic Special Interest Areas (GSIAs). Six of the areas fall within the Porcupine Watershed. These areas are: Deep Crater, Giant Crater Lava Tube system, Little Glass Mt., Paint Pot Crater, Pumice Stone Mt. and Spatter Cones. Descriptions of these features can be found on page III-79 of the FEIS.

The FEIS also lists candidate areas to be evaluated for GSIA designation. The candidate GSIAs within the Porcupine Watershed include the Burnt Lava Flow, Papoose Hill and Tilted Rock Lava Flow. Descriptions of these features can be found on page III-81 of the FEIS.

Chapter 2

Issues and Key Questions

2.1 Background

The purpose of this chapter is to focus the analysis on the key elements of the ecosystem that are most relevant to the management questions and objectives, human values, or resource conditions in the watershed. Watershed concerns are identified and framed within the context of issues. The Porcupine Watershed Analysis Interdisciplinary Team formulates issues and key questions for the watershed.

All information needed to address the issues and key questions is presented within the context of the watershed analysis core topics. The core topics and core questions that accompany each topic address the basic ecological conditions, processes, and interactions (elements) at work in the watershed. Core topics and core questions are presented in part 2 of *Ecosystem Analysis at the Watershed Scale, Federal Guide for Watershed Analysis, Version 2.2* (August 1995). Core topics that should be covered in all watershed analyses include erosion processes, hydrology, vegetation, stream channels, water quality, species and habitats and human uses. Because hydrologic features are scarce within the watershed the core topics of Erosion Processes, Hydrology, Stream Channel and Water Quality have been grouped into the topic of Riparian Reserves.

Watershed Core Topics

- Erosion Processes *
- Hydrology *
- Stream Channel *
- Water Quality *
- Vegetation
- Species and habitats
- Human uses

* Addressed in Riparian Reserves Core Topic.

Issues focus the analysis on the main management questions to be addressed. Issues are those resource problems, concerns, or other factors upon which the analysis will be focused. Some of these issues prompted initiation of the analysis. Other issues were developed from public input in response to scoping or were identified by the team during the analysis process.

This chapter describes the major issues identified in the Porcupine Watershed. Key analysis questions are developed for each issue. These questions are organized by analysis step to help focus the analysis and to provide organization to the document while addressing the issues.

Watershed Issues

- Vegetation And Wildlife Habitat Diversity
- Forest Health
- Riparian Area Management

2.2 Issue: Vegetation And Wildlife Habitat Diversity

Vegetation in the Porcupine Watershed is continuously being modified through management activities and natural processes. Timber harvest is the management activity that has had the greatest impact on the area; however, large changes have also occurred through wildfire, insect attack, and natural succession. There is a concern that changes in the amount and distribution of various habitat types has not been analyzed in the watershed and that there is a need to understand the effects of intensive forest management on wildlife habitat at watershed and landscape scales.

Key Questions:

Step 3 - Current Conditions

- What is the current distribution and condition of seral stages in the watershed?
- What unique habitats (hardwoods, wet meadows, caves, old growth, etc.) exist within the watershed? Where are they located and what is their current condition?

Step 4 - Reference Conditions

- What was the past seral stage distribution in the watershed?
- What was the past condition of unique habitats in the watershed?

Step 5 - Interpretation

- How has the distribution and condition of seral stages in the watershed changed over time and what are the future trends?
- What management activities and natural processes have contributed to changes in the distribution and condition of seral stages?
- What is the capability of the watershed to sustain various seral stage conditions?
- What is the desired future condition for seral stage distribution for the watershed?
- What changes are occurring in unique habitats in the watershed and what are future trends?
- What management activities and natural processes have contributed to changes in unique habitats?

Step 6 - Recommendations

- What actions can be taken to move the watershed towards the desired future condition for seral stage distribution?
- What actions can be taken to protect or enhance unique habitats in the watershed?

2.3 Issue: Forest Health

Forest health concerns in the Porcupine Watershed focus on fuel conditions and the susceptibility of forest stands to insect attack.

There is a history of large wildfires within the watershed. Fire exclusion has resulted in the accumulation of dead and down fuels on the forest floor. The exclusion of fire has also encouraged the development of understory vegetation that has formed live fuel ladders that extend into the forest canopy. There is also a concern that fuel conditions in the watershed are a threat to resources and private property.

Low precipitation and competition for limited moisture have increased the susceptibility of overstocked stands to insect attack. A major outbreak of the fir engraver beetle *(Scolytus ventralis)* in 1992-93 killed large amounts of white fir in the southeast portion of the watershed and greatly reduced stocking levels and closed canopy habitat in the area. High mortality levels have also been observed in ponderosa pine and sugar pine in overstocked conditions due to the insect attack. There is a concern that overstocked stand conditions in the watershed are making the area susceptible to future insect outbreaks, especially during drought periods.

Western gall rust *(Endocronartium harknessii)* is prevalent in lodgepole pine stands where its cankers kill trees outright or weaken the bole sufficiently enough to make the tree susceptible to wind breakage. Mortality and breakage due to gall rust also contributes to high fuel loads. Gall rust also infects ponderosa pine plantations in the watershed.

Key Questions:

Step 3 - Current Conditions

- What are the current forest health problems in the watershed and in the LSRs?
- What are the current risks of catastrophic wildfire to resources and property?

Step 4 - Reference Conditions

- What forest health problems and resource losses have occurred in the past?

Step 5 - Interpretation

- How have forest health problems in the watershed changed over time and what are the future trends?
- What natural processes are influencing forest health in the watershed?
- Are current management activities and policies influencing forest health and, if so, in what way?

Step 6 - Recommendations

- What actions can be taken to move the watershed towards the desired future condition for forest health?

2.4 Issue: Riparian Area Management

There is a striking contrast in the character of Riparian Reserves in different parts of the watershed.

The north portion of the watershed has very few channels that meet the criteria for Riparian Reserves. These channels are typically void of riparian vegetation and inner gorges and generally run for very short distances (<¼ mile) before filtering into the soil. Riparian Reserves in this area mostly occur around several small lakes, ponds, and springs. There are no fisheries or downstream water uses in this area.

The south portion of the watershed is typified by wet meadow systems that generally run northwest to southeast along the base of escarpments and lava rims. These areas provide unique habitat for several sensitive plant species. Water levels fluctuate annually depending on snow conditions from the previous winter and Riparian Reserve boundaries are often difficult to determine on the ground.

Because precipitation averages less than 30 inches annually and the volcanic soils of the watershed are very permeable, Riparian Reserves in the northern portion of the watershed generally do not provide the functions described in the Aquatic Conservation Strategy (ROD B-12). Riparian Reserves are almost completely absent from the northern half of the watershed. The number of stream channels that display "annual scour" and meet the criteria necessary to be categorized as Riparian Reserves is actually lower than the channels shown on USGS topographic maps in the Porcupine Watershed (i.e. many of the channels shown on the maps do not carry surface runoff on an annual basis). The location and function of Riparian Reserves should be determined to provide direction for management activities occurring in and adjacent to these areas and to determine if changes in the interim Riparian Reserve widths are needed. Wet meadow systems in the southern portion of the watershed are considered to be more sensitive and interim Riparian Reserve widths should be evaluated to determine if adequate protection is being provided.

Key Questions:

Step 3 - Current Conditions

- What are the types, function, and distribution of Riparian Reserves in the watershed?
- What are the current conditions for Riparian Reserves in the watershed?

Step 4 - Reference Conditions

- What was the past condition of Riparian Reserves in the watershed?

Step 5 - Interpretation

- What are the natural processes and land use activities that affect the condition of Riparian Reserves?
- What changes are occurring to Riparian Reserves?

Step 6 – Recommendations

- What actions can be taken to move Riparian Reserves towards the desired future condition for forest health?
- What management activities are appropriate within Riparian Reserves?
- Are current guidelines for Riparian Reserve widths appropriate for the watershed?

2.5 Issue: Geologic Special Interest Areas

The Porcupine Watershed contains many features of Geologic Interest. Six Geologic Special Interest Areas (GSIAs) were designated by the Shasta-Trinity National Forest LRMP; three others were designated for further evaluation. Other potential GSIAs are also recognized. In 1998 the Decision Notice for the Modoc Volcanic Scenic Byway was signed. Visitor use will likely increase with the designation of the scenic byway.

Key Questions:

Step 3 - Current Conditions

- Where are the Designated GSIAs, candidate GSIAs, and the other features in the watershed that might be included in GSIAs?
- What are the levels of sensitivity for each of the GSIAs (i.e. biological and archaeological, etc.)?
- What are the issues relating to public safety and potential for damage to geologic features of interest?
- What was the level of public use and interest in these areas prior to designation of the scenic byway?
- Are the currently designated GSIAs accurately mapped and are they emphasizing the most suitable features?
- Is there a better way to classify these features and present them to the public?

Step 4 – Reference Conditions

- No Key Questions.

Step 5 – Interpretation

- What mapping changes might be made to more accurately depict the GSIAs?
- The LMP calls for evaluation of three sites in the Porcupine Watershed. What is the suitability of these sites for GSIA?
- What other features might have sufficient geologic interest to warrant that they be included?
- Are these appropriate features to draw to the public's attention? Are they of sufficient public interest? How might they pose unacceptable hazards? How might they be damaged?

Step 6 – Recommendations

- What changes are recommended in the Porcupine GSIAs?
- How can the Porcupine GSIAs best be presented to the public?

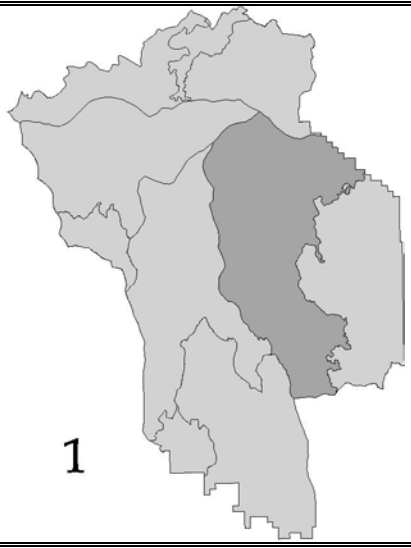
Chapter 3

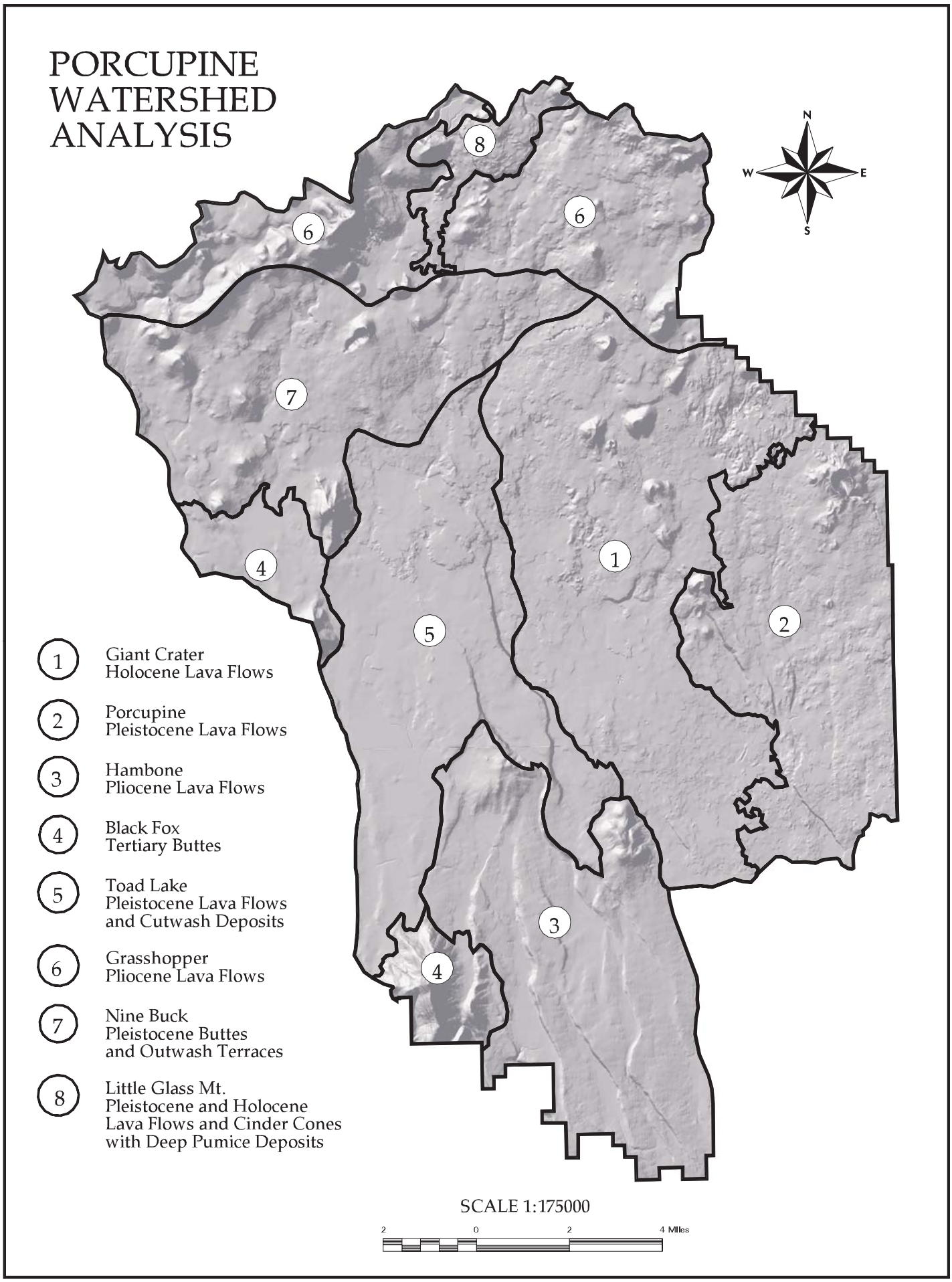
Current Conditions

The purpose of this chapter is to develop information relevant to the issues and key questions identified in Chapter 2. The current range, distribution, and condition of the relevant ecosystem elements are discussed.

For the purpose of this analysis the watershed was partitioned into eight distinct land type associations (LTAs). The LTAs were identified based on combinations of similar landforms and vegetation types (Map 11 – Land Type Associations). The land types are identified and discussed in Section 3.1 and are tiered to throughout the remainder of the document.

3.1 Land Type Associations

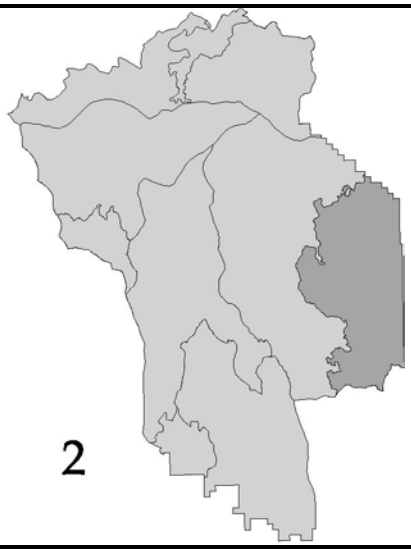
LAND TYPE NAME: GIANT CRATER LAVA FLOW **LAND TYPE NUMBER:** 1 **SIZE:** 32,025 ACRES **PERCENT OF WATERSHED:** 21%	
Land Type Description: The lava flow surfaces consist of a very gently sloping landscape that is either jumbled fields of rough AA lava or smooth lava flows interspersed with deep depressions from collapsed lava tubes. Within the flow are many buttes, cinder cones and slightly elevated surfaces of slightly older lava flows are exposed where they were not inundated by the basalt flows. These features exist today as forested islands and inclusions amid the vast surrounding, semi-barren landscape of lava rock.	***Geology:*** Holocene basalt lava flow. Eruptions at Giant Crater, Shastine Crater, Double Hole Crater and others occurred at the end of the Pleistocene Epoch, about 10,000 ybp. These basalt lava flows, termed "flood basalts" because of their low viscosity, extend 45 km in length and cover approximately 206 km^2. These flows are known collectively as the Giant Crater Lava Flow. Older flows of some relief form "islands" within this latter flow.



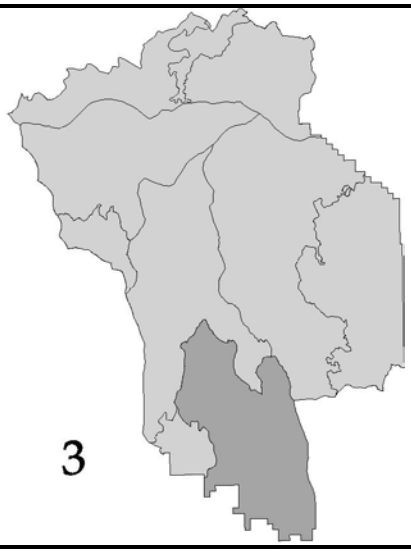
Map 11. Land Type Association

Hydrology: Area is almost completely devoid of surface hydrologic features. No streams or springs occur within the land type. Groundwater flow predominates.	***Soils:*** Soil development is minimal except on the islands of older flows. The forested islands within the flows are typified by deep, sandy soils that support ponderosa pine/bitterbrush stands or mixed conifer forest that includes ponderosa pine, white fir, incense cedar and sugar pine. Characterize site productivity
Primary Vegetation Type: The Giant Crater Lava Flow is characterized by sparse stands of ponderosa pine dominated mixed conifer including, incense cedar, sugar pine, white fir and lodgepole pine. Bitterbrush, mountain mahogany and gooseberry, are the primary shrubs. Since 1975 many shrub fields have been converted to ponderosa pine plantations. Most conifer stands fall into the early (30 to 60 years old) or mid mature (60 to 120 years old) seral stages. With the majority of stands being between 50 and 70 years of age. There are scattered predominant trees throughout the area, but not many acres of old growth (>180 years old).	***Secondary Vegetation Type(s):*** There are several buttes and cinder cones; Papoose Hill, Timber Hill, Snag Hill, Saddle Hills, Stud Hill and Powder Hill. Vegetation types found on cinder cones and buttes are white fir types, knobcone and mixed conifer. Timber hill has a large component of knobcone pine. Inclusions of ponderosa pine dominated mixed conifer can be found on islands of old flows (flower pots) where deep soils are found. AA and Pahoehoe flows are characterized by sparsely scattered incense cedar, ponderosa pine, sugar pine, white fir and lodgepole pine along with scattered shrubs, primarily pinemat manzanita, curly leaf mountain mahogany, fern bush, bush chinquapin, ocean spray and gooseberry. Many herbaceous species can be found on the flows as well as grasses and carex species. Some areas of the AA type flows are un-vegetated. The southern edge of the Giant Crater Land Form is characterized by scattered western juniper, manzanita and curlyleaf mountain mahogany. Open grasslands are limited. Seasonal or wet meadows are not found in this area. There are no known sites of any plants listed as noxious by the State of California or the Shasta-Trinity National Forest.
Fire Regime and Fuels: Described as an infrequent, moderate to high intensity fire regime. High "Risk" factor due to lightning ignition occurrence, but low "Hazard" due to fuels. Included as a special Fire Management Area. Hazard/Risk as follows: High: 70%, Moderate: 25%, Low: 5%.	***Habitat Description:*** Generally poor productivity makes this area low value to most wildlife. Woody debris and snags far below forest standards due to natural limitations and fire in most areas, but also logging in the conifer islands. Mid and early seral stages are dominant with no old growth, but a few very old trees scattered in areas inaccessible to logging. Diversity generally poor, but lava tubes and ice caves are vital to sensitive bats, deer, and general wildlife. Habitat has been improved with guzzlers.

Wildlife and Game Species: Typical of the interior Rocky Mountains dry mixed conifer type or Ponderosa Pine type in the conifer islands in the flow. Deer have the most economic interest. Caves have several undescribed species of arthropods, or very long-range extensions of known species. Many caves are known but neither unexplored nor surveyed, and some lack human access.	***Species of Concern (Plants/Wildlife):*** T&E and S&M animal species likely absent. There is one sensitive plant population in this land type. *Iliamna bakerii* (Baker's globemallow) is found near Lava Tank. Baker's globemallow is a perennial herb that grows from a woody caudex. Habitat includes chaparral, pinyon and juniper woodland. Substrates are usually volcanic. Often found in burned areas at elevations between 1000-2500 meters. Threatened by alteration of fire regimes and grazing. Endangered in Oregon. No Survey & Manage fungi or bryophytes have been found in this land type. Sensitive species of big-eared bats reside here, with possible seasonal use by pallid bats. The big-eared bat hibernates and roosts in lava tubes in this flow. Goshawks and marten likely absent. MIS species would be the Open habitat Assemblage, with many members missing due to poorer dry habitat.
Dominant Land Uses: Timber production and management of a scenic corridor with geologic special interest.	***Heritage Resources:*** A few scattered prehistoric sites have been recorded within the interior of the Giant Crater Lava Flow, but a large number lie on the western and northern margins. Railroad logging was conducted in the southern portion of this landform after 1920, and one large logging camp has been recorded at Chippy Spur
Management Prescriptions: Matrix – 86% (7, 9, 70) Special Area Management – 10% LSR – 2% Private – 3% **For all land types: Percentage of lands within each management prescription is shown. Numbers in parentheses indicate percentage of matrix lands in prescription 3, 6 and 8, respectively. Acres of Riparian Reserves and Heritage Resource Management areas account for approximately 1% of watershed area and are not included in Management Prescriptions block for each land type.*	***Range:*** The Hambone allotment permittee avoids this area due to rock hazards and poor forage. Useless for cattle and sheep. Allotment may be cancelled.

LAND TYPE NAME: PORCUPINE LAVA FLOW **LAND TYPE NUMBER:** 2 **SIZE:** 19,883 ACRES **PERCENT OF WATERSHED:** 13%	
Land Type Description: The Porcupine Flows are also flood basalt and thus represent a broad, very gently sloping landscape. The subdued terrain is interrupted by numerous fault scarp, talus slopes, some up to 100 feet high.	***Geology:*** Pleistocene vesicular basalt lava flows. Most of the Porcupine Watershed is underlain by lava flows termed "Modoc Basalt" by Powers (1932). Much of this flow within the watershed was covered by more recent eruptions from the Giant Crater Flow. The remnants of Modoc Basalt were referred to by Baer (1973) as the "Porcupine Formation". Baer dates them as early Pleistocene.
Hydrology: Area is almost completely devoid of surface hydrologic features. No streams or springs occur within the land type. Groundwater flow predominates. Julia Glover Flat (a seasonal wetland) is located in the southeastern corner of the land type.	***Soils:*** Soils are very sandy and cobbly with frequent rock outcrops. Yearly rainfall averages less than 20 inches.
Primary Vegetation Type: The primary vegetation type is montane mixed chaparral made up mostly of decadent green-leaf manzanita, bitterbrush, bitter cherry and mountain mahogany.	***Secondary Vegetation Type(s)***: The secondary vegetation type is ponderosa pine primarily in the form of plantations of varying ages. Most of these were a product of shrub field conversions in the 70s and 80's. Knobcone pine stands are common especially in the eastern half of this land type. Along the western edge mixed conifer and ponderosa pine mixed conifer stands can be found. Most of these between early (30-60 years old) and Mid (60 – 120 years old) seral stages. There are scattered predominate conifers through out the area. Open grasslands are limited. Seasonal wetlands are limited to Julia Glover Flat. Riparian vegetation is minimal at Porcupine Lake. There are no known sites of any plants listed as noxious by the State of California or the Shasta-Trinity National Forest.

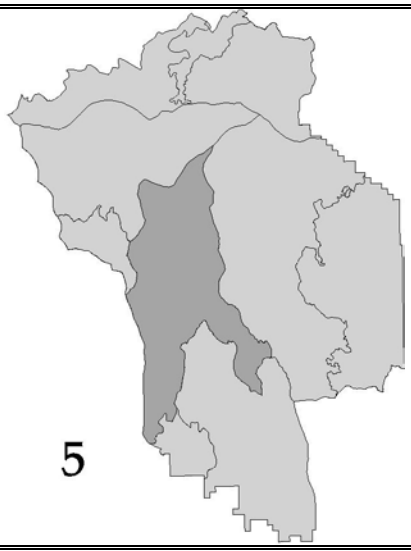
Fire Regime and Fuels: Described as an infrequent, moderate to high intensity fire regime. Large contiguous patterns of potential high intensity fuels are seen here. Large investments/concerns due to major power line route. Hazard/Risk is as follows: High: 60%, Moderate: 35%, Low: 5%	***Habitat Description:*** Generally poor productivity makes this area low value to most wildlife. Woody debris and snags far below forest standards due to natural limitations and fire in most areas, but also logging in the conifer brush lands. Mid and early seral stages are dominant with no old growth, but a few very old trees scattered in areas inaccessible to logging. Diversity generally poor, but may have lava tubes and ice caves vital to sensitive bats, deer and other wildlife. Habitat improved with guzzlers.
Wildlife and Game Species: Typical of the interior Rocky Mountains dry mixed conifer type or Ponderosa Pine Type. Deer have the most economic interest. Caves have several undescribed species of arthropods, or very long-range extensions of known species.	***Species of Concern (Plants/Wildlife):*** T&E and S&M animal species likely absent. No TES plant species are known to occur in this land type. No S&M fungi or bryophytes have been found in this land type. Sensitive big-eared bats resident, with possible seasonal use by pallid bats. Goshawks and marten likely absent. MIS species would be the Open habitat Assemblage, with many members missing due to poorer dry habitat.
Dominant Land Uses: Timber production and management of utility corridors.	***Heritage Resources:*** A few prehistoric obsidian scatters are located within the landform. Railroad logging took place in the southern portion of the landform after 1920, and two historic sites have been recorded.
Management Prescriptions: Matrix – 98% (0, 0, 98) Special Area Management – 2% LSR – 0% Private – 0%	***Range:*** The Hambone sheep allotment permittee avoids this area due to poor forage. Useless for cattle and sheep. Allotment may be cancelled.

LAND TYPE NAME: HAMBONE **LAND TYPE NUMBER:** 3 **SIZE:** 21,910 ACRES **PERCENT OF WATERSHED:** 15%	
Land Type Description: This formation was defined by Gardner (1964). The Hambone formation is a basalt flow of the Pliocene epoch (up to 10mm years old). Since its formation it has undergone extensive faulting, resulting in a terrain of broad, gently sloping dip slopes and steep fault scarps. The fault scarps typically form outwash terraces at the base.	***Geology:*** Vesicular Pahoehoe Pliocene lava flows. These flows are typically punctuated by cinder and lava cones, horst and graben morphology.
Hydrology: The majority of hydrologic surface features are concentrated in this land type. Wet meadows, intermittent streams, seasonal springs and intermittent and perennial ponds occur in association with fault scarps.	***Soils:*** Soils of the Hambone formation are typically alfisols on the dip slopes and inceptisols on the terraces. Forests on the dip slopes are typically mixed conifer with black oak. Stands on the terraces are typically ponderosa pine/ bitterbrush.
Primary Vegetation Type*:* Pine dominated mixed conifer/Black oak. Mixed conifer species include white fire, lodgepole pine, incense cedar and small amounts of sugar pine. Primary shrub species include green-leaf manzanita, serviceberry, Bloomer's goldenbush, bitterbrush and gooseberry. Most stands fall between early (30-60 years old) and Mid (60 – 120 years old) seral stages. There are scattered predominate conifers through out the area.	***Secondary Vegetation Type(s):*** Mixed conifer-Black oak, Ponderosa pine/Bitterbrush, White fir types, Lodgepole pine stands, ponderosa pine plantations, open grasslands and a system of degraded, seasonally wet meadows and aspen stands. Meadows and aspen stands are in a degraded condition due to a lack of disturbance, especially the exclusion of fire, and other timber management practices that have encouraged conifer and shrub encroachment into these habitats. The building of roads has also impacted most meadows. Whitlow Lake is a vernal pool that would also benefit from the re-introduction of fire to rejuvenate grass and grass-like species. There are no known sites of any plants listed as noxious by the State of California or the Shasta-Trinity National Forest.

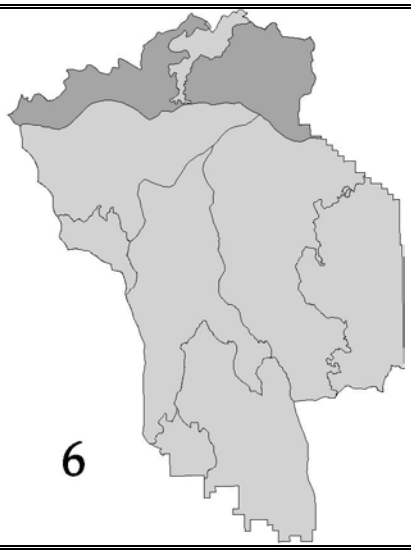
Fire Regime and Fuels: Described as an infrequent, moderate to low Intensity fire regime displaying the most prominent changes from its historical, frequent, low intensity regime description. The Hazard/Risk is as follows: High: 30%, Moderate: 65%, Low: 5%.	***Habitat Description:*** Productivity fair to good due to excellent mosaics of timbered ridges with valley meadows. The best elk and deer situation on the district, and excellent variety for birds and raptors due to good diversity potential. No old growth forest, has limited snags/woody debris, has decadent aspen stands. Water potentially available, especially in wet years, but sometimes aided by dugout ponds in meadow aquifers. Whitlow Lake large and intermittent, presenting unusual T&E shrimp habitat. Occasionally used by ducks in early spring.
Wildlife and Game Species: Typical of the interior Rocky Mountains dry mixed conifer type or Ponderosa Pine Type. Harvest species predominantly deer, with some elk, bear, turkey, and grouse. Deer and elk have the most economic interest. Caves have several undescribed species of arthropods, or very long-range extensions of known species. Many neotropical bird species near waterholes.	***Species of Concern (Plants/Wildlife):*** Endangered tadpole shrimp has high biological interest. S&M animal species likely absent. Sensitive big-eared bats reside here, with possible seasonal use by pallid bats or marten. Great gray owls are possible. Goshawks nest near waterholes or buttes. MIS species would be the Open habitat Assemblage and Riparian Assemblage. Plant species of concern in this land type are the sensitive species *Calochortus longebarbatus var. longebarbatus* (Long-haired star tulip) and aspen (*Populus tremuloides*). Aspen falls into this category because of wildlife habitat and species diversity issues. Aspen stands have decreased in size considerably due to the exclusion of fire and other timber management practices. There are several populations of *Gomphus bonari,* a S&M Category B Fungi species, along the western edge of this land type.
Dominant Land Uses: Timber production, management of utility corridors, wildlife habitat management and dispersed recreation.	***Heritage Resources:*** Although a few prehistoric sites have been recorded, the Hambone landform area is particularly rich in historic sites resulting from logging activities of the McCloud River Lumber Company. One sheep ranch abandoned in 1946 is also present.
Management Prescriptions: Matrix – 98% (2, 6, 90) Special Area Management – 0% LSR – 0% Private – 1%	***Range:*** Best part of Hambone Sheep Allotment. Poor for cattle, fair for sheep, excellent for deer, elk, bear, grouse, and other wildlife, especially in seasonally wet meadow areas with waterholes. Allotment may cancel.

LAND TYPE NAME: BLACK FOX **LAND TYPE NUMBER:** 4 **SIZE:** 7,065 ACRES **PERCENT OF WATERSHED:** 5%	
Land Type Description: Bear Mountain is a typical volcanic butte. It rises from a nearly level surrounding plain. Typical slopes are 20 to 45%.	***Geology:*** Tertiary lava cones. This formation consists of Bear Mountain in the Porcupine Watershed. It is part of the much larger Black Fox Uplands in the Bartle Watershed to the west. This formation is mapped by the California Geological Survey as "undifferentiated tertiary". It is believed to be early Pliocene in age. Typically these cones are traversed by more recent north-south trending normal faults.
Hydrology: Area is almost completely devoid of surface hydrologic features. No streams or springs occur within the land type despite the steeper topography (20-45% slopes). Seasonal wet meadows occur on the northeast base of Bear Mountain and east of Toad Mountain.	***Soils:*** Soils are shallow to moderately deep on the upper slopes with white fir/red fir forests. Lower flanks typically exhibit deep soils with mixed conifer forests. Surrounding the mountain are soils with seasonally high water tables, these areas support mixed conifer stands with inclusions of willows and lodgepole pine.
Primary Vegetation Type: Mixed conifer-Black oak and Mixed conifer-Pacific dogwood. Mixed conifer includes Douglas fir, white fir, ponderosa pine, sugar pine and incense cedar. Common shrubs are green-leaf manzanita, gooseberry, shrub chinquapin, snowbush, serviceberry and chokecherry. Most stands fall between early (30-60 years old) and Mid (60 – 120 years old) seral stages. There are scattered predominate conifers through out the area.	***Secondary Vegetation Type(s):*** Ponderosa pine dominated mixed conifer, pure stands of white fir, lodgepole pine, ponderosa pine plantations and a small amount of open grasslands. There are no known sites of any plants listed as noxious by the State of California or the Shasta-Trinity National Forest.
Fire Regime and Fuels: Described as an infrequent, moderate to low Intensity fire regime displaying the most prominent changes from its historical, frequent, low intensity regime description. Higher elevations show less transitions. Vertical stand structure once more open is now dense. Hazard/Risk is as follows: High: 50%, Moderate: 47%, Low: 3%.	***Habitat Description:*** Productivity fair to good due to excellent mosaics of timbered ridges with valley meadows. Good elk and deer situation on the district, and excellent variety for birds and raptors due to good diversity potential. Lacks old growth forest, has limited snags/woody debris, has decadent aspen stands. Water available in wet years, aided by artificial dugout ponds into meadow aquifers.

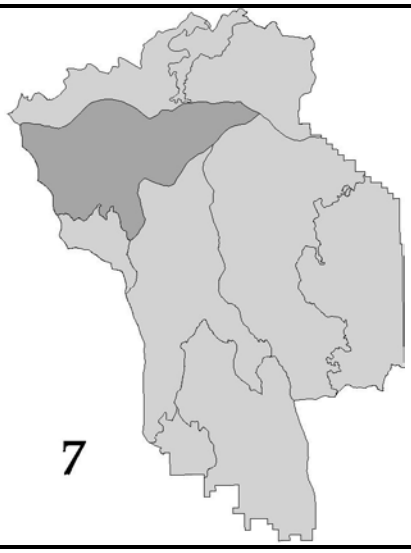
Wildlife and Game Species: Typical of the interior Rocky Mountains dry mixed conifer type or Ponderosa Pine Type. Harvest species predominantly deer, with some elk, bear, turkey, and grouse. Deer have the most interest. Many neotropical bird species near waterholes.	***Species of Concern (Plants/Wildlife):*** Threatened spotted owls were heard once, but would be unlikely to have an activity center. Sensitive big-eared bat has high biological interest. Possible seasonal use by pallid bats. Goshawks and marten may nest near water or buttes. S&M animal species are probably absent. MIS species would be the Open habitat Assemblage and Riparian Assemblage. There are no known populations of T&E plant species. There are several populations of *Gomphus bonarii,* a Category B, S&M fungi species, north and east of Bear Mountain.
Dominant Land Uses: Timber production, wildlife habitat management and scenic corridor management.	***Heritage Resources:*** There are very few heritage sites recorded within this landform.
Management Prescriptions: Matrix – 93% (1, 8, 84) Special Area Management – 0% LSR – 7% Private – 0%	***Range:*** Part of Hambone Sheep Allotment, mostly too steep to graze. Poor range for cattle, fair for sheep, excellent for deer, elk, and bear in seasonally wet meadow areas or foot slopes. Allotment may be cancelled.

LAND TYPE NAME: TOAD LAKE **LAND TYPE NUMBER:** 5 **SIZE:** 23,762 ACRES **PERCENT OF WATERSHED:** 16%	
Land Type Description: The Toad Lake LTA is underlain by basalt flows that were formed in the Pleistocene Epoch. At the end of the Pleistocene this area was inundated by glacial outwash deposits that buried much of the lava flows. The resulting terrain is characterized as rocky outcrops and alluvial terraces.	***Geology:*** Pleistocene vesicular basalt lava Flows, outwash and fluvial deposits.
Hydrology: Area is almost completely devoid of surface hydrologic features. Several seasonal ponds and one intermittent Lake occur within the land type.	***Soils:*** The rocky outcrops exhibit minimal soil development and support sparse stands of ponderosa pine/bitterbrush. The outwash terraces support stands of lodgepole pine mixed with ponderosa pine and white fir.
Primary Vegetation Type: Ponderosa pine-mixed conifer is the primary vegetation type in the Toad Lake Land Type. Most stands are in the early (30-60 years old) and mid (60-120 years old) seral stages, with most stands being between 50 and 70 years of age. Scattered predominate conifers, primarily ponderosa pine, incense cedar and sugar pine are found through out the area. Bitterbrush, serviceberry, green-leaf manzanita and gooseberry are common shrubs.	***Secondary Vegetation Type(s):*** Lodgepole pine, white fir, shrubs and open grasslands. There are struggling aspen stands throughout the area especially at Lava Crack Springs, Toad Well, White Deer Lake, Toad Lake and Mud Well. Toad Well and Mud Well are degraded meadows. White Deer Lake is actually a series of vernal pools with surrounding meadow. White Deer Lake also has one population of the sensitive plant *Rorripa columbiae* (Columbia yellow cress). Toad Lake is also a vernal lake. White Deer Lake, Toad Lake and Mud Well have been modified by at least one water development. White Deer Lake has two dug out ponds. There are no known sites of any plants listed as noxious by the State of California or the Shasta-Trinity National Forest.

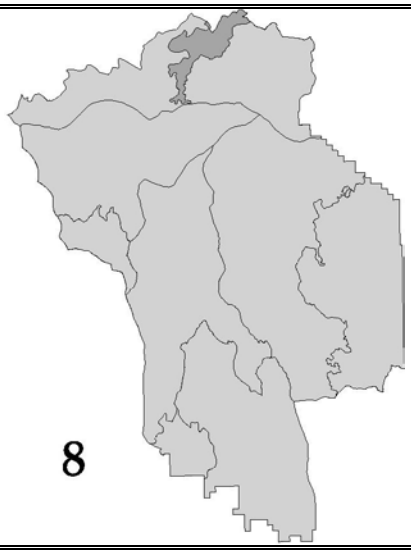
Fire Regime and Fuels: Described as an infrequent, moderate to low Intensity fire regime displaying the most prominent changes from its historical, frequent, low intensity regime description. Large components of lodge pole pine and mix conifer in a historical pine dominated regime. The Hazard/Risk is as follows: High: 25%, Moderate: 50%, Low: 25%.	***Habitat Description:*** Productivity fair due to some mosaics of timbered buttes with spring-fed meadows. A fair deer situation, with some diversity for birds and raptors. Lacks old growth forest, has limited snags/woody debris, decadent aspen. Water potentially available, especially in wet years, but some help made up by dugout ponds into shallow aquifers. White Deer Lake intermittent, presenting unusual shrimp. Duck habitat in wet years.
Wildlife and Game Species: Typical of the interior Rocky Mountains dry mixed conifer type or Ponderosa Pine Type. Harvest species predominantly deer, some elk and bear. Deer have the most economic interest. Caves have several undescribed species of arthropods, or very long-range extensions of known species.	***Species of Concern (Plants/Wildlife):*** Threatened spotted owls present six years ago. Endangered tadpole shrimp at White Deer Lake. Possible seasonal use by pallid bats and marten. Goshawks near water or buttes. S&M animal species probably absent. MIS species would be the Open habitat Assemblage and Riparian Assemblage. Plant species of concern include known populations of *Rorripa cloumbiae*, a sensitive plant. Two species of S&M, Category B fungi e present, *Gomphus bonarii,* north of Bear Mountain and *Cortinarius verrucisporus* east of Big Sand Flat.
Dominant Land Uses: Timber production, fuelwood cutting, dispersed recreation and wildlife habitat management.	***Heritage Resources:*** This landform is rich in prehistoric obsidian workshops and historic railroad logging sites, some of them very large. Prehistoric sites are concentrated around the Lost Iron Wells obsidian source, water sources such as Toad Well and Mud Well, and the 'lava crack' on the eastern edge of the landform. Numerous sites related to McCloud River Lumber Company railroad logging date approximately 1910 to 1919. Remnants of sheep grazing camps and dugout ponds persist near meadows.
Management Prescriptions: Matrix – 74% (6, 32, 36) Special Area Management – 2% LSR – 0% Private – 24%	***Range:*** Part of Hambone Sheep and Toad Allotments. Poor for cattle, fair for sheep, good for deer, elk, and bear in seasonally wet lake and meadow areas south of Toad Mountain. Very poor north of Toad Mountain.

LAND TYPE NAME: GRASSHOPPER **LAND TYPE NUMBER:** 6 **SIZE:** 21,474 ACRES **PERCENT OF WATERSHED:** 14%	
Land Type Description: The basaltic andesite flows of the Grasshopper LTA are part of the flanks of the Medicine Lake Volcano. They are generally considered to be Pliocene in age but are overlain in most areas by tephra or outwash deposits. It is a gently sloping terrain with frequent outcrops. Several cinder cones erupted in the area in the Holocene.	***Geology:*** Pliocene basaltic lava flows punctuated by cinder and lava cones.
Hydrology: Area is almost completely devoid of surface hydrologic features. No streams occur within the land type. Groundwater flow predominates.	***Soils:*** Soils are moderately deep and very cobbly.
Primary Vegetation Type: Red fir dominated mixed conifer/montane chaparral. Red fir-mixed conifer is a mixture of red fir, white fir, sugar pine, white pine incense cedar and lodgepole pine. Shrub species include Scouler's willow, snowbush, bush chinquapin, gooseberry, manzanita and bitter cherry.	***Secondary Vegetation Type(s):*** White fir, mixed conifer, montane shrubs, lodgepole pine and scattered grasslands. Ponderosa pine is found at the lower elevations in this land type. Grasshopper Flat is an example of an open grassland combined with bitterbrush, gooseberry and willow. There are no known sites of any plants listed as noxious by the State of California or the Shasta-Trinity National Forest.
Fire Regime and Fuels: Described a s a very infrequent, moderate to high intensity fire regime. This high elevation fir/lodge pole regime has shown little change from its historical pattern. Hazard/Risk is as follows: High:15%, Moderate:75%, Low:10%	***Habitat Description:*** Generally poor productivity makes this area low value to most wildlife. Woody debris and snags far below forest standards due to natural limitations and fire in most areas, but also logging in the conifer brush lands. Mid and early seral stages are dominant with no old growth, but a few very old trees scattered in areas inaccessible to logging. Diversity is generally poor, but has lava tubes and ice caves vital to bats, deer and other wildlife. Habitat improved with guzzlers.

Wildlife and Game Species: Area generally so low in productivity that species presence and distribution is limited in this dry mixed conifer type. Harvest species predominantly deer near water, very few bear and elk. Caves have several undescribed species of arthropods, or very long-range extensions of known species.	***Species of Concern (Plants/Wildlife):*** T&E and S&M animal species probably absent. There are no known populations of TES plant species in this land type. There is one known site for *Gastroboletus subalpinus* and Two sites for *Ptilidium californica. G. subalpinus* is a Category B, S&M fungi, and *P. californica* is a Category A, S&M bryophyte. In this area, *P. californica* habitat is the base of older white firs. There are several populations of *Allotropa virgata* (sugar stick). This plant species is no longer on the Region 5 sensitive plant list, but is still considered a plant of special concern for the Shasta-Trinity. Most populations are in the area of Red Cap Mountain. Habitat for *A.virgata* in this area is red fir-lodgepole pine at elevations above 5,000 feet. Sensitive marten and goshawks present near water sources (including ice caves), but uncommon. MIS species would be the Open habitat Assemblage.
Dominant Land Uses: Timber production, dispersed recreation, cultural and spiritual values and potential geothermal development.	***Heritage Resources:*** Large number of prehistoric heritage sites in the Grasshopper Flat area as well as a continuing use of traditional sites by Native Americans. Of primary importance to prehistoric peoples was the large obsidian quarry at Grasshopper Flat. Recorded obsidian workshop sites surround the quarry site.
Management Prescriptions: Matrix – 92% (6, 18, 68) Special Area Management – 3% LSR – 1% Private – 5%	***Range:*** Not in an allotment. Useless for cattle or sheep, poor for deer. Almost no wet meadows.

LAND TYPE NAME: NINEBUCK **LAND TYPE NUMBER:** 7 **SIZE:** 21,092 ACRES **PERCENT OF WATERSHED:** 14%	
Land Type Description: This LTA is typified by buttes, such as Harris Mt., and Nine Buck Butte and cinder cones including Oso Butte and Cub Hill. The terrains separating these features are a nearly level post-glacial outwash terraces and lava flows. The buttes and cones slope up to 45%.	***Geology*:** Pleistocene lava and cinder cones, outwash terraces, and vesicular basalt lava flows.
Hydrology: Area is almost completely devoid of surface hydrologic features. No streams or springs occur within the land type. Groundwater flow predominates.	***Soils:*** Terrace and cinder cones soils are deep and gravelly, sideslope and lava flow soils are moderately deep.
Primary Vegetation Type: The dominant vegetation types are pure stands of white fir and white fir dominated mixed conifer. There are a few predominant trees scattered throughout the area. Most stands are between 30 and 80 years of age. The white fir mixed conifer stands may include red fir, white pine, sugar pine, ponderosa pine and incense cedar. Combinations of species determined by elevation and microclimates usually involving aspect.	***Secondary Vegetation Type(s):*** Terraces support lodgepole pine stands and ponderosa pine plantations. Buttes and lava flows support mixed conifer forests that include equal proportions of ponderosa pine and white fir. Grasslands are few. Pine plantations cover a fairly large percentage of area in this land type due to brush conversions and clear cutting during the 60's and 70's. There are no known sites of any plants listed as noxious by the State of California or the Shasta-Trinity National Forest.
Fire Regime and Fuels: Described as an infrequent, moderate to low Intensity fire regime displaying the most prominent changes from its historical, frequent, low intensity regime description. The Hazard/Risk is as follows: High: 50%, Moderate: 45%, Low: 5%.	***Habitat Description:***

Wildlife and Game Species: Typical of the interior Rocky Mountains dry mixed conifer type or Ponderosa Pine Type, but limited by poor habitat and climate. Harvest species predominantly deer, few elk and bear. Deer have the most economic interest. Caves have several undescribed species of arthropods, or very long-range extensions of known species.	***Species of Concern (Plants/Wildlife):*** Threatened spotted owls present six years ago. Possible seasonal use by pallid bats. Goshawks and marten near water or buttes. S&M animal species probably absent. There are no known populations of TES plant species. There are two populations of *Gastroboletus subalpinus*, a S&M, Category B fungi and one population of *Ptilidium californica*, a S&M, Category A bryophyte. MIS species would be the Open habitat Assemblage and Riparian Assemblage.
Dominant Land Uses: Timber production, wildlife habitat management, fuelwood cutting and scenic corridor management.	***Heritage Resources:*** A number of obsidian workshop sites extend into this landform, particularly where it intersects the edges of the Giant Crater Lava Flow and other recent lava outcrops. Historic sites include a number of examples of early railroad logging camps and other features.
Management Prescriptions: Matrix – 80% (1, 3, 76) Special Area Management – 0% LSR – 8% Private – 11%	***Range:*** Mostly not in an allotment. Useless for cattle or sheep, poor for deer. Almost no wet meadows.

LAND TYPE NAME: LITTLE GLASS MOUNTAIN **LAND TYPE NUMBER:** 8 **SIZE:** 2,985 ACRES **PERCENT OF WATERSHED:** 2%	
Land Type Description: The Little Glass Mt. LTA is defined as cinder cones and lava flows buried in a deep mantle of rhyolite pumice. In the Pleistocene eruptions on the lower flanks of the Medicine Lake Volcano created a landscape of buttes and cinder cones. About 1200 years ago a large eruption occurred which deposited pumice over approximately 30 square miles. After the pumice eruption, obsidian whelled up from the vent and created Little Glass Mt., an obsidian flow about 1 mi^2 in area. The deepest pumice deposits (2ft. to 20 ft. thick) are included in this LTA and encompass about 15 $mi.^2$ At approximately the same time a cinder cone formed at Paint Pot Crater. This was followed by a flow of rhyolitic scoria that emanated from Paint Pot Crater. The flow is about one mile in length.	***Geology:*** Pleistocene and Holocene basalt lava flows, cinder cones and plug dome volcanoes. Deep pumice deposits.
Hydrology: Area is almost completely devoid of surface hydrologic features. One seasonal pond (Pumice Stone Well) occurs within this land type between Pumice Stone Mountain and Little Glass Mountain.	***Soils:*** Soils are composed mainly of pumice and cinders.
Primary Vegetation Type: Typical forest type in this land type is lodgepole pine in the basins amid the buttes, cinder cones and areas of excessive pumice over burden.	***Secondary Vegetation Type(s):*** There is a small amount of red fir mixed conifer, small amounts of open grassland and small amounts of montane chaparral in the area of Little Mt. Hoffman. There are no known sites of any plants listed as noxious by the State of California or the Shasta-Trinity National Forest.

Fire Regime and Fuels: Described a s a very infrequent, moderate to high intensity fire regime. This high elevation fir/lodge pole regime has shown little change from its historical pattern. Hazard/Risk is as follows: High:0%, Moderate:10%, Low:90%	***Habitat Description:*** Generally poor productivity makes this area low value to most wildlife. Woody debris and snags far below forest standards due to natural limitations and fire in most areas, but also logging in the conifer brush lands. Mid and early seral stages are dominant with no old growth, but a few very old trees scattered in areas inaccessible to logging. Diversity generally poor, but may have lava tubes and ice caves vital to sensitive bats, deer and other wildlife. Habitat improved with guzzlers.
Wildlife and Game Species: Area generally so low in productivity that species presence and distribution is limited in this dry mixed conifer type. Harvest species deer where water is available. Caves have several undescribed species of arthropods, or very long-range extensions of known species.	***Species of Concern (Plants/Wildlife):*** T&E and S&M animal species probably absent. Sensitive marten and goshawks present near water sources or buttes, but uncommon. There is one plant species of special concern in this land type. One of the five known locations in California of *Collomia larsenii*, Tallus collomia, is located at Little Mt. Hoffman near the lookout. Habitat has been degraded by the building of the road up to Little Mt. Hoffman and by foot traffic from visitors to the lookout. This plant occurs on volcanic talus slopes at elevations above 7,000 feet. Other populations are near Mt. Lassen. There are no known populations of S&M fungi or bryophytes in the land type. MIS species would be the Open habitat Assemblage.
Dominant Land Uses: Management of the Modoc Volcanic Scenic Byway, Cultural and spiritual values, Developed recreation at Little Mt. Hoffman and geologic special interest area management.	***Heritage Resources:*** Few recorded Heritage sites within this land type, but Little Glass Mountain lies within the Medicine Lake Area Traditional Cultural Places District, and contains ethnographic sites that are still in use by Native Americans for cultural and ceremonial purposes.
Management Prescriptions: Matrix – 60% (35, 23, 2) Special Area Management – 40% LSR – 0% Private – 0%	***Range:*** Useless for cattle or sheep, poor for deer. Few seasonally wet meadow areas. No allotment.

3.2 Human Uses

3.2.1 Heritage Resources

Heritage resources in the Porcupine Watershed are described according to the landform they are associated with.

Grasshopper Flat: Heritage sites include the large obsidian quarry at Grasshopper Flat as well as more than 30 obsidian workshop sites dating over the past 8,000 to 10,000 years. Distribution is not random; rather sites tend to cluster near the edges of the Giant Crater Lava Flow and other recent lava outcrops, presumably because of the presence of ice or water which lasts into the summer season. Grasshopper Flat is also part of the Medicine Lake Area Traditional Cultural Places District, and contains ethnographic sites that are still in use by Native Americans for collecting obsidian, medicines, and other resources, and observing spiritual beliefs and practices. The Medicine Lake Area Traditional Cultural Places District has recently been determined eligible for the National Register of Historic Places as a Traditional Cultural Property.

Little Glass Mountain: Heritage sites of historic age found within this landform are the Davis Road; a stage stop, constructed in 1904 to connect the McCloud River with a steamboat landing on Klamath Lake; and the Little Mount Hoffman Lookout, originally constructed in 1924.

There are no prehistoric "obsidian workshop" sites associated with the Little Glass Mountain flow since the obsidian is inferior quality for manufacturing artifacts. However, there is a continued use of the area by Native Americans, particularly those from the Pit River and Modoc tribes, for spiritual and ceremonial purposes, and lies within the Medicine Lake Area Traditional Cultural Places District.

Nine Buck: The type and distribution of prehistoric sites is much like that found in the Grasshopper Flat land type. Numerous obsidian workshop and quarry sites have been recorded, with many oriented around the edges of the Giant Crater Lava Flow and other recent lava flows. During the period between 1915 and 1919, after acquiring two Shay engines built for power and steep terrain, the McCloud River Lumber Company extended operations northward to the edges of the Medicine Lake Highlands. Camps, grades and other features have been recorded.

Black Fox: A few scattered prehistoric obsidian workshops and historic logging sites have been recorded on this landform.

Toad Lake: Prehistoric obsidian sites are abundant in this landform. The Lost Iron Wells obsidian source, now located on privately owned land at the northern edge of this landform, was heavily used during prehistoric times, and a large number of workshop sites lie nearby on both private and Federal land. Farther south, water sources such as Toad Well, Toad Lake, Lost Iron Well, and Mud Well drew seasonal habitation. Along the eastern edge, obsidian scatters are concentrated along the "lava crack," presumably because water or ice was available into the summer months.

Railroad logging activities, conducted by the McCloud River Lumber Company, began in the area with the construction of the mainline northward from Bartle to the vicinity of Harris Mountain. From this point, grades extended eastward to the edge of the lava flows, and a number of large logging camps have been recorded as archaeological sites.

Giant Crater: A few prehistoric sites have been recorded within the interior of the Giant Crater Lava Flow. These are not concentrated, and are associated with suitable soil and vegetation. A large number of obsidian workshop sites lie along the northern and western margins, some within the land form and some adjoining.

Railroad grades were extended into the southern portion of the Giant Crater landform in the early 1920s, and a large logging camp has been recorded at Chippy Spur.

Porcupine Lava Flow: A small number of prehistoric obsidian scatters have been recorded within the land form. Railroad logging by the McCloud River Lumber Company extended into the land form after 1920 and two sites, the "Porcupine cinder pit" and a segment of railroad grade with spurs and switchbacks, have been recorded. The historic Mayfield Road crossed the southern edge of the landform.

Hambone: A few prehistoric obsidian scatters are recorded within the Hambone landform area. However, this landform is particularly known for sites of the McCloud River Lumber Company, which represent a new phase in railroad logging. Between 1920 and 1928, the Company extended their mainline into the landform and established a large, centralized camp at Hambone that included housing, a school, post office and repair shop. The McCloud River Lumber Company railroad logging system has been found eligible for the National Register of Historic Places, with many of the recorded sites contributing to its significance.

3.2.2 Timber Management

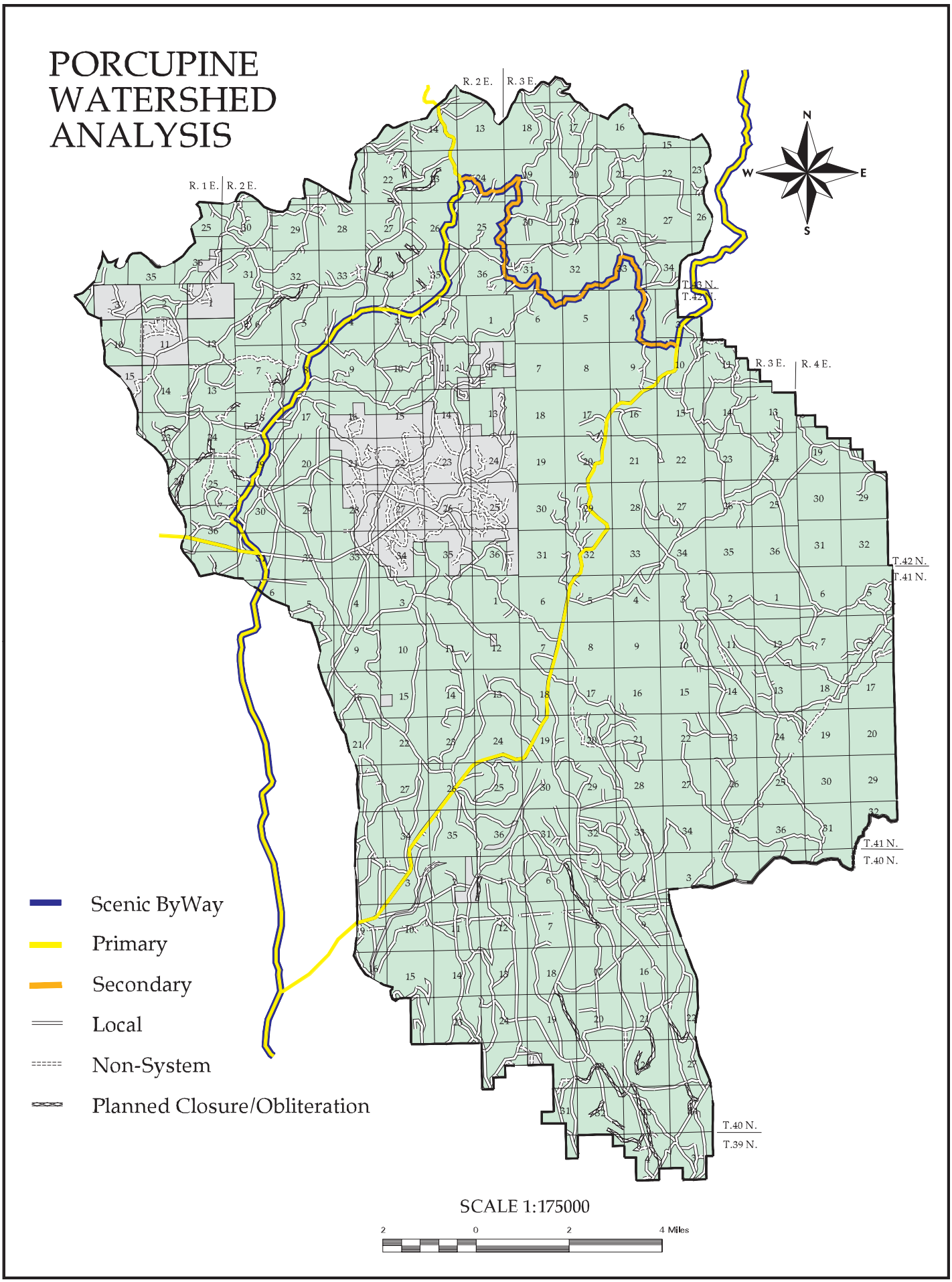
Timber harvest has been and continues to be the dominant land-use activity occurring within the Porcupine Watershed. At the time of the writing of this analysis, there are currently 7 timber sales under contract on National Forest lands within this watershed. These sales cover approximately 11,000 acres and will result in the removal of an estimated 40 MMBF of saw logs and biomass material over the next three to five years. The predominant silvicultural treatment for all these sales is commercial thinning, removing pole size and small saw logs from overstocked stands.

Three timber sales are currently being planned within the watershed. These sales will cover an estimated 14,000 acres and remove an estimated 100 MMBF of saw logs and biomass material starting in 2002 and continuing for the next four to six years. These sales are also predominantly commercial thinning but include approximately 900 acres of regeneration harvest. The regeneration treatment is mostly conversion of lodgepole pine and knobcone pine stands to Ponderosa pine and eventually a more mixed conifer composition.

Timber management on the private lands, mainly the Harris Mountain Tract, is mostly an individual tree selection treatment, with stands maintained in a more open, multistoried condition over there entire area.

3.2.3 Transportation

The current GIS transportation layer (4/99) shows the Porcupine Watershed has approximately 775 miles of road including 575 miles of system road and 200 miles of non-system road (Map 12 - Transportation System). This transportation layer is currently being updated. Included in the transportation system for Porcupine watershed are all or parts of the following roads:



Map 12. Transportation System

Arterial roads	Collector Roads
FA03 Mayfield	43N04 Lost Spring
FA13 Pilgrim Creek	42N32 Harris Mountain
FA15 Harris Springs	43N35 Lost Iron Well
42N17Y Oso Butte	43N70 Fisk
FA24Y Tom Young	
FA49 Powder Hill	

Most roads in the watershed were originally constructed in support of timber sale activities. There are approximately 21.5 miles of cost-share road in the area, with both Sierra Pacific Industries and John Hancock as cooperators.

The heaviest use of the road system occurs in the spring/summer/fall season when public and commercial use is at its peak. Roads in this watershed access a variety of seasonal recreational uses including hunting, dispersed camping, snowmobile, and off-highway vehicle use.

Current road density in the watershed is approximately 3.3 miles of road per square mile of land. The East McCloud Road Management Unit encompasses much of the northern part of the watershed area. This seasonal closure period coincides with deer hunting season and lasts from August to October. Many other local roads in the watershed area are closed with guardrail barricades. Existing open road density is approximately 2 miles of road per square mile.

3.2.4 Range

The Porcupine Watershed contains portions of the Hambone and Toad grazing allotments (Map 13 – Range Allotments). Toad allotment is currently active while Hambone may be cancelled for non-use. The size and distribution of allotment areas in the Porcupine Watershed is shown in Table 3-1.

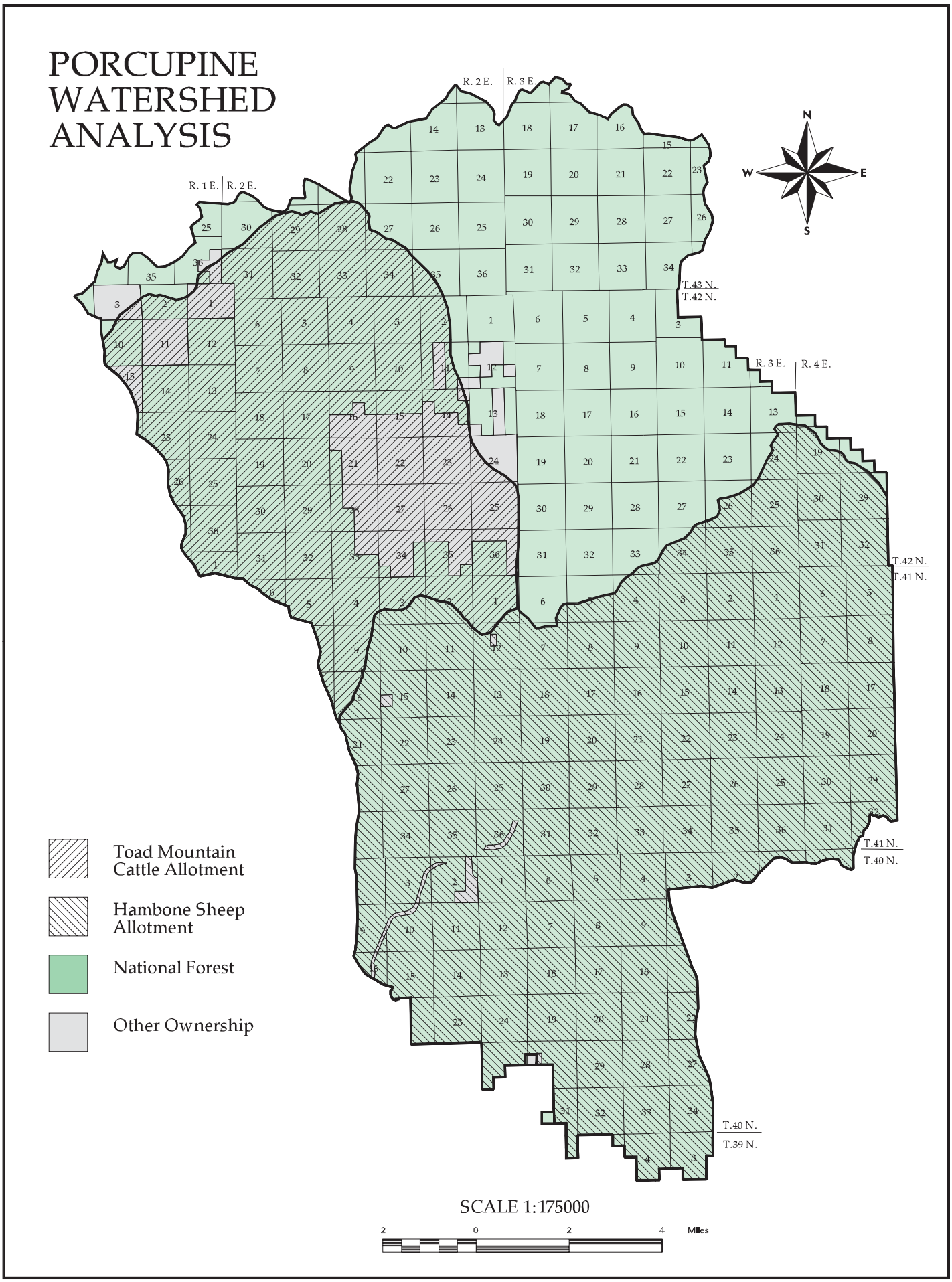
Range Allotment	Total Allotment Acres	Allotment acres within Porcupine Watershed	Percent of allotment within Porcupine Watershed	Percent of Porcupine Watershed within allotment
Toad Mountain	76,812	31,411	40.9%	21.7%
Hambone McCloud	45,747	38,561	84.3%	26.6%
Both Allotments	122,559	69972	57.1%	48.2%

Table 3-1: Range allotment information for Porcupine Watershed.

Hambone McCloud Allotment

The Hambone McCloud Allotment is a sheep allotment with an ewe/lamb permit for 1,200 sheep. The allotment is active from May 16th to October 15th. This very large allotment includes about half of the Porcupine Watershed and lower elevation lands to the west of the watershed. Grazing is concentrated on 5-50 year old clearcuts. Sheep camps generally move from one pasture to another every 3-5 days. Sheep normally do not graze in riparian areas. Sheep grazing provides weed control in plantations and fuelbreak maintenance benefiting silvicultural and fuels resources respectively.

The Porcupine Watershed contains over half of the Hambone McCloud Allotment area but only about one third of the available forage. Productivity is poor due to limited rainfall, high elevation and dry soils. Despite the low forage productivity of the land the allotment still provides enough forage for sheep due to its large area. The allotment has few effects on wildlife species. The Hambone McCloud



Map 13. Range Allotments

Allotment may be abandoned in a few years due to economic reasons and marginal productivity.

Toad Allotment

The Toad Mountain Allotment permits 100 cattle with a cow/calf permit from July 16th to October 30th. The watershed contains less than half of the Toad Allotment area, and about one tenth of the available forage. Cattle generally do not graze the north half of the allotment due to poor productivity. Water developments have not improved grazing conditions in this area.

Continuous grazing allows cattle to concentrate on riparian areas and creates distribution and control problems with chronic overutilization damage. Overutilization creates multiple conflicts with sensitive, threatened, endangered, and other wildlife species. (See the sections on sensitive plants, particularly *Rorippa columbiana* and *Iliamna bakeri.* See also under animals: tadpole shrimp, deer, goshawks, and spotted owls). Cattle often enter the allotment before the season from private land and concentrate early on riparian areas, then go to the sheep allotment into riparian areas such as White Deer Lake, Mud Well, Lava Crack and Hambone Meadows. Attempts to control cattle have mixed success.

Water Availability

Water is critical to range allotments in the watershed. Most water sources were improved to increase water availability. Spring water is insufficient for the 100 permitted cattle. Bear and Harris Springs diminish to less than one gallon per minute or dry up. Toad Lake and other well ponds are limited to areas with high water tables. Water sources in the sheep allotment are usually closed to livestock, inaccessible, or reserved for other uses and usually go dry in the summer. Permittees haul water for livestock to supplement natural sources. Hauling water raises operating costs for the allotment.

3.2.5 Geothermal Resources in the Porcupine Watershed

Geothermal Development is currently proposed in the Medicine Lake Area on the Modoc National Forest. Six sections east of Little Glass Mountain are under geothermal leases. In 1981 the Forest Service prepared an Environmental Assessment (EA) to examine the possible impacts of geothermal leasing and exploration. The Decision Notice that followed provided Forest Service consent for the Bureau of Land Management (BLM) to issue leases within the Known Geothermal Resource Area (KGRA).

In 1984 the Forest Service and the BLM prepared a joint supplemental EA to address the impacts from full-scale exploration and development. Between 1981 and 1984 all of the KGRA had been leased. During this time a total of 24 temperature gradient holes were drilled to ascertain the extent and depth of the commercial geothermal potential. Three viable fields were identified. One is immediately adjacent to the eastern boundary of the Porcupine Watershed in the vicinity of Telephone Flat on the Modoc National Forest. Another is on the Klamath National Forest at Four Mile Hill, immediately adjacent to the northwest boundary of the Porcupine Watershed. The third is at Medicine Mountain on the northern boundary of the Porcupine Watershed. Industry estimates indicate that the geothermal fields have the potential to generate hundreds of megawatts of electricity.

While most of the exploration activities have occurred on the adjacent Forests, roads on the Shasta-Trinity National Forest offer the best access and carry most of the traffic to the drilling sites. This includes large drill rigs, trucks carrying drilling steel, fuel trucks as well as many other kinds of support vehicles.

In the 18 years since the issuance of leases there has been varying levels of geothermal exploration and development activities. Development was initially spurred by a federal tax subsidy. Interest in geothermal exploration waned when the subsidy expired. When a 500kv power line was built a few miles to the east of the KGRA interest in geothermal exploration increased. Despite the cost, proponents claim that renewable and geothermal energy is in demand and that state subsidy and consumer preference will prove geothermal development viable.

In 1996 and 1997 the leasers submitted Plans of Operations to the BLM to construct and operate two 49-megawatt geothermal power plants at Four Mile Hill and Telephone Flat. Environmental Impact Statements were prepared to analyze the impacts from these projects. In 2000 the Records of Decision were issued. The proposal to develop at Four Mile Hill was approved. The proposal to develop at Telephone Flat was denied. The key issues involved in these decisions were:

- Project location relative to Medicine Lake and the caldera.
- Native American spiritual significance.
- Impacts on air and water resources.

The Four Mile Hill project is located outside of the caldera and the Telephone Flat project is within the caldera. The impacts on Native American sites at Four Mile Hill were possible to mitigate while the Telephone Flat impacts were not. The relevance of this finding to the Porcupine Watershed Analysis is that the Medicine Mountain lease is also outside of the caldera. The lease sections are in Matrix prescriptions in the Land Management Plan and have been managed as timberlands for decades. In 2001 the Calpine Corporation stated their intention to drill an exploratory well on the Medicine Mountain lease with the expectation that they would move to develop the lease within the next several years. The decision criteria that led to granting the proposal at Four Mile Hill may set a precedent for approval of the Medicine Mountain lease.

3.2.6 Geologic Special Interest Areas

Three designated GSIAs occur within the Porcupine Watershed. Each GSIA is described below.

Giant Crater Lava Tube System (GCLTS) /Spatter Cones

The GCLTS was recognized as a special interest area because of its scientific and geologic interest. The special interest area is named for Giant Crater, the largest crater on the Medicine Lake Volcano and one of the main vents of the Giant Crater Lava Flow (GCLF). The lava tube system that emanates from the crater extends approximately 30 km through the length of the GCLF. The lava tube system consists of many caves and collapsed caves. The GCLF consists of recent basalt flows; barren to semi-barren fields of lava, cinder cones, vents and caves. Much of the flow supports scattered old growth pines and cedars. It is a landscape largely untouched by the hand of man.

Spatter Cones are a series of five volcanic vents aligned along a fissure. They are 25 to 40 feet tall. When they were formed the lava was very viscous and mixed with gases. The spattering effects left a feature with cones of colorful lava and scoria. The area abuts the GCLF.

The GCLTS GSIA was designated in the LMP to recognize its unique character and geologic interest. The boundary that was drawn on the LMP maps is an inaccurate representation of the actual location of the tube system. The LMP listed Papoose Hill as a feature to be evaluated for GSIA status. Papoose Hill is located on the Giant Crater Lava Flow immediately adjacent to Giant Crater. Other geologically

significant features in the immediate vicinity are: Shastine Crater, Chimney Crater, Double Hole Crater, Jot Dean Ice Cave, Breached Crater and the Roadside Cave Complex. In addition there are many lava tube caves in the vicinity.

The features listed above generate great geologic interest. With the exception of the caves, no biological or archaeological significance is attached to these features nor do they present any unusual hazards to the public. Caves are known to often contain biologically or archaeologically sensitive resources. Many caves are dangerous. Before inviting the public to any cave or emphasizing any cave in a GSIA, the cave should be evaluated to determine what resources exist in the cave and what their sensitivity is.

The Federal Cave Resource Protection Act of 1988 directs land managers to determine potential significance of all caves on public lands. To accomplish this, the Shasta-Trinity National Forest has entered into a cooperative agreement with the National Park Service, Lava Beds National Monument to provide the services of a cave management specialist to evaluate caves in the Giant Crater GSIA and make recommendations on their management. The inventory is on going.

Cave features including Spatter Cones and Jot Dean Ice Cave have recognized archaeological importance. Both caves have interpretive signs. The Roadside Cave Complex is not considered biologically or archaeologically sensitive. The cave inventory considers these "safe" caves. Many other cave exist in the area. Some have been evaluated and judged too dangerous for those less than "expert" cave explorers.

Little Glass Mountain/Pumice Stone Mountain/Paint Pot Crater

These features were designated by the LRMP as GSIAs. Little Glass Mountain is located on the southern flank of the Medicine Lake Volcano. About 1000 years before present, what is now Little Glass Mountain erupted in an explosion of pumice that covered the landscape to the southwest with a plume 50 km long and 10 km wide. Subsequently, obsidian, volcanic glass, whelled up and buried the vent. The obsidian flow covers approximately 2 km^2.

Pumice Stone Mountain abuts Little Glass Mountain to the west. It is a cinder cone that was covered with a deep mantle of pumice from Little Glass Mountain. Paint Pot Crater abuts Pumice Stone Mountain on the south. It is a series of cinder cones that erupted after the Little Glass Mountain eruption. It is named for the many brightly hued cinders on its slopes.

The LMP listed Tilted Rock Lava Flow as a feature to be evaluated for GSIS status. Tilted Rock Lava Flow is also known as the Paint Pot Crater Flow because it emanated from the base of the Paint Pot Crater cinder cones. It is physically and geologically connected to Paint Pot Crater. The Tilted Rock Lava Flow is a landscape of rough, semi-barren lava flows with scattered old growth pines and cedars.

None of these features is known to have biological or archaeological sensitivity. The greatest potential for damage to these sites is from OHVs.

Burnt Lava Flow/Triad Crater/Deep Crater

Deep Crater was designated in the LMP as a GSIA. It is a large crater that was the main vent for the Porcupine Lava Flows. The crater is about 400 feet deep and covers about 2 km^2. The rim of the crater is cinders and scoria formations.

The LMP listed Burnt Lava Flow as a feature to be evaluated. The Burnt Lava Flow is a recent lava flow; a stark, barren landscape of jumbled lava. Most of the flow lies within the Modoc National Forest;

about 250 acres lie within the Shasta-Trinity NF. It is recognized by the Modoc NF as a GSIA.

Triad Craters are three cinder cones that were surrounded by the Burnt Lava Flow. The flow breached and filled the crater of the smallest cone. The largest cone is about 300 feet high. The Triad Craters cover about 10 acres.

None of these features has any recognized biological or archaeological sensitivity. There is no potential for damage to these features with increased public usage.

GSIA Use

The Porcupine Watershed and the GSIAs in it are geographically isolated. Visitation has been low due to the remote location and low standard roads. In 1999 the Modoc Volcanic Scenic Byway was dedicated. The route includes a portion of the Harris Spring Road, the "Dale's Trail" road and a portion of the Powder Hill Road; all within the Porcupine Watershed. The Dale's Trail segment is not up to the required standards for a scenic byway. This road system was designated largely because of the scenic and geologic interest of the volcanic landforms found along the route. When the scenic byway is completed use rates can be expected to rise.

Little effort has been invested in bringing these features to forest visitor's attention. Each of the three National Forests that encompass the Medicine Lake Highlands has a Medicine Lake area visitor's guide. These guides are old and do not fit together. The Shasta-Trinity NF field guide does not mention or describe points of geologic special interest on the Modoc NF. or vise versa. A single guide for the Medicine Lake area would be much more useful.

GSIAs in the Porcupine Watershed are not mapped or displayed in any format other than the LMP maps. The LMP maps do not accurately depict the GSIAs and they do not include many special features within or adjacent to the GSIA.

3.2.7 General Use

The Porcupine Watershed experiences low levels of widely dispersed public use. Deer hunting and mushroom gathering are the two popular recreational activities undertaken by the general public. Deer hunting occurs from mid-August to the end of October. This watershed is in the X-1 zone and permits and enforcement are the responsibility of the California Department of Fish & Game. Mushroom gathering is done both in the spring and fall seasons. During the spring the Boletus and Morel mushrooms are collected. Most of the mushroom collecting is done by local residents. Free-personal use permits are issued for mushroom collecting. During the fall, a large number of commercial mushroom collectors come to the watershed in search of the Matsutake mushroom. Charge permits are issued for this use. Approximately 400 personal use and 800 to 1000 commercial use mushroom permits are issued for mushroom collecting each year.

There are two developed recreation facilities in the watershed. The Harris Springs campground contains 20 units and receives low amounts of use during the summer season. Occupancy is generally 20 percent or less. The Little Mt. Hoffman Lookout is a public rental that receives moderate use from July through October.

Fuelwood gathering occurs throughout the summer primarily in areas of lodgepole pine on the western edge of the watershed.

Winter recreation use is limited to snowmobiling. There are approximately 20 miles of groomed snowmobile trails. Snowmobile trails are located on forest system roads that do not have snow removal during the winter months.

A limited amount of lava tube and cave exploration occurs within the watershed. Currently there is no information on the number of users who visit the watershed to explore caves.

The Modoc Volcanic Scenic Byway traverses through the watershed. The Scenic By Way is one of the more popular routes for public travel to the Medicine Lake area on the Modoc National Forest.

Permitted and authorized uses in the watershed include grazing, powerlines, railroad rights-of-way and an electronics site. Two high-voltage (500 KV) powerline rights-of-way traverse the watershed. A double line right-of-way in the far southeast corner of the watershed is permitted to Pacific Gas & Electric and the Western Area Power Administration. A single line easement just west of the PG&E/WAPA line is permitted to the Transmission Agency of Northern California (TANC) and WAPA. Activities associated with these lines are generally limited to hazard tree removal and tower maintenance. Both the McCloud River Railroad and Burlington Northern Railroad have rights-of-way on a single track through the middle of the watershed. Use of this track is generally limited to one or less trains per week. One electronics site is located on Bear Mountain in the south end of the watershed. The site consists of a PG&E repeater, a Cal North cellular repeater and a lookout operated by the California Department of Forestry.

Mineral extraction activity is confined to minor amounts of pumice from the Little Glass Mountain area. This area is also part of a larger Known Geothermal Resource Area within the Medicine Lake Highlands.

3.3 Species and Habitats

The Porcupine Watershed contains habitat for 1 Threatened and 1 Endangered Wildlife Species, 6 Sensitive Species, and an additional 4 species of special concern. These species and their status are listed in Table 3-2 and discussed in the following sections. Discussions on Survey and Manage Species, Management Indicator Species and Neotropical Migratory Birds also follow.

Wildlife Species of Concern	Status
Northern Spotted Owl	Federally Threatened
Tadpole Shrimp	Federally Endangered
Northern Goshawk	Sensitive
Great Gray Owl	Sensitive
California Wolverine	Sensitive
American Marten	Sensitive
Pallid Bat	Sensitive
Townsend's Big Eared Bat	Sensitive
Mule Deer	Game
Elk	Game
Bear	Game
Turkey	Game
Grouse	Game
Pygmy Short Horned Lizard	Local Interest

Table 3-2: Wildlife Species of Concern.

3.3.1 Threatened and Endangered Wildlife Species of Concern

Northern Spotted Owl

Status: Federally Threatened

Presence in watershed: The Porcupine Watershed is located at the edge of the range of the spotted owl. The Harris Mountain spotted owl activity center (AC #218) is in the Porcupine Watershed within the LSR (see Table 3-3). Matrix lands have no activity centers. Single transient sightings have occurred at Toad and Bear Mountains.

Landscape overview: The owl migration corridor to Harris Mountain is located outside the watershed except for the portion that passes over Oso Butte. Low use activity centers occur north of the watershed on the Klamath National Forest. Dispersal to from the Klamath to the Shasta-Trinity National Forest is unlikely due to very poor habitat at high elevations.

Survey extents: Since 1991 all reasonable habitats in the watershed (95%) have been called to protocol for migration corridors, activity centers and for timber sales. Habitat conditions at the Harris Mountain center are fair at best. Logging in 1996 fragmented the corridor leading to Harris Mountain. Owls have not been observed at Harris Mountain since 1996.

Habitat description: Owls prefer mature dense conifer forests with snags and multi-layered canopies. Surface water is present in the nest stand for local populations.

Habitat condition: Poor soils, dry climate, and low productivity combine to create poor natural habitat for the Northern Spotted Owl. Cattle grazing may be reducing prey numbers and diversity for owls. Timber harvest removed most snags and large woody debris for prey. The current condition of existing late-successional habitats indicate that vegetation management activities could be used to create quality habitat on the south and west edge of the watershed.

Owl AC#	Status	Status Verified	Reproduction Verified
218	Pair	1989(X); 1990(U); 1991(PY); 1992(P); 1993(U); 1994-96(P); 1997-02(X)	1991 (one young) No young since.

Table 3-3: Current status and survey history of spotted owl Activity Centers within the Porcupine Watershed. Based on data through 1998 field season.

(P) = Pair (TS) = Territorial Single (Y) = Young
(S) = Single (M/F) = Male/Female - no pair (U) = Unknown
(X) = No detection

Tadpole Shrimp

Status: Federally Endangered

Presence in watershed: Found in White Deer Lake and Whitlow Lake.

Landscape overview: Local populations are high elevation in atypical habitat. Largest population is in Dry Lake west of watershed.

Survey Extents: All local intermittent lakes have been surveyed, but no protocol exists. More locations are unlikely (e.g., Julia Glover, Powerline, Sand Meadow), but could occur.

Habitat description: Intermittent shallow lakes and ponds below 5000' elevation.

Habitat condition: Intermittent lake habitats are in poor condition. Intermittent lakes are affected by overgrazing and OHV use. Recreation vehicle impacts include compaction and rutting of approximately 10% of the lakebeds and are minor compared to grazing impacts. All intermittent lakes have populations of alien weeds and constructed ponds, some of which have been illegally planted with fish.

Elimination of natural fire has resulted in conifer encroachment around the lakes, which may influence water table elevations. Encroaching conifers are killed off during prolonged wet periods.

3.3.2 Sensitive Species of Concern

Northern Goshawk
Status: Forest Service Sensitive, Federal and California Species of Concern
Presence in watershed: Sightings in new and old territories have declined since 1991. Goshawk territories and the most recent activity in each territory are listed below.

Harris A; active 1995	Harris B; active before 1990
Fawn Hill; active 2001	Hambone Butte; active 1992
Grasshopper lower; active 1996	Six Shooter Butte; active before 1988
Hunter Hill; active before 1990	Lost Iron Well; active before 1990
Toad Mountain; active before 1990	Mud Well; active before 1990
Sand Flat; active before 1990	Dry Lake; active before 1990

Landscape overview: Local populations may occupy marginal habitat, always near water.
Survey Extents: All moderate and high quality habitats have been surveyed. Survey intensity and area vary annually. Documented nest sites are checked periodically.
Habitat description: Mature dense conifer forests with openings, riparian preference.
Habitat condition: Low capability goshawk habitat. Cattle suppress prey base numbers and diversity in or near riparian areas. Logging fragmented and removed most habitats by 1991.

Great Gray Owl
Status: FS Sensitive, California Endangered.
Presence in watershed: No great gray owls have been found in this watershed. Gray owls may eventually be found in the best potential habitat at Sand/Caribou Meadows.
Landscape overview: Found in meadows near Medicine Lake.
Survey Extents: All moderate and high quality habitats have been surveyed. Surveys have found no great gray owls in this watershed.
Habitat description: Meadows over ten acres are preferred with surface water and forest edge habitat.
Habitat condition: Older forests and snags are very limited. Cattle grazing has suppressed prey base numbers and diversity near Toad Lake meadows. Fire prevention has altered local ecology.

California Wolverine
Status: Forest Service Sensitive, Federal and California Species of Concern.
Presence in watershed: Non-professional reports occur, species is likely not present.
Landscape overview: Scattered unconfirmed sightings in adjacent western forests.
Survey extents: Intensive furbearer surveys in and adjacent to this watershed indicate a few marten and no wolverine are present.
Habitat description: Large areas of remote, dense forest with riparian habitat for prey.
Habitat condition: Older forest habitats are very limited. Cattle grazing suppresses prey base numbers and diversity, especially near Toad Lake meadow. Fire prevention has altered local ecology.

American Marten
Status: Forest Service Sensitive, California Species of Concern
Presence in watershed: Marten have been observed near Bear Springs (west edge) and Pumice Pond.

Landscape overview: Marten are uncommon but widespread elsewhere.
Survey extents: Formal surveys indicate a large population west of the watershed on Buck Mountain and a few on associated buttes north into the Klamath National Forest.
Habitat description: Mature conifer forest types over 4000 feet, with riparian habitat.
Habitat condition: The best habitat is near Harris Mountain, Oso Butte, and Bear Mountain. Older forest habitats and snags are very limited. Cattle grazing suppresses prey base numbers and diversity, especially near Toad Lake meadow. Fire prevention has altered local ecology.

Pallid Bat
Status: Forest Service Sensitive, California Species of Concern
Presence in watershed: Pallid bats were not observed but are widespread in California.
Landscape overview: Pallid bats are uncommon but known on Modoc and Sacramento.
Survey extents: Sonic surveys and surveys of prominent caves are completed on an irregular basis.
Habitat description: Habitat includes a variety of forest types with snags, with riparian associations.
Habitat condition: Older forest habitats and snags are very limited. Cattle grazing suppresses prey base numbers and diversity, especially near Toad Lake meadows. Fire prevention has altered local ecology. Habitat is considered naturally marginal and may be seasonally occupied.

Townsend's Big-eared Bat
Status: Forest Service Sensitive, California Species of Concern
Presence in watershed: Big-ears have a hibernaculum in at least one cave in this watershed.
Landscape overview: Big-ears are very uncommon but have widespread colonies in the West.
Survey extents: Bat experts located several roosts and nursery colonies in the watershed.
Habitat description: A variety of forest types with lava tube caves without human disturbance are critical to survival. Prefers forest moths in semi-riparian areas for foraging.
Habitat condition: Older forest habitats and caves are very limited. Cattle grazing suppresses prey base numbers and diversity, especially near Toad Lake meadows. Fire prevention has altered local ecology. Gates and secrecy protect some caves.

Other Sensitive Animal Species
The following sensitive species are not expected to occur due to no recorded sightings, poor habitat, and outside of normal species range:

- Swainson's hawk has not been seen in adjacent watersheds for 15 years.
- Willow flycatchers need brushy riparian habitat, no adjacent populations or habitat.
- Pacific fishers occur at lower elevations, no riparian corridors for access.
- Amphibians & aquatics--Almost all water sources are intermittent and no populations of sensitive amphibians or aquatic species have been recorded.

3.3.3 Game Species of Concern

Mule Deer
Several deer herds inhabit the watershed during the summer. The deer herds usually migrate out of the watershed in September/November. Some deer winter at Long Bell, Dana Bench, Lake Britton and North Shasta Lake. Portions of the herds return in May for fawning.

Deer habitat concerns include loss of edible herbaceous and young shrub layers in forest or riparian understory, competition with cattle, and aspen encroachment by conifers. Fire exclusion has resulted in

a shift from a mosaic of habitats to what is locally called a pine needle desert. Plowing and rototilling activities used to control competition in plantations have removed almost all edible forage species (Mangels, range inspection files). Goldenbush, needlegrass, squirreltail, and manzanita are prevalent in tilled plantations. Most grazing animals will not eat these four plants. Specific areas where habitat degradation has occurred have been surveyed and data is on file. Isolated aspen trees have been mapped as the last remnants of aspen stands vital for restoration of deer populations.

Other deer habitat, such as tree canopy, hiding cover, fawning cover, and new brush within the watershed is not limiting the herd and appears to be unimportant. Lava flows and pumice soils north of Toad Mountain have very low value for grazing animals and little potential for effective improvement.

Bitterbrush is a preferred browse for mule deer at all seasons except midwinter and before bud break. Deer arrival and departure coincides with this preferred season and hunter anecdotes testify to deer stomachs full of bitterbrush in September and October (Young, 2002). Signs of heavy grazing are unusual in this drainage, though bitterbrush is obviously used and important to the deer. Bitterbrush is very abundant and widespread, so use is likely difficult to detect except on strategically located plants (e.g., in meadows, near water). Coupled with this, at least two obvious ecotypes, the columnar and decumbent forms, are intermixed and hybridized. Additionally, deer have shown obvious preference for one bitterbrush and not the other growing beside it. Deer also eat a great variety of species, and the uncommon aspen, oak, other brush, and riparian habitats must also be important to forage diversity.

The deer herd population appears to be close to prehistoric numbers. Growth of this population is limited by several factors. Pumice soils or lava areas have such poor productivity that few deer forage there effectively. Limited dugout pond development in semi-wet meadows has not provided enough water alongside riparian forage for significant increases in fawning habitat.

Water availability is likely the greatest single factor limiting deer population size and distribution in the watershed. Water is critical in this dry watershed area for deer and elk. The most prominent and important waterholes are Toad Lake, White Deer Lake, Mud Well, Lava Crack Spring, Tamarack Lake, Lost Spring, Bear Spring, Harris Spring, Pumice Stone Well, Porcupine Lake, Whitlow Lake and the Caribou/Sand Meadow Complex south of Hambone. Recreational camping occurs at or near many of these water sources. People (often with roving dogs) camp at waterholes and prevent deer from drinking during the summer.

High road densities and high human activity (mainly timber harvest and cattle grazing) limit deer use in the watershed, displacing deer from meadow areas (Smith and Murphy, 1973). Hunters and poachers concentrate on the few waterholes available and prevent deer use as well as kill the best deer. Fire prevention allows meadow areas to grow rank with poor quality forage and timber encroachment.

The Lower McCloud Deer Herd Management Plan (1983) provides direction for managing mule deer in the Porcupine Watershed. The plan was created by the California Dept. of Fish and Game, Region I in cooperation with U.S. Forest Service, U.S. Bureau of Land Management and the U.S. Park Service. This plan describes population trends, fawning habitat and management guidelines for winter and summer range. A subsidiary study of deer distances from water in the drainage is inconclusive because the researcher was aware of only half the actual water sources present.

Elk

Elk migrate from Shasta Lake or southern areas into Porcupine watershed for summer range. An estimated 100 elk use the meadows in the southern half of the watershed. Elk concentrate in riparian timber edge habitats near meadows. Lava flows and pumice soils north of Toad Mountain have very

low value for grazing animals and little potential for effective improvement. Bitterbrush has low value for browsing on summer range and is seldom grazed by elk in this watershed. Elk sightings increase annually within the watershed (pers. communication, S. Self, 1997, Sierra-Pacific Industries, Wildlife Biologist; Smith and Murphy, 1973. District biologist Mangels, 1992-02).

High road densities and human activity (mainly timber harvest and cattle grazing) limit elk use in the watershed, displacing elk from meadows (Smith and Murphy, 1973). Hunters and poachers concentrate on the few waterholes and prevent elk use as well as kill the best bulls. Fire prevention and overgrazing have resulted in conifer encroachment and loss of quality forage in meadows.

Bear

Bear sightings mostly occur around lakes, meadows and ponds on the west and south boundaries nearer to better habitat. Poor forage conditions, lack of adequate surface water, poor prey base, and a relatively dense road system outside lava areas limit bears. The main limiting factor for bears in this area is a limited prey base and lack of quality forage. The prey base and forage are limited by both natural climatic factors and land-use activities. Bear hunting is limited in the watershed.

Turkey

Turkeys are limited by water and found only on the south edge of the watershed. Local NWTF experts agree the watershed has adequate forage and cover, but it does not have enough surface water for expansion to Toad Lake or Harris Mountain. Lava and pumice areas are unusable.

Grouse

Grouse are limited by water and found mainly on the south and west edge of the watershed. Local experts believe the watershed has adequate forage and cover, but not enough surface water for expansion to Toad Lake or Harris Mountain. The lava and pumice areas are unusable. Grouse are not common at this time, possibly due to the decline of aspen groves necessary for winter forage.

3.3.4 Neotropical Migratory Birds

Seventy-two (72) neotropical migratory birds (NTMBs) are suspected to occur within the watershed (see Appendix C). Common examples include:

- Riparian guild - Cooper's hawk, sharp-shinned hawk, yellow warbler, merlin
- Open-shrub guild - green-tailed towhee, golden eagle, prairie falcon

NTMB species are casually observed within the Porcupine Watershed. Limited habitat exists throughout the watershed. Habitat for old growth, cavity-dwelling, and riparian species is very marginal. Cattle grazing suppresses the prey base, especially near Toad Lake meadows. Fire prevention has altered local ecology.

The general Forest standards and guidelines require habitat to be managed for NTMBs to maintain viable population levels. Management to restore Riparian Reserves, fragmented forested habitat, aspen, old-growth/late seral habitat, diverse seral stages, protection buffers, snags, dispersal habitat, and special lands will help preserve and restore breeding habitat and migration corridors for NTMBs. Minimal water sources and lack of quality old growth forest limit most bird populations.

3.3.5 Other Wildlife Species of Concern

Pygmy Short-horned Lizard

The pygmy short-horned lizard, suspected to be a subspecies of the short-horned lizard (phrynosoma douglasii), occupies open semi-arid habitat in forests of eastern Siskiyou County. Kelly Zamudio proposed the pygmy short-horned lizard as a subspecies, based on genetic studies. Populations occur in Grasshopper Flat, dry pebbled meadows and clear cuts. Suitable habitat includes loose, friable soils for burrowing and hibernation and brush for thermoregulation and cover.

Populations in Grasshopper Flat occur at a density greater than elsewhere within the range of short-horned lizards (K. Zamudio, personal communication 4/96). High densities relate to the location of the suitable habitat and forested habitat restricting dispersal. Lizards disperse when the forest floor 'opens' through thinning or a natural disaster (K. Zamudio, 1992 memo).

Until 1990, pygmy short-horned lizards inhabited Big Sand Flat (K. Zamudio, pers. communication 4/96), with a substantial population before. Site preparation and cattle grazing contributed to lizard decline and possible extirpation from Big Sand Flat.

Cave Species

The district biologist surveyed local caves and sent specimens to cave biology experts. Several undescribed species are found in lava tube caves, including cyclops shrimp, diplurans, comb-foot spiders, millipedes and fungus gnats.

Fish

Toad Lake, Powerline Pond, and Julia Glover Pond were dug out to improve depth about 40 years ago. Sportsmen illegally planted these one-acre ponds with bass and bullhead. Toad and Powerline Pond always have fish, but Julia Glover Pond dries up most years.

3.3.5 Management Indicator Species

Currently, early seral stages are abundant in the watershed. Brush fields remain very extensive in many areas. Capable soils allowed brush conversion to tree plantations, which created extensive areas of early stage forest. Fire rejuvenated very little brush since the big fires before 1930. Water scarcity keeps species at low population levels except near waterholes and guzzlers.

This report is based on the consolidated list of MIS recommended the four northern province forests, draft of 8/26/02. It delineates species and assemblages, which will be jointly addressed in this report. The district biologist studied the project area in the field over 100 days.

ASSEMBLAGES

Late Seral

Late seral stages are limited in the watershed due to continuous logging and fire history. The forest needs time to re-grow to provide habitat for this assemblage. Limited water keeps the species assemblage at low population levels except near waterholes. Any occurrence of the associated species would be sporadic or irregular due to lack of almost all other old growth attributes. See the individual species discussion below, where all seven are addressed.

Snag and Down Log
This project contains very little of this type due to a preponderance of young trees from logging and fire. Snag density is usually under 1 per acre, with few prospects of sizeable snag recruitment in the next decade. Any occurrence of associated wildlife species would be sporadic or irregular.

The associated species were not observed during surveys by protocol for other species, nor observed in basic surveys. Specific surveys for the associated species would be illogical because the probability of an observation would be extremely low. The project is outside the acorn woodpecker range and too high elevation for tree swallows.

Riparian
This type occurs in the southern third of the watershed as seasonally wet meadows with very short-season intermittent streams. Any occurrence of the associated species would be sporadic or irregular.

Aquatic
This type occurs as two small perrennial ponds and no streams. Two large intermittent lakes occur, with numerous intermittent ponds. Any occurrence of the associated species would be sporadic or irregular.

Hardwood/Oak
This type occurs irregularly as black oak in the southern third of the watershed, with widely scattered aspen grove remnants of single trees. Very rarely aspen groves exceed a half acre. Any occurrence of the associated species would be sporadic or irregular due to very limited acreage and limited water.

Chaparral
This project does not contain this type in the strict sense. Large almost monotypic brushfields occur at high dry elevations or in clearcuts. Any occurrence of the associated species would be sporadic or irregular due to high elevation and limited water.

Rocks, Cliffs, and Caves
This type occurs as small outcrops to the large Giant Crater Lava fields, with occasional lava tube caves. Any occurrence of the associated species would be sporadic or irregular due to limited water.

Grassland-Shrub-Steppe/Opening and Early Seral
The area has abundant early seral stage forest. While this will diversify in a few decades, the effect will likely be minimal due to naturally poor soils, limited water, and poor climate causing very poor productivity and foraging conditions for wildlife in the northern half of the watershed. Very little can be practically done to improve the wildlife situation north of Toad Lake.

INDIVIDUAL SPECIES DISCUSSIONS

The 11 management indicator species are listed in the STNF LRMP appendix G, including habitat capability. The best population estimates available from incidental sources and DFG interviews include the likely past, present and future progress of the species in the project.

Spotted owl – Habitat generally unsuitable, with corridor use very unlikely.
Peregrine falcon -- Habitat unsuitable.
Pine marten –Habitat usually unsuitable due to very limited water and no corridors.
Fisher – Outside of range for the species, habitat unsuitable. High elevation and limited water.

Acorn woodpecker – Habitat unsuitable. High elevation and limited oak trees are factors.
Goshawk – Habitat usually unsuitable, but sometimes nests where water is found.
Black bear – See below.
Western gray squirrel – See below.
Elk – Habitat unsuitable. See below.
Mule deer – See below.
Pileated woodpecker – See below.

Summary – species to be addressed
Black bear, western gray squirrel, mule deer, elk, pileated woodpecker, and goshawk will be discussed. Limited water, limited old growth/late successional forest, limited hardwoods, limited forage diversity, limited large snags, limited large trees, and high road density result in moderate/low capability to marginal/unsuitable habitats for these species.

Black Bear
The habitat is moderate to low capability. High quality habitat includes all seral stages, mid-successional and late successional forest with more than 40% crown closure, more than 24 down logs per acre, and over 40 square feet of oak per acre. The area has abundant early seral stages (age under 100 years) with limited old growth forest. Oaks are limited to the south end. Water is absent most of the year. The better habitat is south of Toad Lake, and improves southward.

Bear populations in the area are low. Poor habitat is a local limiting factor according to California fish and game biologists/wardens. Hunting pressure from houndsmen groups is very low because few bears live here. Road density limits bear populations and hunters or black market poachers prevent normal numbers, but hunting in this project area is unusual.

The past and present populations have been relatively static due to effective hunting. The future bear population will depend on habitat improvement. Hunting pressure may prevent larger bears due to hunting selection of "trophies," but no observable change is expected.

Western Gray Squirrel
The habitat is low capability. The species prefers late-successional pine and hardwood forest, especially black oak habitat. Projects occasionally benefit this species by selecting in favor of (i.e., not harvesting) hardwoods, sugar pine, and ponderosa pine.

Populations of gray squirrel are not measured, due to low economic importance as a seldom-hunted species. They thrive near oak trees and in city streets and parks with large-seeded trees. Management for deer and bear usually results in excellent squirrel populations, so the species is generally ignored.

We know nothing of past and present populations, but the species is common in typical habitats. Due to project emphasis on enhancing diversity, future populations will increase slightly.

Mule Deer
The habitat is low capability north of Toad Lake due to very poor forage and lack of water. No corridors exist, as deer usually stay at lower elevations and go to winter range south and west of the project at yet lower elevations. Deer prefer high-diversity habitats, preferring a forage/cover ratio of 50/50 within a mile of water. The area lacks dense old forest cover. Mule deer have increased hunting mortality at high road densities.

Populations of mule deer decreased from very high numbers 50 years ago to present near-normal historical numbers. These numbers greatly exceed past market hunting days of the all-time low of 1910. Fire prevention policy eliminated fire from the ecosystem and reduced forage. No increase is expected.

Elk

Elk would have the same problems as mule deer but more acutely in this habitat. Additionally, they are limited by high road density and limited riparian areas. Due to excellent meadows and reduced livestock grazing in the south half of the watershed, the local elk population is now about 100.

Pileated Woodpecker

The habitat is low capability or unsuitable. The species prefers late-successional forest with canopy closure over 40%, with snags greater than 30" DBH and 80' height. The species is likely not present due to a severe shortage of large snags, large trees, and old growth forest with closed canopy. The area has poor foraging and nesting opportunities.

The species is heard rarely in or outside the project due to its characteristic loud drilling sound, distinct call, and characteristic rectangular holes in trees. The species finds few large nesting snags generally on the entire forest and this may be limiting its numbers. No effort has been made to count these uncommon birds because the species is widespread.

Poor populations occur because past logging and fires created a forest now only 80 years old with a few small patches of old growth usually under 20 acres. This area is presently recycling. The future of this species will be very marginal until old growth conditions return in 50 years. Areas with severe natural limitations have low potential.

Northern Goshawk

The habitat is seldom better than moderate capability, and nearby water is absolutely necessary for nesting. This species prefers late-successional forest with riparian associations and high diversity of habitats for a diverse prey base, seldom found in this watershed due to past logging, grazing, and fire suppression.

Surveys are regularly conducted for the species to discover and check nesting sites. All have been located near natural or artificial water sources, including livestock troughs or guzzlers.

Poor populations occur because past logging and fires created a forest now only 80 years old with a few small patches of old growth usually under 20 acres. This area is presently recycling. The future of this species will be very marginal until old growth conditions return in 50 years. Areas with severe natural limitations have low potential, with limited water the most significant for this species.

3.3.6 Survey and Manage Species

All mollusks – Extensive protocol surveys conducted for range allotments and timber sales in 2002 have not found any S&M snail species are absent in the watershed. The apparent absence of survey and mollusks can be attributed to the dry climate, limited old growth and few deciduous trees.

3.3.7 Land Allocations and Prescriptions Emphasizing Wildlife Habitat

Management prescriptions that emphasize wildlife habitat on National Forest land in the watershed

include the following:

- Prescription VI - Wildlife Habitat Management (LMP 4-66)
- Prescription VII - Late-successional Reserves (LMP 4-43)
- Prescription IX - Riparian Management (LMP 4-59)

The Porcupine Watershed contains no Critical Habitat Unit.

The Shasta-McCloud subprovince represents the southeastern portion of the northern spotted owl's distribution. Within this subprovince, LSR RC-335 is the largest LSR and the LSR established for maintaining linkage and genetic interchange with the Northern California subspecies (see Map 3 - Adjacent Late-Successional Reserves). This LSR is also considered the key to maintaining the viability of the sub-province by providing a source population (Gertsch, 1994).

Table 3-4 shows LSRs located within and adjacent to the watershed. Linkage with other LSRs, especially LSRs RC-357 to the southwest is a concern because of limited and highly fragmented dispersal habitat between LSRs to RC- 359. Concerns within LSR 359 include extensive logging fragmentation, dry climate and its high risk to natural catastrophes like wildfire. RC-358 is apparently totally isolated by poor natural habitat and RC-361 by poor natural habitat plus logging on private land.

Table 3-4: Late-Successional Reserves within and adjacent to the Porcupine Watershed.

LSR#	CHU#	National Forest Acres	# Pairs Expected	Activity Centers present	Name and Comments
RC-357	CA-2	26,891	15	4 P; 2 TS	Bartle. Maintains distribution. Adjacent and not in watershed
RC-358	CA-	1,070	0	0 P; 0 TS	see main text, Porcupine/Six Shooter.
RC-359	CA-	2,224	1	1 P; 0 TS	see main text, Harris Mountain.
RC-361	CA-	14,504	1	1 P; 0 TS	Mt. Shasta to Stevens Butte. Adjacent and not in watershed.

- LSR# - Late-Successional Reserve numbers.
- CHU# - Critical Habitat Number
- # of pairs expected - as described in Gertsch 1994.
- Activity Centers - P = pair; TS = Territorial Single.

3.3.8 Vascular Plants, Bryophytes, Fungi and Lichens of Special Interest

KEY

S = Sensitive

S&M = Survey & Manage: Category A (Rare, Pre-disturbance surveys practical, Protect known sites); Category B (Rare, Pre-disturbance surveys not practical, Protect all known sites); Category D (Uncommon, Pre-disturbance not practical or not necessary).

PS = Plants of Special Concern (National Forest Management Act)

California Native Plant Society (CNPS) Listing Labels: 1B = Rare or Endangered in California and Elsewhere; 2 = Rare or Endangered in California, More Common Elsewhere; 4 = Plants of Limited Distribution.

Habitat descriptions and threats pertain only to the Porcupine Watershed, and may vary elsewhere.

Vascular Plants:

Allotropa virgata – Sugar stick (PS)
Habitat: Found at high elevation, 5,700 to 6,700 feet. Associated with Red fir-White fir and Red fir-Mixed conifer vegetation types. There are four populations in this watershed. They are found in the northern part of the watershed near Pumice Stone Mountain and Red Cap Mountain. *A. virgata* was listed as a Category A species and a Region 5 Sensitive Species until the year 2000. It was dropped from the Survey & Manage list because it proved to be quite common in most areas under the Northwest Forest Plan. However, it isn't common on the Shasta-Trinity National Forest, and not at all common in the Porcupine Watershed. It is still considered "special" on the Shasta-McCloud Management Unit.
Threats: logging, stand replacing wildfire and major ground disturbance.

Calochortus longebarbatus var. longebarbatus **– Long-haired star tulip (S, 1B)**
Habitat: Seasonally moist openings including meadows, seeps and springs with heavy clay soils at elevations between 3800 feet and 4200 feet. There are several populations in the southeastern corner of the watershed.
Threats: Alteration of the natural fire regime leading to encroachment of conifers on openings and driving vehicles through meadows are the biggest threats. Grazing and logging are minor threats at this time.

Collomia Larsonii **– Talus collomia (PS, 2)**
Habitat: Volcanic talus at 7300 feet elevation. One of five known sites in California is located near the Little Mt. Hoffman Lookout. All known populations in California occur in Shasta and Siskiyou counties.
Threats: Foot traffic from visitors to the Little Mt. Hoffman Lookout.

Iliamna bakeri **– Baker's globe mallow or Mountain hollyhock (S, 1B)**
Habitat: There is one population known at this time located on the Southeastern edge of the watershed. The area is disturbed and open with scattered ponderosa pine at an elevation of 3800 feet. Responds well to fire.
Threats: Alteration of natural fire regime and grazing.

Rorippa columbiae **– Columbia yellow cress (S, 1B)**
Habitat: There is one population known at this time in the watershed. It is located at White Deer Lake where it grows along the edge of several of the vernal pools.
Threats: Grazing and trampling by livestock and crushing by vehicle traffic pose the greatest threats to the survival of individual plants at White Deer Lake. Changes in hydrology such as building roads and digging out deep ponds and seasonal drought may also be a danger. There is an old railroad grade going through White Deer Lake that is now used by other vehicles. There are two dugout ponds. The other threat is from lodgepole pine encroachment due to changes in the natural fire regime.

Trillium ovatum ssp. oettinger – Salmon wake robin (PS, 4)
Habitat: Salmon wake robin grows in lower montane coniferous forest, riparian scrub and upper montane coniferous forest in shady, moist locations between 3,900 and 5,800 feet. In the McCloud Flats, this species is generally found in or near riparian reserves. Although not a Sensitive Species, the habitat it requires is limited and therefore requires special management considerations. There are no known populations within the Porcupine watershed but potential habitat exists for this species. There are several populations in the Bartle Watershed located directly to the west. This species is mentioned in the LMP (pg. 4-81) along with the long-haired star tulip and the Columbia yellow cress as plants species whose habitats are to be managed for maintenance or enhancement of the species.
Threats: Greatest threats come from grazing and logging.

Bryophytes:

Ptilidium californica **– Pacific fuzzwort, Liverwort (S&M Category A)**

Habitat: There are three known populations at this time in the Porcupine Watershed. All are found near the base on mature white fir. One location is in the Oso Butte area and the other two are just east of Paint Pot Crater. Elevation ranges from 5200 feet to 6100 feet.

Threats: Loss of late seral habitat from logging, fire, wind throw, disease etc.

Fungi – Survey & Manage

Cantharellus subalbidus **– White Chanterelle (Category D)**

Six known populations are scattered throughout the watershed

Habitat: Common under second growth conifers in late summer, fall and winter in Oregon, Washington and Northern California (Arora, 1986).

Cortinarius verrucisporus **– (Category B)**

There are three known populations in the watershed.

Habitat: Found under mountain conifers especially firs and pines under the duff. It is fairly common throughout the higher mountains of California particularly in the late spring and summer (Arora, 1986).

Gastroboletus subalpinus **– Gastroid King Bolete (Category B)**

There are three known populations in the watershed.

Habitat: Found in soil or duff under mountain conifers in the late spring and summer (Arora, 1986).

Gomphus bonarii **– Scaly Chanterelle (Category B)**

Most of the 17 known populations are in the southwestern portion of the watershed

Habitat: Common under conifers in the spring, summer and fall. Has a tendency to grow in clusters (Arora, 1986).

Threats for all fungi: Logging, major ground disturbance causing disruption of the mycelium. Mycelium is the vegetative portion of the fungi.

Common Fungi Important for Commercial and Personal Collecting

Amanita calyptrata - Coccora
Armillaria ponderosa - Matsutake
Armillairiella mellea - Honey mushroom
Boletus edulis - King bolete
Boletus appendiculatus - Butter Bolete
Calvatia booniana - Giant puffball
Calvatia sculpta - Spike puffball
Cantharellus cibarius - Chanterelle
Coprinus comatus - Shaggy mane
Hericium erinaceus, spp. - Old Man's Beard, Lion's Mane Hericium
Lactarius deliciosus - Delicious milk cap
Lactarius rubrilacteus - Bleeding Milk Cap
Lentinus ponderosus - Sawtooth
Lycoperdon spp. - Wood puffballs
Morchella deliciosa - Common Morels
Morchella elata - Black Morels

Lichens:

There are no known locations of S&M lichens in the Porcupine Watershed.

3.3.9 Noxious Weeds

Noxious weeds in the Porcupine watershed consist mainly of introduced, annual brome grasses such as cheatgrass (Bromus tectorum), and introduced forbs such as dandelions (Taraxacom officinale), woolly mullin (Verbascum thapsus), Klamath weed, also known as St. John's wort (Hypericum perforatum) and assorted thistles, mainly bull thistle (Cirsium vulgare). Generally, these are found in disturbed areas such as landings, plantations and along roads. Many are found in meadows where livestock tend to spend a lot of time. At the present time, no musk thistle (Carduus nutans), Canada thistle (Cirsium arvense) or any species of Centaurea, knapweeds and purple or yellow starthistle, have been found in the watershed. However, yellow starthistle (Centaurea soltitialis) is found in the Squaw Valley Creek area just south of the town of McCloud, along the road around Lake McCloud and down into the Hawkins Creek drainage. The challenge for the future will be to keep the watershed relatively free of noxious weeds.

3.3.10 Ethnobotanical Plants of Concern

The Pit River Tribe has used this area historically for gathering bulbs, berries, nuts, acorns and medicinal plants. They have voiced a desire to do so in the future. Many others collect plants in the watershed also. All species of pine are important for their nuts and oaks are important for their acorns. Many shrubs provide fruit: serviceberry, western chokecherry, currents, gooseberries, Modoc plum and thimbleberries. Blue camas (Camissia quamash) and yampa (Perideridia sp.), both members of the lily family, were important food sources found in the seasonally wet meadows throughout the watershed. At the present time, according to tribal members, bulbs are too small to collect due to the exclusion of fire. Many species of fungi are also gathered for personal and commercial purposes. Small diameter lodgepole pine is used for tipi poles. Pacific dogwood is important as a traditional food and medicine source.

Many forbs in the watershed are important for medicinal purposes: Rose hips (Rosa sp.), snowberry (Symphoricarpos), angelica (Angelica sp.), little princes pine (Chimaphila menziesii), Princes pine (Chimaphila umbellate), coyote mint (Monardella odorissima), selfheal (Prunella vulgaris), Klamath weed (H. perforatum), false Soloman's seal (Smilacena racemosa) and star Soloman's seal (Smilacena stellata). Many conifer needles can be used in teas. These are just a few examples. The list of plants used for food and medicine is very long. There are many books on the subject. A good reference for Siskiyou County is *Walking the Medicine Path* by Barbara Davis (Evening Star), Museum Series #2, 1985. This reference contains an excellent bibliography. Another excellent reference is *Plants and the People* by Barbara Davis and Michael Hendryx, Museum Series #5, 1991, Siskiyou County Museum.

3.4 Vegetation

Discussion of the current vegetation condition in the Porcupine Watershed is divided into the following sections:

- **Vegetation types (Section 3.4.1) -** This section focuses on the species composition of the various vegetation types and describes the distribution and condition of each type within the watershed.
- **Seral stages (Section 3.4.2) –** This section focuses on the size, density, and successional stage of vegetation rather than species. Seral stages are useful in describing the amount and distribution of various habitat types within the watershed.
- **Late-successional forest (Section 3.4.3) –** Late-successional forest is discussed separately because it includes additional attributes that cannot be identified solely by tree size and density classifications - such as age and decadence.

3.4.1 Vegetation Types

This section describes the major vegetation types and their general distribution within the Porcupine Watershed. The current condition of each vegetation type is described in terms of forest health, the potential for catastrophic wildfire, and the potential for change due to natural succession.

Overview

Mixed conifer and ponderosa pine forest types dominate the Porcupine Watershed. Dominant conifer species in these forest types include ponderosa pine, white fir and red fir. Minor species include incense-cedar, sugar pine, Douglas-fir, lodgepole pine, and knobcone pine. Other forest types occurring in the watershed are red fir, lodgepole pine and knobcone pine.

The amount of land in each vegetation type within the Porcupine Watershed is displayed in Table 3-5. The current distribution of vegetation types is displayed in Chapter 4 on Map 17d – Vegetation Types.

Table 3-5: Summary of major vegetation types within the Porcupine Watershed.

Vegetation Types	Strata Codes	acres	%
Non-forested (lava, rock, etc.)	NF	7723	5.6
Open Conifer Forest on Poor Sites	all conifer types with low productivity class	14950	10.8
Mixed Conifer	all mixed conifer types	53376	38.5
Red Fir	all red fir types	10134	7.3
Ponderosa Pine	all ponderosa pine types	12601	9.1
Lodgepole Pine	LPX	4552	3.3
Knobcone Pine	KPX	5362	3.9
Plantations	XX1, XX2, XX3	19223	13.9
Brush	SX, SR	10019	7.2
Meadows	GR	573	0.4
Hardwoods	occurs only as a component of other veg. types	-	-
	Totals	138513	100.0

Non-Forested (unvegetated lava and rock)

Description: This vegetation type is dominated by large areas of lava and barren rock where vegetation is absent or very sparse. This type also includes rock quarries, railroads, and powerlines.

Distribution: This vegetation type occurs on 7,723 acres or 5.6% of National Forest land within the watershed. Large non-forested areas include Little Glass Mountain, Giant Crater Lava Flow, and Tilted-Rock Lava Flow.

Land Types: Giant Crater Lava Flow (#1); Porcupine Lava Flow (#2); Little Glass Mountain (#8).

Condition: Very little vegetation occurs on this vegetation type. Due to lack of fuels, there is no potential for catastrophic wildfire. No change is expected in the near future.

Open Conifer Forest on Sites with Low Productivity

Description: This forest type is characterized by a very open ponderosa pine and incense-cedar overstory above scattered brush (typically mountain-mahogany) and saplings. This type occurs on lava flows and rocky areas where site productivity is very low. The overstory conifer canopy rarely reaches 40%.

Distribution: This forest type occurs on 14,950 acres or 10.8% of National Forest land within the watershed. Most of this acreage occurs on the Giant Crater Lava Flow.

Land Types: Giant Crater Lava Flow (#1); Porcupine Lava Flow (#2); Little Glass Mountain (#8).

Condition: This forest type is considered to be in a climax condition with no noticeable change over the past 50 years. Due to the sparse fuels, the potential for catastrophic wildfire is low.

Mixed Conifer Forest

Description: The mixed conifer forest is the most extensive vegetation type in the Porcupine Watershed. Dominant conifer species in this forest type are ponderosa pine and true fir. Minor species include incense-cedar, sugar pine, Douglas-fir, lodgepole pine, and knobcone pine. Ponderosa pine tends to dominate the warmer, dryer sites while white fir tends to dominate the moister, cooler sites.

Distribution: This forest type occurs on 53,376 acres or 38.5% of National Forest land within the watershed.

Land Types: Common in the Hambone (#3); Black Fox (#4); Toad Lake (#5); Grasshopper (6#); Ninebuck (#7) land types. Also occurs on large inclusions of suitable soils within the Giant Crater Lava Flow (#1).

Condition: Many mixed conifer stands currently have very high stocking levels and tend to be susceptible to insect attack. White fir is especially susceptible to attack by the fir engraver beetle (*Scolytus ventralis*) when overstocked stands combine with drought conditions to increase tree stress. This is a concern in the Giant Crater Lava Flow (#1) and Hambone (#3) land types where annual precipitation frequently drops below levels that can adequately sustain white fir in dense conifer forests (approx. 20”). Frequent attacks by the red turpentine beetle (*Dendroctonus valens*) and the western pine beetle (*Dendroctonus brevicomis*) result in significant mortality in ponderosa pine in overstocked forest conditions.

True fir dwarf mistletoe (*Arceuthobium abietinum* f. sp. *concoloris*) is common in white fir. Although mistletoe rarely kills trees directly, it does kill limbs and creates large bole cankers that make the tree susceptible to breakage. Deformities and decay resulting from dwarf mistletoe also contribute to a significant loss in commercial timber value.

High stocking levels and high mortality rates have combined in many areas to create very high fuel loads.

Red Fir

Description: Red fir is the dominant species within the red fir forest type. White fir may make up a significant portion of this type, especially near the transition with the mixed conifer forest type. Minor species include, lodgepole pine, sugar pine, and incense-cedar.

Distribution: This forest type occurs on 10,134 acres or 7.3% of National Forest land within the watershed. The red fir forest type generally occurs in the highest elevations along the northern boundaries of the watershed.

Land Types: Grasshopper (#6)

Condition: Many red fir stands are currently above desired stocking levels. Due to the exposed topographic location of many red fir stands, major windthrow damage is common. Although windthrow damage in thinned stands tends to be limited to individual trees, dense stands with heavy crown canopies tend to suffer severe damage with almost all trees being blown down over several acres. This situation is thought to result from heavy snow accumulations on the crown canopy during heavy winds.

True fir dwarf mistletoe (Arceuthobium abietinum f. sp. magnificae) is found occasionally in red fir. This mistletoe species will not infect white fir. Cytospera canker (Cytospera abieties) frequently attacks true fir stands that have been infected with dwarf mistletoe, resulting in extensive branch killing.

Ponderosa Pine

Description: The ponderosa pine forest type occurs in the southeastern portion of the watershed where annual precipitation is lowest. Much of the existing ponderosa pine forest type has developed from ponderosa pine plantations that were established in the 1960's and 1970's. Many of these plantations have developed to size and density levels that reclassify them as a ponderosa pine forest type, rather than plantation.

Distribution: This forest type occurs on 12,601 acres or 9.1% of National Forest land within the watershed. Most of the ponderosa pine forest type occurs in the eastern portion of the watershed.

Land Types: Giant Crater Lava Flow (#1); Porcupine Lava Flow (#2).

Condition: Frequent attacks by the red turpentine beetle (Dendroctonus valens) and the western pine beetle (Dendroctonus brevicomis) result in significant mortality in overstocked ponderosa pine stands.

Lodgepole Pine

Description: The lodgepole pine forest type in the Porcupine Watershed occurs in three distinct environmental situations:

- wet flats – wet meadows and areas prone to seasonal flooding.
- cold air basins – areas prone to trapping cold air.
- infertile soils – areas of low soil productivity.

Distribution: This forest type occurs on 4,552 acres or 3.3% of National Forest land within the watershed.

- wet flats – Lodgepole pine stands in the southern half of the watershed tend to occur in wet meadows and areas prone to seasonal flooding. Saturated soil conditions tend to favor lodgepole pine and exclude

other conifer species.

- cold air basins – Lodgepole pine stands at the higher elevations of the watershed tend to develop in "frost-pockets" where cold air favors relatively frost-resistant lodgepole pine seedlings over other conifer species.
- infertile soils – Lodgepole pine stands near Little Glass Mountain and Paint Pot Crater have developed on deep pumice deposits over scoria. Such soil conditions promote rapid drainage and have resulted in stands of stunted lodgepole pine.

Land Types:
- wet flats – Hambone (#3); Toad Lake (#5)
- cold air basins – Toad Lake (#5); Grasshopper (#6); Ninebuck (#7)
- infertile soils – Grasshopper (#6); Little Glass Mountain (#8)

Condition: Lodgepole pine stands are frequently infested with western gall rust (Endocronartium harknessii) and lodgepole pine dwarf mistletoe (Arceuthobium americanum). Gall rust in lodgepole pine stands will also infect ponderosa pine and is a concern where there is a potential to infect adjacent ponderosa pine plantations.

Lodgepole pine dwarf mistletoe is host specific and rarely infects other conifer species.

Knobcone Pine

Description: The knobcone pine forest type typically occurs as homogeneous, even-aged stands following fire and is a relatively short-lived species. Approximately 50% of trees in a stand are dead within 60 years. This high mortality within a short period of time results in areas of heavy fuel loads with large amounts of both standing snags and down logs.

Distribution: This forest type occurs on 5,362 acres or 3.9% of National Forest land within the watershed. Most of the knobcone pine forest type occurs in the eastern half of the watershed with significant stands occurring on Powder Hill and near Julia Glover Flat.

Land Types: Giant Crater Lava Flow (#1); Porcupine Lava Flow (#2).

Condition: Many knobcone pine stands within the Porcupine Watershed exhibit the high mortality and heavy fuel loads described above. The potential for catastrophic wildfire in this vegetation type is very high.

Plantations

Description: Plantations in the Porcupine Watershed vary greatly in acreage and age.

- Older plantations (<25 years) - Large brush conversion projects in the 1960s and 1970s established extensive pine plantations near Lost Spring, Doe Peak, and Red Hill. Dense brush understories are common in older plantations.
- Younger plantations (>25 years) – Plantations established in the 1980s and 1990s tend to be smaller and more numerous. Although ponderosa pine was always the most common species planted in the watershed, regeneration practices in the 1980s began to save residual small trees of other species and planted a mix of other species to promote species diversity. Younger plantations generally have very open understory conditions due to intense site preparation and plantation maintenance practices.

Distribution: Plantations occur on 19,223 acres or 13.9% of National Forest land within the watershed. Larger, older plantations dominate the landscape in the northern and

eastern portion of the watershed.

Land Types:
- Porcupine Lava Flow (#2); Ninebuck (#7) – typically larger, older (>25 yr.) pine plantations.
- Giant Crater Lava Flow (#1); Hambone (#3); Black Fox (#4); Toad Lake (#5); Grasshopper (#6) – typically smaller, younger (<25 yr.) mixed-species plantations.
- Little Glass Mountain (#8) - no plantations.

Condition: Past regeneration harvests within the Grasshopper (#6) land type have been difficult to regenerate with frequent plantation failures. Poor success is generally due to deep pumice soils and severe weather conditions at higher elevations. Those plantations that have been successfully established are frequently damaged by heavy snow loads later in their development.

Plantations in the remainder of the watershed have generally been highly successful. Gentle terrain and good soil conditions have permitted efficient use of mechanized site preparation and plantation maintenance methods. This has resulted in effective control of competing vegetation with few plantation failures and few plantation health problems.

The Plantation Thin project (2002-2003) is currently thinning 8,632 acres of the oldest plantations in the watershed. These plantations generally range in age from 30 to 45 years. Following the completion of this project, the thinned plantations will be reclassified as small sawtimber stands, rather than plantations.

Brush

Description: Two general brush types occur within the Porcupine Watershed:
- chaparral brush (mainly bitterbrush, mountain-mahogany).
- montane brush (mainly manzanita, snowbrush, and willow).

Distribution: This vegetation type occurs on 10,019 acres or 7.2% of National Forest land within the watershed.
- the chaparral brush type occurs on dry, droughty, alluvial flats with shallow soils and on lava flows.
- the montane brush type tends to occur on slopes, buttes, and lava flows.

Land Types: Although minor amounts of each brush type occur in most of the land types, the two brush types tend to be associated with the land types as follows:
- chaparral brush: Hambone (#3); Toad Lake (#5);
- montane brush: Giant Crater Lava Flow (#1); Porcupine Lava Flow (#2); Black Fox (#4); Grasshopper (#6); Ninebuck (#7)

Condition: The chaparral brush type tends to be fairly stable due to droughty soil conditions with a low potential for natural conifer encroachment. Dry soil conditions also make such areas unsuitable for conversion to conifer plantations. Due to the sparse fuels, the potential for high intensity wildfire in the chaparral brush type is low.

In the absence of fire, the montane brush type is developing towards later seral stages due to conifer encroachment. There are very few opportunities to convert the montane brush type to conifer plantations because major type conversion activities occurred in the 1960's. Most remaining montane brush is on rocky terrain or in areas designated for management as wildlife habitat. Due to the dense brush conditions, the potential for high intensity wildfire in the montane brush type is high.

Forage value in both brush types is declining as brush becomes more decadent in the absence of fire.

Meadow (grass and forbs)

Description: Two general meadow types occur within the Porcupine Watershed:
- wet meadows – dense grasses in riparian areas.
- dry meadows – sparse grasses on gravelly openings at higher elevations.

Distribution: This vegetation type occurs on 573 acres or 0.4% of National Forest land within the watershed.
- wet meadows tend to occur in the southern half of the watershed and are associated with riparian areas or areas prone to seasonal flooding. Named wet meadows in the watershed are Julia Glover Flat, Sand Flat Well, Hambone Well, White Deer Lake, Mud Well.
- dry meadows occur on shallow soils at higher elevations and are not associated with riparian areas. The only named dry meadow in the watershed is Grasshopper Flat.

Land Types: Although minor amounts of each meadow type occur in most of the land types, the two meadow types generally tend to be associated with the land types as follows:
- wet meadows: Porcupine Lava Flow (#2); Hambone (#3); Toad Lake (#5);
- dry meadows: Grasshopper (#6); Ninebuck (#7)

Condition: In the absence of fire, wet meadows are generally moving towards later seral stages due to conifer encroachment. Periods of high precipitation and high water tables tend to halt or reverse conifer encroachment, at least temporarily; but there has been a noticeable long-term decrease in wet meadow habitat for the last several decades. Excavated waterholes have occasionally altered the local water tables with a subsequent loss of wet meadows. When wet meadows are in a moist condition, the potential for intense wildfire is low within the meadow itself. However, dry conditions in late summer can result in a rapid fire spread through dry grass vegetation. Encroaching conifers (typically lodgepole pine) around the meadow edge often provide vertical fuel-ladders that can create crown fires in the adjacent forest.

Dry meadows tend to be fairly stable due to shallow soil conditions and have a low potential for natural conifer encroachment. Soil conditions also make such areas unsuitable for conversion to conifer plantations. Due to the sparse fuels, the potential for high intensity wildfire in dry meadows is low.

Hardwoods

Description: Quaking aspen and black oak occur throughout the watershed as a minor component of other vegetation types. Occasional stands of pure hardwood occur but are generally small and not mappable at the watershed scale. Both species are considered to be unique and valuable habitats within the watershed.

Distribution: Quaking aspen and black oak are common components of conifer forests in the southern and western portions of the watershed. The frequency of hardwoods declines towards areas of lower precipitation on the east side of the watershed and towards areas of higher elevation along the northern boundary of the watershed.

Land Types: - common in Hambone (#3); Black Fox (4#); Toad Lake (#5); Ninebuck (#7).
- uncommon (but occasionally occurs) in Giant Crater Lava Flow (#1); Porcupine Lava Flow

Condition: Quaking aspen has been in decline due to fire exclusion and recent management practices. Fire exclusion has allowed white fir understories to become established in many aspen stands. As the white fir developed, it eventually overtopped and "shaded out" the aspen.

Past reforestation practices attempted to retain aspen in plantations by creating untreated islands. However, residual white firs that were also left within these islands eventually developed to a height at which they overtopped the aspen.

Black oak tends to decline when it becomes overtopped in dense conifer forests. However, timber harvest activities in the watershed have created forest openings and open crown conditions conducive to black oak.

3.4.2 Seral Stages

This section describes the current distribution of vegetation in the watershed by seral stages. Seral stages are generally described by the size and density of vegetation and the types of habitat they provide. Seral stages described in this section conform to the classification used in the Shasta-Trinity Land and Resource Management Plan (LMP 4-15). The current condition of each seral stage is discussed in terms of forest health, the potential for catastrophic wildfire, and the potential for change due to natural succession.

Overview

The current seral stage distribution in the Porcupine Watershed has developed from a combination of soil conditions, climate, fire history, and past management activities. Early seral stages generally tend to occur on lava flows, droughty soils, and areas with low annual precipitation. Later seral stages tend to occur on productive soils and areas of higher annual precipitation.

The amount of land in each major seral stage within the Porcupine Watershed is displayed in Table 3-6. The current pattern of seral stages across the landscape is displayed in Chapter 4 on Map 18d – Seral Stages.

Table 3-6: Summary of current seral stage distribution for the Porcupine Watershed.

Seral Stage	Strata Codes	acres	%
Non-forested (lava, rock, etc.)	NF	7,723	5.6
Grass/forb	GR, XX1	3,740	2.7
Brush/seedling/sapling	SR, SX, 1P, 1G, XX2	19,110	13.8
Medium tree - open canopy (<40%)	2P, 3P	32,870	23.7
Medium tree - closed canopy (>40%)	2G, 3G, KPX, LPX, XX3	68,900	49.8
Large tree – open canopy (<40%)	4P, 5P, 6P	1,570	1.1
Large tree – closed canopy (>40%)	4G, 5G, 6G	4,600	3.3
	Totals	138,513	100.0

Non-Forested (unvegetated lava and rock)

Non-forested conditions occur on 7,723 acres or 5.6% of National Forest land within the watershed. This acreage includes areas of barren lava and rock with no vegetation. This area is stable with no potential for change in the near future.

Additional information on the distribution and condition of the Non-Forested vegetation type can be found in previous discussions in Section 3.31

Grass/forb (WHR 1)

This seral stage occurs on 3,740 acres or 2.7% of National Forest land within the watershed.

The grass/forb seral stage is described as annual and perennial grasses and forbs with or without scattered shrubs and seedlings. In the Porcupine Watershed this seral stage includes natural meadows, powerline corridors, and plantations less than 10 years old (Table 3-7).

Table 3-7: Summary of the grass/forb seral stage within the Porcupine Watershed.

Vegetation Type	Strata Codes	Low Site	High Site	Watershed	
		acres	acres	acres	%
Grass	GR	0	573	573	15.3
Plantation (<10 years)	XX1	0	3,167	3,167	84.7
	Totals	0	3,740	3,740	100.0

This seral stage is expected to decline to less than 1400 acres (1.0%) in the next decade, mostly due to the development of the existing 3,167 acres of plantations. Based on proposed projects for the next decade, only 800 acres of new plantations are expected to be created in the watershed for a net loss of approximately 2300 acres (Table 3-8).

Wet meadows are decreasing in size due to continuing conifer encroachment. Dry meadows are fairly stable with a low potential for conifer encroachment due to soil conditions.

Table 3-8: Expected changes to the grass/forb seral stage in the watershed for the next decade.

Current acreage of grass/forb stage	3,740 ac.
loss of current of <10 year old plantations (advances to brush/seedling/sapling seral stage)	- 3,167 ac.
loss of wet meadow habitat due to conifer encroachment (advances to brush/seedling/sapling seral stage)	unknown
loss of dry meadow habitat due to conifer encroachment (advances to brush/seedling/sapling seral stage)	minor
estimated gain of new plantations from future proposed projects (based on proposals for Davis, Hemlock, Powder projects)	+ 800 ac.
Expected acreage of grass/forb stage in 10 years	1,373 ac.

Additional information on the distribution and condition of this seral stage can be found in the previous discussions of meadow and plantation vegetation types in Section 3.3.1

Shrub/seedling/sapling (WHR 2)

This seral stage occurs on 19,110 acres or 13.8% of National Forest land within the watershed (Table 3-9).

The shrub/seedling/sapling seral stage is described as mixed or pure stands of brush or conifers up to 20 feet in height. This seral stage also includes plantations 10-20 years old.

Table 3-9: Summary of the current shrub/seedling/sapling seral stage in the watershed.

Vegetation Type	Strata Codes	Low Site	High Site	Watershed	
		Acres	Acres	acres	%
Brush	SR, SX	2,275	7,744	10,019	52.4
Plantations (10-20 years)	XX2	0	9,091	9,091	47.6
	Totals	2,275	16,835	19,110	100.0

This seral stage is expected to decline to approximately 12,600 acres (9.1%) in the next decade due to the development of plantations and sapling stands into the pole/medium tree seral stages. This loss would be partially offset by the development of 0-10 year plantations that are currently included in the grass/forb seral stage (Table 3-10).

Table 3-10: Expected changes to the shrub/seedling/sapling seral stage in the watershed for the next decade.

Current acreage of shrub/seedling/sapling stage	19,110 ac.
loss of current 10-20 year old plantations (advances to pole/medium tree seral stages)	- 9,091 ac.
loss of current brushfields with a significant conifer component (advances to pole/medium tree seral stages)	- 584 ac.
gain of current 0-10 year old plantations (advances from grass/forb seral stage)	+ 3,167 ac.
Expected acreage of shrub/seedling/sapling stage in 10 years	12,602 ac.

Of the 10,019 acres of brush vegetation in the watershed, 7,744 acres (77%) occur on highly productive soils and are expected to progress fairly rapidly towards later seral stages. This includes 584 acres with a significant conifer sapling component (see table above) that are expected to develop into stands of small trees within the next decade. The remaining 2,275 acres (23%) of brush vegetation occur on areas of low soil productivity and any progression to later seral stages would occur at a much slower rate.

Additional information on the distribution and condition of this seral stage can be found in the previous discussions of brush and plantation vegetation types in Section 3.3.1

Pole/medium tree – open canopy (WHR 3a)

This seral stage occurs on 32,287 acres or 13.8% of National Forest land within the watershed (Table 3-11). The "pole/medium tree – open canopy" seral stage is described as trees 20-50 feet in height and crown closure less than 40%. In the Porcupine Watershed this seral stage includes all pole and small sawtimber conifer stands with crown closure less than 40%.

Table 3-11: Summary of the "pole/medium tree – open canopy" seral stage in the watershed.

Vegetation Type	Strata Codes	Low Site	High Site	Watershed	
		acres	acres	acres	%
Pole/medium conifers	2P, 3P	14,222	18,648	32,870	100.0
	Totals	14,222	18,648	32,870	100.0

Very little change is occurring on the 14,222 acres (43%) of this seral stage on sites with low soil productivity. This condition typically occurs on lava flows where the existing tree density is often at the carrying capacity of the site. Vegetative cover in such areas has undergone very little change over the last sixty years and very little change is expected in the future.

A continuing decline is expected in the 18,648 acres (57%) of this seral stage identified on moderately to highly productive soils. Open canopy conditions on productive soil are usually the result of past disturbance, such as fire or timber harvest, and not the result of limitations in the carrying capacity of the site. This seral stage has declined dramatically in the watershed during the last sixty years and is expected to continue to decline as conifer stocking and tree size increase and forest stands progress into later seral stages.

The decline in acreage of this seral stage would be slightly offset by the development of portions the brush/seedling/sapling seral stage.

Additional information on the distribution and condition of this seral stage can be found in the previous discussions of conifer vegetation types in Section 3.3.1

Pole/medium tree – closed canopy (WHR 3b, 3c)

This seral stage occurs on 68,900 acres or 49.7% of National Forest land within the watershed. The "pole/medium tree – closed canopy" seral stage is described as trees 20-50 feet in height and crown closure greater than 40%. In the Porcupine Watershed this seral stage includes all pole and small sawtimber conifer stands with crown closure greater than 40%. It also includes lodgepole pine, knobcone pine, and plantations 20-30 years old (Table 3-12).

Table 3-12: Summary of the "pole/medium tree – closed canopy" seral stage in the watershed.

Vegetation Type	Strata Codes	Low Site	High Site	Watershed	
		acres	acres	acres	%
Pole/medium conifers	2G, 3G	575	51,446	52,021	75.5
Lodgepole pine	LPX	51	4,501	4,552	6.6
Knobcone pine	KPX	454	4,908	5,362	7.8
Plantations (20-30 years)	XX3	0	6,965	6,965	10.1
Totals		1,080	67,820	68,900	100.0

Very little change is expected to the 1,080 acres (2%) of this seral stage on sites with low soil productivity. However, dense conifer forests on sites with low productivity are at risk to insect attack during periods of extended drought. Dense knobcone pine forests on low sites are often at risk to wildfire due to the even-aged character and short lifespan of the species. Knobcone pine on low sites often occurs as isolated stands in lava flows where management is difficult due to terrain and access.

A continuing increase is expected in the 67,820 acres (98%) of this seral stage identified on moderately to highly productive soils (Table 3-13). This seral stage has increased dramatically in the watershed during the last sixty years and is expected to continue to increase as forest stands develop from earlier seral stages. Increases in the acreage of this seral stage will come from the continuing development of plantations, sapling stands, and open canopy stands.

The increase in acreage of this seral stage would be partially offset by the natural progression of some stands into the large tree seral stage. It is also likely that some management activities would be proposed in the next decade to break up the continuity of fuels in large knobcone pine stands. Such activities would probably convert treatment area to earlier seral stages.

Table 3-13: Expected changes to the "pole/medium tree – closed canopy" seral stage in the watershed for the next decade.

Current acreage of shrub/seedling/sapling stage	68,900 ac.
loss through natural development to next seral stage (advances to "large tree – closed canopy" seral stages)	Unknown
loss due to probable knobcone pine conversion (conversion to grass/forb seral stage)	Unknown
gain due to development of current open canopy stands (advances from "pole/medium tree – open canopy" seral stage)	Unknown
gain of current conifer sapling stands (advances from shrub/seedling/sapling seral stages)	+ 584 ac.
Gain of current 10-20 year old plantations (advances from shrub/seedling/sapling seral stage)	+ 9,091 ac.
Expected acreage of shrub/seedling/sapling stage in 10 years	78,575 ac.

Additional information on the distribution and condition of this seral stage can be found in the previous discussions of conifer vegetation types in Section 3.3.1

Large tree – open canopy (WHR 4a)

This seral stage occurs on 1,570 acres or 1.1% of National Forest land within the watershed (Table 3-14). The "large tree – open canopy" seral stage is described as trees generally over 50 feet in height and crown closure less than 40%. The average age of the stand is generally over 110 years and the stage corresponds roughly to a late-successional classification. In the Porcupine Watershed this seral stage includes all conifer stands in the large tree size classes (4, 5, 6) with crown closure less than 40%.

This seral stage has gradually increased in acreage over the last several decades and this trend is expected to continue into the future. Many of the remaining stands of large conifers in the watershed are located in areas that are difficult to manage due to steep slopes and rugged terrain. The Shasta-Trinity Land and Resource Management Plan has established two Late-Successional Reserves within the watershed and provides for minimum levels of late-successional forest. Gradual increases in acreage will occur over time through the natural development of stands from the "pole/medium tree – open canopy" seral stage.

Table 3-14: Summary of the "large tree – open canopy" seral stage in the watershed.

Vegetation Type	Strata Codes	Low Site	High Site	Watershed	
		acres	acres	acres	%
Large conifers	4P, 5P, 6P	117	1,453	1,570	100.0
	Totals	117	1,453	1,570	100.0

Large tree – closed canopy (WHR 4b, 4c, 4c-older)

This seral stage occurs on 4,600 acres or 3.3% of National Forest land within the watershed.
The "large tree – closed canopy" seral stage is described as trees generally over 50 feet in height and crown closure greater than 40%. The average age of the stand is generally over 110 years and the stage corresponds roughly to a late-successional classification. In the Porcupine Watershed this seral stage includes all conifer stands in the large tree size classes (4, 5, 6) with crown closure greater than 40%.

Table 3-15: Summary of the "large tree – closed canopy" seral stage in the watershed.

Vegetation Type	Strata Codes	Low Site	High Site	Watershed	
		acres	acres	acres	%
Large conifers	4G			4,600	100.0
	5G, 6G		112		
Totals				4,600	100.0

This seral stage has gradually increased in acreage over the last several decades and this trend is expected to continue into the future. Many of the remaining stands of large conifers in the watershed are located in areas that are difficult to manage due to steep slopes and rugged terrain. The Shasta-Trinity Land and Resource Management Plan has established two Late-Successional Reserves within the watershed and provides for minimum levels of late-successional forest. Gradual increases in acreage will occur over time through the natural development of conifer stands from earlier seral stages.

Many forest stands in the "large tree – closed canopy" seral stage have high stocking levels and dense understories. Such stands are at risk to wildfire and insect attack during periods of extended drought.

3.4.3 Late-Successional Forest

This section describes the current amount and distribution of late-successional forest within the watershed. While seral stage descriptions in Section 3.3.2 focus on the size and density of vegetation, descriptions of late-successional forest include additional forest attributes such as stand age, decadence, layering, large snags, and large down logs.

Standards and guidelines for the retention of old-growth patches and late-successional forest are included in the Shasta-Trinity Land and Resource Management Plan (LMP 4-62). These guidelines include specific direction for "fifth field watersheds in which federal forest lands are currently comprised of 15 percent or less late-successional forest." Therefore, this section provides an assessment of the current condition of late-successional forest on National Forest land within the Porcupine Watershed.

Overview

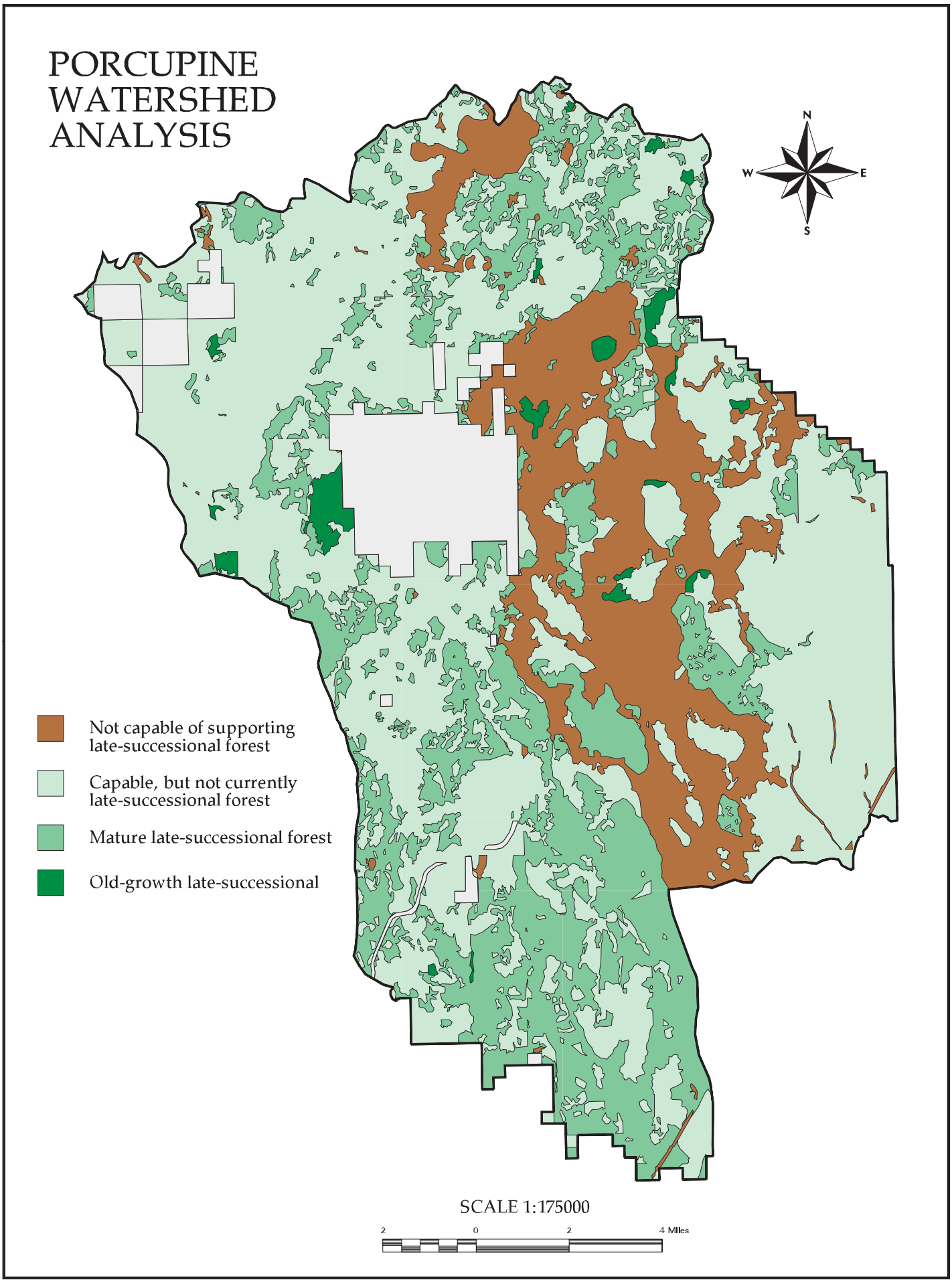
The current acreage and distribution of late-successional forest in the Porcupine Watershed has developed from a combination of soil conditions, climate, fire history, and past management activities.

There are 25,452 acres (18.4%) of National Forest Land within the watershed that have been identified as not capable of supporting late-successional forest (see Table 3-16). These areas are mostly occupied by lava flows and rocky areas that support only scattered conifers. Smaller areas of dry meadows and powerline corridors are also included in this acreage.

There are 113,061 acres (81.6%) of National Forest Land within the watershed that have been identified as capable of supporting late-successional forest (see Table 3-16). Of this acreage of capable land, a total of 38,528 acres (34.1%) are currently occupied by forest types that meet the criteria of late-successional forest.

For purposes of this assessment, the determination of late-successional forest follows definitions used in the FEMAT report (1993). Late-successional forest is subdivided into two subsets:

- **Mature forest** – those forest stands generally greater than 80 years of age but not meeting the old-growth definition. For this assessment, all current 3N and 3G stands were classified as mature forest if they were determined to have reached size class 3 by 1944.



Map 14. Distribution of Late-Successional Forest

- **Old-growth forest** – those forest stands exhibiting old-growth characteristics including: large trees, multi-layered canopies, decadence, large snags and down logs.

Table 3-16 summarizes the categorization of the watershed into capable and non-capable lands in terms of ability to support late-successional forest. The table further separates late-successional forest into mature and old-growth forest subsets. Map 14 – Late Successional Reserves shows the distribution of these various categories throughout the watershed.

Table 3-16: Summary of the capability of the Porcupine Watershed to support late-successional forest and the current extent of late-successional forest within the watershed.

	acres	percent of watershed	percent of capable land
Total National Forest land in Porcupine Watershed	138,513	100.0	
Lands not capable of supporting late-successional forest (Barren lava, scattered trees on lava, powerline, dry meadows, etc.)	25,452	18.4	
Lands capable of supporting late-successional forest.	113,061	81.6	100.0
Not currently occupied by late-successional forest. Includes grass, brush, size class 1 and 2, density class S and P, knobcone pine, lodgepole pine. Also includes all current 3N/3G stands that were size class 2, brush, grass, or plantation in 1944 (these are assumed to be less than 80 years old today).	74,533	53.8	65.9
Currently occupied by mature late-successional forest. Generally 80-150 years old. Includes all current 3N or 3G stands that were size class 3 in 1944. Stands that were size class 2, brush, grass, or plantation in 1944 were excluded because they are assumed to be less than 80 years old today.	36,538	26.4	32.3
Currently occupied by older late-successional forest. Generally >150 years years old. All 4N, 4G, 5N, 5G, 6N, 6G and selected 3N/3G stands. Aerial photographs or field knowledge were used to identify or verify stands classified as old growth.	1,990	1.4	1.8

Mature Forest

Mature late-successional forest occurs on 36,538 acres or 26.4% of National Forest Land within the watershed. This represents 32.3% of all lands capable of supporting late-successional forest.

If left unmanaged, mature late-successional forest conditions within the watershed tend to develop dense, overstocked forest conditions with high fuel loads that make them increasingly susceptible to catastrophic events - such as wildfire and insect attack. Timber harvest is frequently used to reduce stand densities to healthy levels and to reduce fuel loads. As a result, most forest stands classified as mature late-successional forest have had some form of timber harvest in the past.

In the absence of future natural disturbance, such as wildfire or insect attack, the amount of mature late-successional forest in the watershed will continue to increase over the next decade. Currently planned management activities will not significantly reduce this forest type. Large acreages of younger 60-80 year old conifer stands are expected to progress naturally into late-successional forest. Ongoing forest thinning treatments throughout the watershed are frequently modifying stocking levels and understory vegetation. However, such treatments usually retain sufficient crown cover, tree size, and average stand age to maintain mature late-successional forest characteristics.

Old-Growth Forest
Old-growth late-successional forest occurs on 1990 acres or 1.4% of National Forest Land within the watershed. This represents 1.8% of all lands capable of supporting late-successional forest.

Most existing old-growth late-successional forest in the watershed occurs on rough or steep terrain that was difficult to access or harvest in the past. As a result, most of the remaining old-growth forest occurs on the steeper slopes of buttes and mountains, such as Harris Mountain, Papoose Hill, Six Shooter Butte, and Bear Mountain.

Due to the lack of past management activities, existing old-growth forest stands are typically overstocked with dense understory vegetation and heavy fuel loads. These stands are susceptible to catastrophic events - such as wildfire and insect attack.

In the absence of future natural disturbance, such as wildfire or insect attack, the amount of old-growth late-successional forest in the watershed will continue to increase slightly over the next decade. Due to the importance of old-growth forest as a limited and unique habitat, current standards and guidelines limit the removal and manipulation of remaining old-growth forest. Additional ingrowth is expected from current mature late-successional forest. As a result, a continuing gradual increase of old-growth late-successional forest is expected in the future.

3.4.4 Fire Regimes

There is a history of large fires occurring in the Porcupine Watershed. Within the past 85 years approximately 140,000 acres have burned in large fires. This represents 93% of the watershed analysis area. Records covering historical fires from 1917-2002 have shown that fire has been an integral part of the watershed's ecological development. The range of diversity that was seen in fires in past years throughout the watershed and vicinity can be explained by differences in fire regimes. Each fire regime creates a unique type of disturbance due differences in each regimens in seasonality, dimensions and characteristics. Historically the largest component of the Porcupine Watershed was best described as a moderate to low intensity, frequent interval regime. However the mere size and range of this watershed make it difficult to describe under one regime due to the diversity of elevational and vegetation differences. The fire regimes are general descriptions and therefore do not necessarily follow the geological boundaries as described in the following land types. Some land types therefore are combined under the same general fire regime. There are only two defined fire regimes within the nine listed land types below. Two of the land types while being under the same regime are described separately because of their unique characteristics:

Land Type Description	Current Fire Regime
Grasshopper Little Glass Mountain	Very infrequent interval, moderate to high intensity
Ninebuck Butte Toad Lake Hambone Black Fox Giant Crater Lava Flow Porcupine	Infrequent interval, moderate to high intensity

Individual descriptions of fire regimes within the designated land types are listed below:

Land Type Name: Grasshopper, Little Class Mountain

High elevation(6000-7500 ft) Red Fir Zone

Very infrequent interval, moderate to high intensity regime. Fires that burn in Red-Fir forest span a wide range of intensities, resulting in a wide range of severity outcomes, thus a classification based solely on even age structure is too simplistic. However on some sites the stand replacement pattern of even age structure can be traced to stand replacement fire events. Lodgepole pine is a common associate of this regime as is Western White pine which often serves as an indicator of past fire events of moderate to high severity. Most Red-Fir forests have not experienced major alterations in forest species composition and structure within this century. This fire regime comprises 20% of the analysis area in the northern quarter of the watershed between Stud Hill and Fisk Ridge.

Land Type Name: Ninebuck Butte, Toad, Hambone, Black Fox

Mid to low elevation (3800-6000 ft) Ponderosa Pine/Lodgepole/Mixed Conifer

Infrequent intervals of moderate to high intensity fires. This regime is outside of its historical frequent interval, low intensity characteristics primarily due to fire exclusion. Ponderosa Pine and Mixed Conifer are the dominant vegetation types, however there is a large component of lodgepole pine as well, some owing its presence to historical large fires. White fir has moved into this area and replaced pine stands over a large portion of this land type. The description of this fire regime is complicated by the diversity of vegetation and elevation zones included within this land type. At higher elevations with moist sites changes in vegetation are less evident, however at lower drier elevations the encroachment of shade tolerant species has clearly changed vertical stand structures and enhanced the potential for crowning and high severity fire behavior. This regime covers approximately 80% of the watershed, including the Giant Crater lava Flow land type as well as the Porcupine land type listed below. This regime displays the most prominent changes from its historical description of a frequent interval, low intensity fire regime.

Land Type Name: Giant Crater lava Flow

Scattered Ponderosa Pine/Incense cedar, Lava flow.

This regime can be described as an *infrequent interval, moderate to high intensity fire regime* typical of the Ninebuck, Toad, Hambone, and Black Fox Land types above. A large portion of this land type consists of a large lava flow with scattered Ponderosa Pine, Incense Cedar and brush. While not considered a separate fire regime in itself, it is uniquely different in its setting due to the surface fuel bed and its fire behavior characteristics. Large areas of lava flow, some with little to no surface fuels, and scattered old survival trees, inhibit fire spread except in extreme wind driven fires. This land type is included in the high Hazard/Risk category due to its lightening fire ignition potential, which elevates the risk factor. This land type is located in a special Fire Management Area designated by the Shasta-Trinity Fire Management Plan. The purpose of this special designation is to provide for an altered suppression response due to the often isolated, low hazard potential nature of fires. This regime is located in the eastern portion of the watershed running northwest from Julia Clover to the Snag Hill area comprising an area of approximately 28,000 acres. The coverage area is included in the 80% portion of the watershed as noted in the Ninebuck, Toad, Hambone, and Blackfox description above.

Land Type Name: Porcupine Lava Flow

Chaparral/Knobcone Pine/Ponderosa Pine Plantation.

Large portions of this land type are covered with a combination of 30 year old Ponderosa Pine plantations (planted in 1959-70's), dense knobcone pine stands and unmanaged brush fields comprised mainly of Manazanita, Snow brush and Mountain mahogany. Many of the brush fields were created

following the Porcupine and Lava Fires that occurred in 1950 and 1959, respectively. While this area falls into the *same fire regime as the Ninebuck, Toad, Hambone, and Blackfox land types described earlier,* the land area is unique from a fuels perspective due to the large contiguous patterns for each vegetation type, high flammability and crown fire potential, and the high resource value of the plantations. Extensive fuelbreak work has been done in this land type over the past 25 years. From 1982 to 1986 the California/Oregon Transmission project invested approximately $150,000 in fuelbreak construction to protect their transmission lines from wildfire. There is approximately 875 acres (35 miles) of fuelbreak system in place and much of the fuelbreak is in need of maintenance.

3.4.5 Hazard and Risk

The Porcupine Watershed was assessed according to hazard and risk classifications to describe the potential risk of catastrophic fire. Fire hazard refers to the potential for catastrophic fire due to existing fuel types. A description of high, moderate and low fire hazard is shown in Table 3-17.

Table 3-17: Fire hazard description for the Porcupine Watershed.

Hazard Rating	Associated Flame Height	Hazard Description
High	8 feet or more	Fires may present serious control problems, such as torching, crowning, and spotting. Control efforts at the fire head is likely ineffective.
Moderate	4-8 feet	Fires are too intense for direct attack on fire head with hand tools. Hand lines cannot be relied on to hold fire. Equipment such as dozers, pumpers and aircraft can be effective.
Low	Under 4 feet	Fires can generally be attacked at the head or flanked by persons using hand tools.

Within the assessment area there are a variety of fuel models due to the diversity of vegetation and forest stand structure. Fire hazard was derived by placing forest vegetation types into nationally accepted fuel model groups that describe the potential fire behavior within defined weather variables. Table 3-18 displays the fuel models found in the Porcupine Watershed.

Table 3-18: Fuel models found in the Porcupine Watershed.

NFFL Fuel Model	Percent Coverage of Watershed	Predicted Flame height	Hazard Rating
Model 4	18%	18.8 ft	High
Model 10,6,2	34%	5.0-6.8 ft	Moderate
Model 8,9	48%	1.4-3.7 ft	Low

Risk describes the potential for ignition starts in the assessment area based on historical occurrence. Risk is based on the number of ignitions per 1000 acres that have occurred historically each decade. The risk categories are identified in Tables 3-19 and 3-20 as follows:

Table 3-19: Risk Categories for the Porcupine Watershed.

Risk Rating	Associated Number of Fire Starts	Risk Description
High	1.0	At least one fire is predicted per 1000ac/decade
Moderate	.5 to .9	At least one fire is expected in 11-20 yrs per 1000 acres
Low	Under .5	At least one fire every 20+ yrs or more is expected per 1000 acres

Table 3-20: Risk Rating and Fire Frequency by Density Zone.

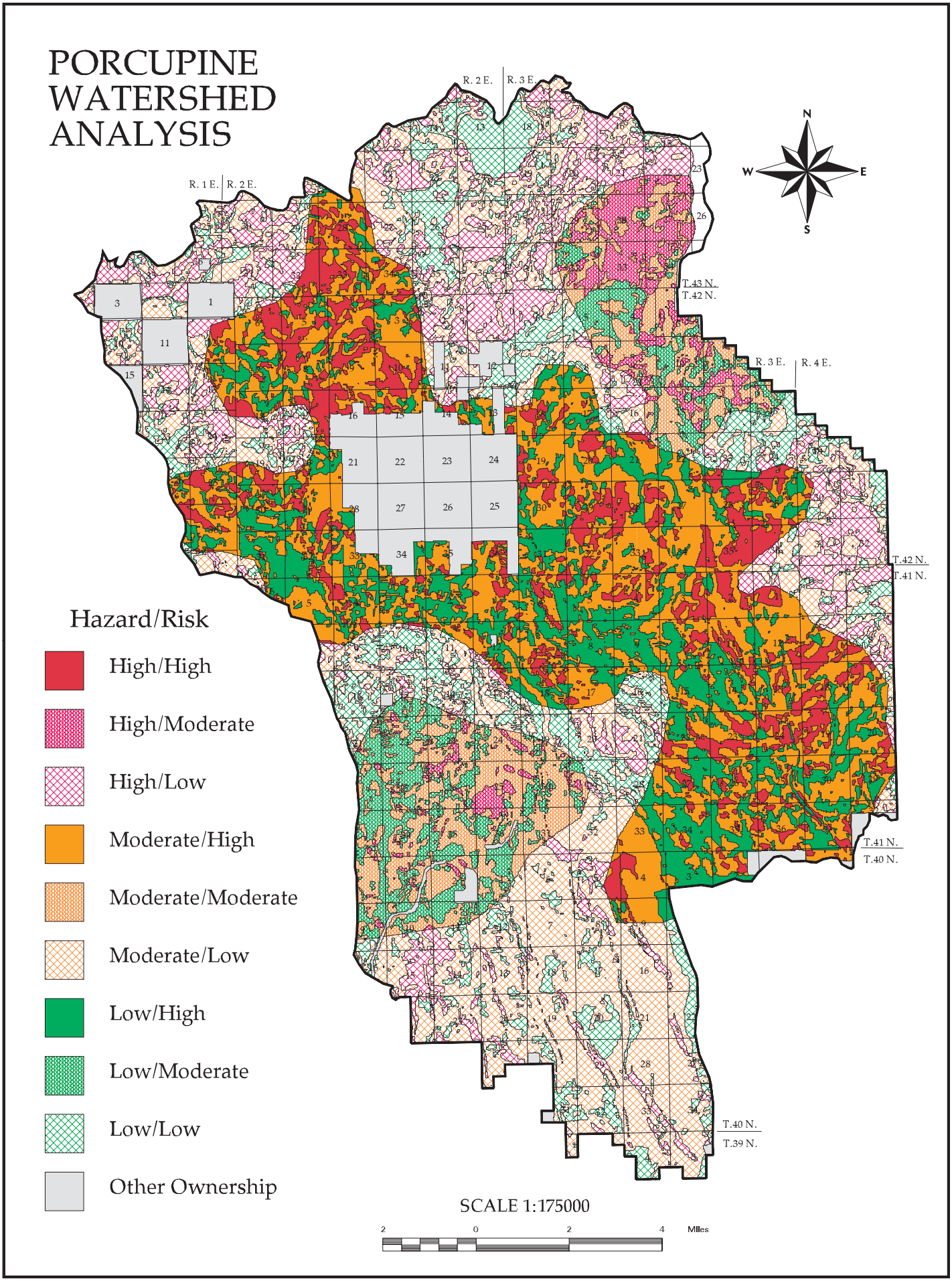
Density Zone	Acres	Total of Watershed	Fires per 1000 acres/per decade	Risk Rating
1	65,873	44%	1.0	High
2	22,884	15%	. 8	Moderate
3	61,193	41%	. 3	Low

Lightening was the primary ignition source in all density zones followed by a smaller number of human caused ignitions which diminished over time as a result of decreased railroad logging activity over the past 70 years. The Porcupine Watershed has been and continues to be one of the more intense lightning concentration areas on the Shasta-Trinity National Forest. The watershed also ranks high in terms of the total number of acres burned in historical fires.

Hazard and Risk: The hazard polygons were overlaid with risk polygons to identify areas where hazard and risk combined to create a high level of management concern (Map 15 – Fuel Hazard and Risk). The resultant hazard/risk rating is summarized in Table 3-21. The same hazard/risk information is also displayed with respect to the land type associations in Table 3-22.

Table 3-21: Hazard/Risk Analysis for the Porcupine Watershed.

Hazard/Risk Combined	Description of Current Condition	Percent of Watershed	Watershed Acres
High	There is a historic probability that at least one ignition will occur every 10 years within any given 1000 acre block of this zone. When fire occurs under the worst-case weather scenario fire behavior will include 8 foot or greater flame heights.	37%	47,513
Moderate	There is a historic probability that at least one ignition will occur every 11-20 yrs within any given 1000 acre block of this zone. When fire occurs under the worst-case weather scenario, fire behavior will include 4-8 foot flame heights.	44%	56,502
Low	There is a historic probability that least one ignition will occur every 20 years within any given 1000 acre block of this zone. When fire occurs under the worst-case weather scenario, fire behavior will include flame heights equal to or less than 4 feet.	19%	24,400



Map 15. Fuel Hazard and Risk

Table 3-22: Hazard/Risk analysis according to land type association.

Land Types:	Giant Crater Lava Flow	Porcupine Lava Flow	Hambone	Black Fox	Toad lake	Grasshopper	Little Glass Mt.	Ninebuck Butte
High	70%	60%	30%	50%	25%	15%	0%	50%
Moderate	25%	35%	65%	47%	50%	75%	10%	45%
Low	5%	5%	5%	3%	25%	10%	90%	5%

The risk of catastrophic fire is considerable in the Porcupine Watershed. Eighty-one percent of the watershed assessment area has a moderate to high potential for catastrophic events. Many forest stands are overstocked and have developed fuel ladders as well as increased concentrations of surface fuels. An ignition in these types of stands could produce extreme fire behavior. Values at risk to loss or damage from fire include wildlife habitat, forest stands and ecological features.

Structural resources in the Porcupine are limited. They include Harris Springs Guard Station, Little Mt. Hoffman Lookout, Hambone sheepherder's cabin, Hambone private residence and the Hambone pump house. Of these structures only the Hambone sheepherder's cabin, the Hambone private residence, and the Harris Springs Guard Station would be considered at risk from wildfire due to their forest setting. Vegetation has been cleared around the structures however they are all still vulnerable to fires occurring during extreme weather conditions.

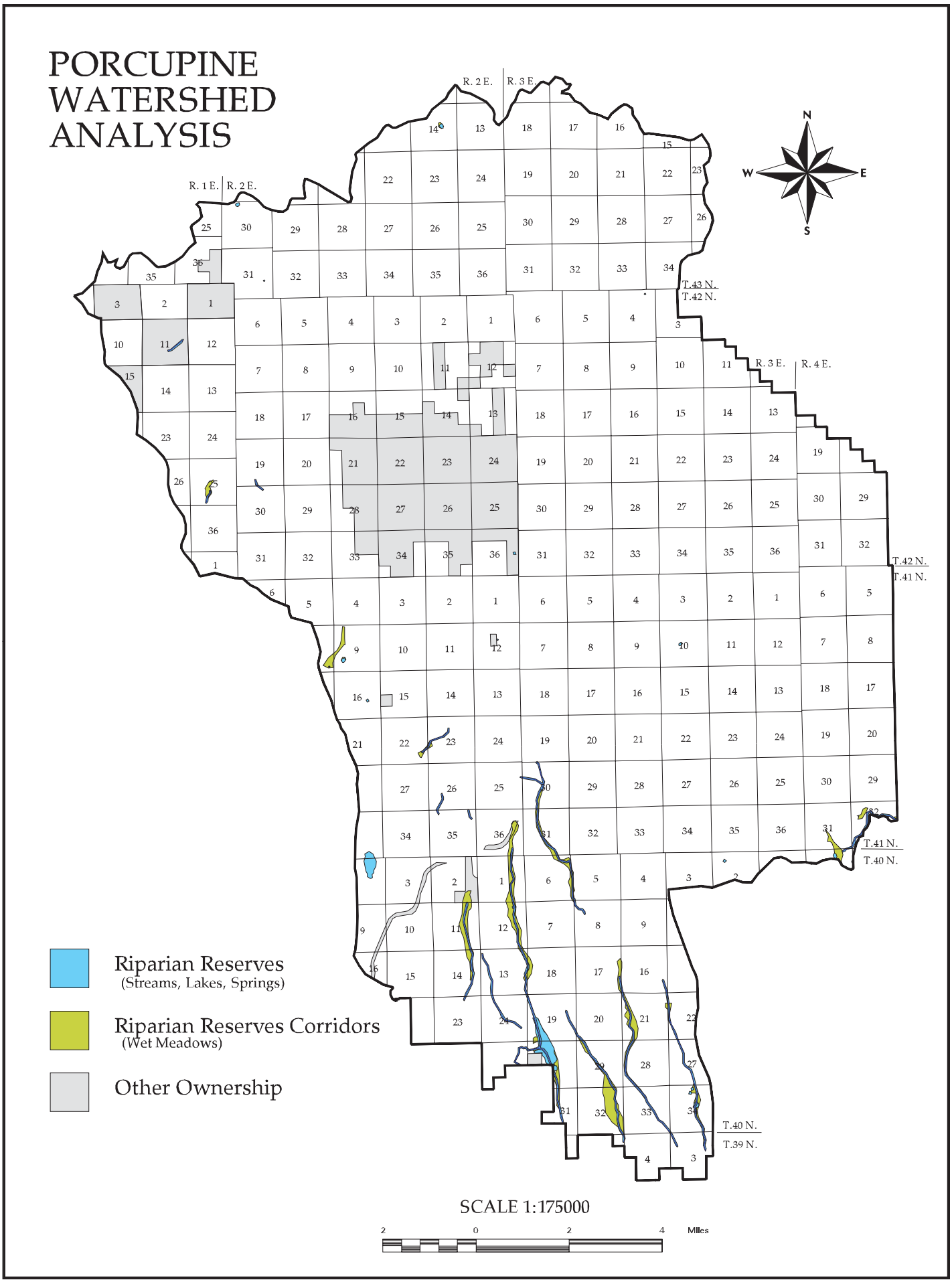
3.5 Riparian Reserves

Due to the limited presence of natural hydrologic features in the watershed the core topics of hydrology, stream channels, and water quality have been integrated into the single core topic of Riparian Reserves. The discussion that follows describes the types and function of Riparian Reserves found in the Porcupine Watershed and the current condition of Riparian Reserves. Riparian Reserves in the Porcupine Watershed are shown on Map 16 - Riparian Reserves.

3.5.1 Watershed Hydrography

The Porcupine Watershed drains terrain of relatively low relief, vegetated primarily by mixed conifer forests to the north and Ponderosa pine forests to the south. The total drainage area of the watershed is 234 square miles. Elevations range from 3800 feet at south end of the watershed to 7580 feet at Medicine Mountain.

Annual precipitation varies from approximately 40 inches in the Medicine Lake Highlands to 25 inches in the southeastern third of the watershed. Approximately 60 percent of the average annual precipitation is available for groundwater recharge, while the remainder is lost to evapotranspiration (Jasso and Haskins, 1983). Almost no precipitation leaves the Porcupine Watershed as surface runoff. Precipitation infiltrating into the ground recharges aquifers located primarily within basalt rock formations. Groundwater movement within the aquifers can occur both horizontally through interflow zones and vertically through fractures within the basalt. Horizontal groundwater flow within the shallow groundwater subsurface is believed to predominate in the watershed. Horizontal groundwater



Map 16. Riparian Reserves

flow occurs along contacts of layered basalt flows and may also be occurring within lava tubes (Fourmile Hill Geothermal Development Project, Final EIS/EIR, 1998). Deep groundwater flow may be limited due to decreased horizontal permeability with increased depth. Water stored within the aquifers in the Porcupine Watershed is presumed to resurface in the Fall River Valley located approximately 10 miles south of the watershed. A smaller amount of groundwater also feeds the headwaters of Bear Creek, which is tributary to the Fall River.

The drainage density of the Porcupine Watershed is approximately 0.13 miles of stream channel per square mile. The watershed contains no perennial streams, 23 miles of intermittent streams and 8 miles of ephemeral streams. Ephemeral streams differ from intermittent streams in that they flow only in response to high intensity precipitation events or rapid snowmelt. Drainage densities are not uniform throughout the watershed. All stream channels are intermittent or ephemeral and concentrated in the southern third of the watershed.

3.5.2 Geologic Controls Governing the Distribution of Riparian Reserves

An understanding of the geology and geomorphology of the Porcupine Watershed is necessary if one is to understand the hydrology of the watershed. The Porcupine Watershed is located within two major geologic provinces. The northern half of the watershed lies within the Cascade Geologic Province and the southern half of the watershed lies on the Modoc Plateau within the Basin and Range Geologic Province. Hydrologic features such as streams, springs and lakes are almost totally absent from the portion of the watershed located within the Cascade Geologic Province. Hydrologic features occur more frequently in the Basin and Range Geologic Province although they are still scarce when compared to neighboring watersheds south of the analysis watershed.

A general description of how the two geologic provinces interrelate is best summarized by a description for the Modoc Plateau found in Ecological Subregions of the United States:

"This area comprises northwesterly trending fault-block mountains and ridges, with intervening bed deposits, shield volcanoes, cinder cones, or lava flows. This is in the Modoc Plateau geomorphic province (part of the Basin and Range Province flooded with volcanics related to those of the Cascade Range Province" (USDA, 1994).

The topography in the southern third of the watershed is characterized by a pattern of alternating ridges and valleys (horst-grabens) that exhibit north-south to north-northwest orientations corresponding to the faults that formed them. The distance between the faults averages about 1.5 miles but the separation can be as little as a hundred yards (Jasso and Haskins, 1983). Areas of high groundwater concentration can be found along the grabens especially where these adjoin the adjacent horst to the east. The majority of all springs and surface drainages encountered within the watershed are aligned with known fault zones. The groundwater that supplies springs and intermittent stream channels originates in the shallow subsurface from perched water tables. The actual water table depths are much deeper. Personnel communication with geothermal drillers indicate that the water table is approximately 1400 feet beneath the surface in the vicinity of Doe Peak (northern watershed). Wells drilled at Hambone Pump and Car "A" in the southern third of the watershed both supply reliable low volume water sources from shallow well depths of less than 200 feet. Both of these wells are dry below 200 feet.

Because they influence water availability, the fault systems also are useful for identifying areas of current and pre-historic human uses. Approximately eighty percent of all known archaeological sites are

located directly within known fault zones (Jasso and Haskins, 1983).

3.5.3 Water Quality

The limited water available in the Porcupine Watershed serves numerous beneficial uses. Beneficial uses of water in the Porcupine Watershed include domestic supply, fire protection, wildlife, stock watering and dust abatement.

The quality of groundwater in the watershed is believed to be very good. Studies by Newcomb (1959) indicate that natural groundwater stored in basalt is characterized by moderate hardness and low alkali content, and a general freedom from harmful materials, except for localized amounts of iron and hydrogen sulfide (Jasso and Haskins, 1983). Water quality from springs discharging into the Fall River is also reported to be excellent (Fourmile Hill Geothermal Development Project, Final EIS/EIR, 1998). Due to the extremely high permeability of the volcanic rocks there is a potential for contamination of the aquifers underlying the watershed (Davis and DeWiest, 1966). The risk of groundwater contamination is believed to be low due to limited habitation in the vicinity of the watershed.

3.5.4 Natural Water Sources

Natural water sources in the watershed are very sparsely distributed. They include springs, intermittent streams, intermittent lakes and ponds, vernal pools, wet meadows and lava depression and/or caves. Together these features make up the Riparian Reserves in the Porcupine Watershed. Of the sources just mentioned, only the springs, lava depressions and caves have reliable water supplies through the summer and fall. Most springs, streams, lakes and meadows contain surface water from April through June and dry out in June or early July. The function, condition and distribution of natural water sources are described below.

Springs are the dominant hydrologic feature in the watershed. The majority of springs occur in the southern third of the watershed. As with most hydrologic features in the watershed, almost all of the springs are located along faults. Examples of springs located along fault lines include Hambone and Harris Springs. Springs occur with increased frequency at the lower end of each graben due to fault boundaries that impede groundwater flow and result in increased hydraulic pressure and upward flow gradients. Most springs are generally associated with seasonally wet meadow complexes, intermittent streams and with high water tables that occur during and shortly after snowmelt (April-May). Where riparian vegetation does occur it is usually found within 10-30 feet of the spring source.

Springs that flow consistently throughout the summer serve many functions. Springs provide water for wildlife, vegetation and for human uses including fire suppression, stock water and road dust abatement. Some of the developed springs located in wet meadows are popular dispersed camping sites. Popular areas for camping and other uses include Harris Spring, White Deer Lake, Pumice Stone Well, Caribou well, Sand Flat Well and Jot Dean Cave. Impacts from campers are generally small.

Humans have modified almost every spring in the watershed. Some of the springs such as Tamarack Springs were dugout in the early 1900's and are now shown as lakes on the current topographic maps. Modifications to springs include construction of dugout ponds, wells, tanks, pipelines and troughs. Because many of the springs were modified in the early 1900's it is difficult to determine how many of

the springs were actually natural surface water sources prior to being developed or excavated. Some of the confirmed natural springs in the watershed include Lost Springs, Bear Springs and Harris Springs.

Small **intermittent streams** occur only in the southern third of the watershed. They are all associated with northwest trending fault systems. Streamflow is limited to the period of snowmelt from April through mid-June. As with the springs, intermittent streams occur within wet meadows and along faults. Intermittent stream channels are generally undefined. Flow features such as banks, scoured channel beds and alluvial deposits occur sporadically along stream courses. Intermittent streams generally flow over wet meadow vegetation in the bottoms of grabens or swales. Due to limited erosion, low channel gradients and low flows, most intermittent stream courses have not formed incised channels. Because the channels are not defined and surface flow is completely absent during the summer many of the intermittent stream channels located above and below wet meadow systems have been affected by timber harvest activities (see Chapter 4). Many intermittent stream courses occur within plantations. Intermittent stream channels located within the plantations tend to be braided and the surrounding vegetation (small conifers) is not typical of sparser stands that existed prior to timber harvest.

Intermittent streams occur within each of the wet meadow complexes described in Table 3-4. Intermittent stream channels flow through a variety of vegetation types. Where channel gradients are greater than one percent, streamflow tends to be confined to a narrow, shallow channel and the surrounding vegetation is either open meadow or scattered pines. Where gradients are less than one percent streamflow is spread out over a wider area and standing water is common. Dense lodgepole-aspen stands are common in areas of standing water. Woody debris impedes water movement in these areas creating seasonal wetlands. Many intermittent stream channels flow through clearcuts and on roads that were constructed in the valley bottoms. These disturbed reaches are apparent in April and May when surface flow is occurring on roads and through plantations.

Shallow, **intermittent lakes** and small **vernal pools** occur within some of the grabens in the southern third of the watershed and along its western perimeter. Examples of intermittent lakes include Toad Lake, White Deer Lake, and the vernal pool area locally referred to as Whitlow Lake. The duration of inundation varies on an annual basis and from lake to lake. Generally the lakes and vernal pools contain water from April through early June. The vernal pools in the Whitlow Lake area dry out slightly earlier than White Deer and Toad Lakes located on the western perimeter. Intermittent lakes, ponds and vernal pools provide unique microhabitats for riparian vegetation and aquatic and riparian dependent species (see Biology information). Intermittent lakes are generally open in the centers and surrounded by dense stands of lodgepole pine. The pine is occasionally killed off during wet years when the lakes and ponds can remain inundated through most of the summer. The high incident of lodgepole mortality on the pond perimeters makes these areas very popular for woodcutting. Impacts to intermittent lakes and ponds include damage from cattle grazing, conifer encroachment, and loss of native vegetation due to the introduction of non-native plant species (see Biology information).

Many of the springs, intermittent streams and intermittent lakes occur within **wet meadow** complexes located along faults in the southern third of the watershed. Wet meadows are characterized by intermittent streamflow and/or phreatophyte vegetation such as sedges, potentilla, penstemon, snowberry and serviceberry. Many of the meadows are partially forested or are being encroached upon by Douglas fir, Ponderosa pine and white fir. Aspen is present within some meadows and on fault scarps to the east of the meadows. The distribution of riparian vegetation and the duration of intermittent streamflow in the meadows are strongly correlated with the depth of the water table along the faults. Six of the largest wet meadow systems were mapped and characterized for this analysis. The meadow complexes include areas of encroaching conifers, lodgepole and aspen stands, and other

vegetation types located in seasonally saturated areas along the intermittent stream corridors. All of the meadows in the Porcupine Watershed dry out in early summer. These meadows will be managed as Riparian Reserves under the Guidelines specified in the Shasta-Trinity Land Management Plan and the Aquatic Conservation Strategy.

Numerous **caves and lava depressions** scattered throughout the watershed provide water sources for wildlife and, in some cases, unique microhabitats for plants and animals. The distribution of caves and lava depression is only partially known. Input from district personnel, historic maps and geologic studies indicate that the frequency and distribution of caves and lava depressions is great enough that they may be serving as water sources for wildlife. Caves and lava depressions are very important wildlife water sources because they occur primarily in the southern two-thirds of the watershed in the lava flows where other natural water sources are completely absent. Examples of caves and lava depressions containing water include Ice River Caves and Porcupine Lakes.

While not considered Riparian Reserves, areas containing contiguous lodgepole pine stands may also be indicative of high water tables. Some of these areas may be saturated for short periods during the spring and could provide water sources for wildlife during and shortly after snowmelt. The lodgepole pine stands, like most riparian areas, occur along the northwest trending fault systems within the grabens.

3.5.5 Water Developments

Numerous water developments occur throughout the Porcupine Watershed. Due to limited water availability every natural surface water source is associated with some form of water development. Water developments include storage tanks and pumps, troughs fed by storage tanks, wells and dugout ponds. Numerous guzzlers have also been placed throughout the watershed to provide water for wildlife. The types, quantities and the purpose of water developments is provided in Table 3-5.

With the exception of the guzzlers and troughs fed by pipelines, all of the water developments shown in Table 3-23 occur within or immediately outside of Riparian Reserves. The condition of some riparian reserves has been affected by water developments. Impacts to Riparian Reserves are restricted to the immediate vicinity of the water developments. They include localized decreases in water table depths around dugout ponds, erosion of pond edges, loss of visual quality in riparian meadows and water contamination.

The condition of current water developments (tanks, pumps, pipelines, and troughs) is highly variable. Some tanks, troughs and ponds are operational and in good condition while others suffer from lack of maintenance, are nonfunctional or abandoned. Other tanks such as Hunters Hill are associated with wells that have never been developed. Given the multiple uses and benefits provided by both natural water sources and water developments it would be useful to inventory all water sources in order to identify the total distribution of water sources (both natural and engineered) within the watershed. The distribution map could be used to identify areas where additional water sources are needed, areas where excess water developments could be removed and areas where existing sources could be more effectively and efficiently utilized. Opportunities for restoration of Riparian Reserves could also be identified.

Table 3-23: Water developments in the Porcupine Watershed.

Water Development	Quantity	Purpose or beneficial use
Storage tanks with pumps	2	Fire control/protection

Storage tanks without pumps	16	Fire control/protection
Cement ponds with pumps	1	Fire control/protection, dust abatement
Dugout ponds, burrow pits, springs	~58	Wildlife water source, stock water
Troughs fed by pipelines or tanks	~10	Wildlife water source, stock water (1-2 troughs are functional)
Guzzlers	>50	Wildlife water source

3.5.6 Riparian Reserve Management

Riparian Reserves are applied along all perennial and intermittent streams and along all ephemeral channels that exhibit annual scour. Mapped hydrologic features such as springs, seeps, intermittent lakes, vernal pools and wetlands are within Riparian Reserves. Unstable or potentially unstable areas are also included within Riparian Reserves (ROD, 1994). Riparian Reserves are intended to provide special protection to areas where land-use activities could significantly affect on-site or downstream aquatic and riparian values. Approximately one percent of public lands in the Porcupine Watershed are classified as Riparian Reserves (see Map 16 – Riparian Reserves).

Riparian Reserves are managed according to the Aquatic Conservation Strategy (ROD, 1994; and standards and guidelines for various resource activities described in the Shasta-Trinity National Forest Land Management Plan (Shasta-Trinity LMP, 1995). Additional guidance for Riparian Reserve management is provided in the draft guide for Riparian Reserve Evaluation and Best Management Practices for protection of water quality (Riparian Reserve Evaluation, 1997; Water Quality Management, 1979).

Chapter 4

Reference Conditions

The purpose of this chapter is to explain how ecological conditions have changed over time as a result of human influence and natural disturbances. A reference condition for natural features and processes is developed for comparison with the current conditions. The effects of land-use activities and their relationship to the natural features and processes occurring in the watershed are discussed.

4.1 Human Use

4.1.1 Pre-1850

Human beings have occupied the Porcupine Watershed as summer range for perhaps as long as 10,000 years as evidenced by artifact types and hydration studies on obsidian artifacts (Jenson and Farber, 1982; Dillon 1994). Brian Dillon distinguishes eight types of prehistoric archaeological sites for eastern Siskiyou County, six of which are appropriate for the watershed area: 1) Temporary spring-side camps, 2) Ambush hunting camps, 3) Major obsidian quarry and workshop sites, 4) Casual obsidian workshop sites, 5) Trails or foot paths, and 6) Hunting blinds (Dillon 1997). More than 130 prehistoric sites have been recorded within the watershed analysis area.

Archaeological and linguistic studies indicate that the Achumawi (Pit River people) arrived in this area at least 4000 years ago and perhaps much earlier (Baumhoff and Olmsted, 1964). The Achumawi winter territory lay along the Pit and Fall Rivers, but in spring and summer the inhabitants traveled to the higher elevations to hunt and gather vegetable products and other resources. Streams, lakes, swamps and meadows were especially important because they provided rich sources of food. Waterways provided a large variety of fish, swamps attracted resident and migratory waterfowl, and meadows were rich in insects as well as vegetable foods and vegetable fibers. The edges of the geologically recent lava flows were important as hunting places for marmots, a major food source in the spring.

Game was probably abundant in the watershed. Large herds of mule deer migrated to the highlands during the summer months. Pronghorn antelope, California bighorn sheep, and elk also inhabited the area during prehistoric times. Other abundant wildlife included snowshoe hare, gray squirrels and golden mantle ground squirrels, badgers, bears, beavers, coyotes, fox and many others. The uplands were covered with fir and pine, and kept open by frequent fires, many set by Native Americans to drive game, stimulate growth of seed and berry plants, and collect insects (Olmsted and Stewart 1978).

The Medicine Lake Highlands is well known as a source of high-quality obsidian, and the Shasta Indians to the northwest and the Modoc to the north as well as the Achumawi commonly made trips to the highlands to collect and reduce obsidian nodules. Although there are a number of geochemically different obsidian sources, obsidian from Grasshopper Flat/Lost Iron Wells source is most commonly represented in archaeological contexts.

The game and obsidian resources described previously represent just a small sampling of resources found and used prehistorically by Native Americans within the watershed area. A more complete list is

available in Olmsted and Stewart (1978).

4.1.2 1850-Present

Early Euro-American Transportation and Settlement

European-Americans first settled the lands along the McCloud River and only gradually moved northward into the higher elevations of the watershed analysis area. In 1856 a wagon road was constructed between Yreka and the Fall River Valley (Luecke 1982), which skirted the western and southern edges of the area. A branch connecting Sisson with the Fall River Road was completed in 1876. The Bartle brothers, Abraham and Jerome, established a ranch in the area around 1873, located roughly halfway between Fall River and Sisson. They later added a "public house" that served as a stage stop, a small sawmill, and a hotel that was completed in 1887. The wagon road was improved in 1887 and a stage ran daily and "came loaded each way" (The North Star 7-23-1887; Mt. Shasta Herald 5-15-1888).

Some records exist of encounters between Europeans and Native Americans in the watershed. One account tells of an engagements fought between Lieutenant (later General) George Cook and the Achumawi in the summer of 1857, somewhere south of the Medicine Lake Highlands. The soldiers attacked an Indian camp and drove away its inhabitants, then burned "a large quantity of drying grasshoppers which were being prepared for the winter food supply" (Neasham 1957, cited in Dillon 1996:39).

Government Land Office surveys were conducted in the late 1870s, and land soon began to be claimed into private ownership under various acts. A number of homestead claimants reportedly were "proving up" claims in the 60-mile stretch between Sisson and Fall River (Dunsmuir News 9-14-1895). Acreage in T42N, R2E began to be transferred into private ownership in 1892 and approximately 240 acres in T43N, R2E were privately acquired in 1905. A number of other blocks of land were claimed, logged, and later exchanged or donated back to the Federal government (Land Status Records, on file at the Mt. Shasta Ranger District).

The road transportation system in the watershed began to evolve slowly beginning in the late-1800s. The construction of roads was hindered due to the relative remoteness of the area and the difficulty of pioneering roads and trails through the rough lava flow terrain. The Mayfield and Davis roads were two of the earliest roads in the watershed. Mr. Mayfield constructed a wagon road through the lava beds, a distance of 12 miles for $8000 and proposed a mail route between Sisson and Adin via Bartles and Lookout (Mt. Shasta Herald 9-13-1887). The Davis Road, a wagon road, begun in 1904 to link Bartle with Laird's steamboat landing at Klamath Lake, passed around the west side of Medicine Lake. In 1905 it was reported that a stage line operated between these two points with a stage stop at Pumice Stone Well; it was discontinued in 1906 (Cassidy 1997). The Davis Road, improved for automobile use, continued for many years to be one of the major access routes to the Medicine Lake Highlands until replaced around 1940 by the Harris Springs Road.

Railroads and Timber Harvest

Early timber harvest activities in the watershed were accomplished by railroad logging which was a major land-use activity in the watershed from 1900 to 1930. A sawmill, the Red Cross Mill #2, was moved from Fall River Valley to the area around Bartle in 1888. The McCloud River Lumber Company was established in 1896, with initial efforts directed toward timber around McCloud. During the period between 1906 and 1919, there was a railroad station at Bartle, which was the end of the line for many years, but served as a hub for many railroad-logging spurs that reached out into previously uncut timber

to the north and east (Dillon 1996:136). The McCloud River Company purchased two large Shay engines in 1911, allowing them to climb steeper grades and extend the line from the McCloud Flats northward toward the Medicine Lake Highlands. Grasshopper Flat and Paint Pot Crater were the northern extent of the Company railroad logging activities. The period between 1920 and 1930 saw company logging activities in the Hambone area, extending from Bear Mountain to Porcupine Butte and Sand Flat Wells (Hoertling 1984; Cassidy 1988). The Yreka Union (4-8-1920) provides an account of timber cruising of 1600 unsurveyed acres in the lava bed country east of Mt. Shasta.

The timber resource became more accessible as the railroad system expanded east from McCloud. The 1916 Forest map showed approximately 63 miles of wagon roads, 15 miles of auto roads, and 6 miles of railroad in the area. By 1936 the railroad had grown to 15 miles and the auto roads to 128 miles, many built on the same corridors as earlier wagon roads and railroad grades. With the advent of tractor logging, motorized firefighting techniques, and World War II, the access gradually changed from a railroad to a truck-based system. Following railroad logging in the watershed, many of the tracks were removed and railroad grades were converted to roads. The only railroad remaining today is the McCloud River Railroad/Burlington Northern mainline through the Hambone Area.

Post-1950 Transportation System Development

Starting in the 1950's more roads were built to accommodate tractor/truck logging and to provide public access to the popular Medicine Lake Highlands for recreation. Most of this activity was on private lands owned by timber companies. Timber harvest on public lands began in the late 1960's and continues today. During this time key roads were improved to provide better access for commercial logging and recreational traffic. Access into the area increased even more rapidly from the 1970's on with the development of additional road systems for timber sales.

The 1949 Forest map showed about the same mileage of auto roads and railroads as the 1936 map, however by 1961 the auto roads had increased to about 200 miles, while the railroad stayed about the same. Until this time most of the timber harvest activity had been on private timberlands, but from the 1960's and 1970's on there was much more activity on public lands with roads constructed for timber sales and powerline and pipeline development. While timber sales were the impetus for most of the developed road system, a secondary goal on public land was to improve access to recreational sites such as Medicine Lake and complete a primary road system across the northeastern part of the forest. The GIS transportation layer currently shows about 575 miles of system road, including private land. This is roughly a threefold increase over the 1961 figure, and corresponds to the increase in human activity in the watershed.

Cattle and Sheep Grazing

Cattle and sheep grazing were widespread throughout the watershed during the late 1800's. "Bonanza grazing" began about 1870. The range was excellent, competitive wild game was nearly exterminated, and industry demand for beef and wool was high. Grazing was encouraged to reduce cover and prevent fire spread. Water sources for grazing were developed and large numbers of sheep and cattle grazed in the vicinity of the limited riparian areas in the watershed. Range was good due to large wildfires that occurred from 1910 to 1930. Sheep grazing was prominent due to the dry climate of the watershed and high demand for wool for military uses.

Formal records of sheep and cattle grazing were not kept until the Shasta National Forest assumed this responsibility in 1909. The Porcupine Allotment, roughly located from Porcupine Butte southward, was assigned from 1909 through 1950. The Lava Beds grazing allotment, grazed from 1913 to 1925, extended from Porcupine Butte northward to include all of the Medicine Lake Highlands. Medicine Lake was closed to grazing after 1925, and the Toad Allotment began from 1927 to 2002. The

Hambone Allotment began in 1958, south of old Lava Beds Allotment (Atlas of historic grazing documents, on file at the Shasta-Trinity National Forests Supervisors Office; Grazing records on file at the McCloud Ranger District Office).

Cattle diseases were a severe problem from 1940 to about 1990. Cases of diphtheria and hoof rot disappeared as permit seasons and numbers were reduced. Diseases now appear absent.

Cattle replaced sheep on the Toad Allotment in 1946. Overgrazing of riparian areas intensified due to increased impacts from cattle. Grazing records document overgrazing occurring repeatedly to the west of the watershed and in the watershed at Toad and White Deer Lakes. Allotment management attempted to hold cattle on dry upland ranges with low to moderately palatable grasses, but success was marginal and the work difficult as cattle preferred low riparian areas such as Toad Lake and White Deer Lake. Toad Lake was in the Hambone Allotment, but cattle could not be kept out and it was ceded to the Toad Allotment in 1992. A similar situation occurred at White Deer Lake and Mud Well, but range management was successful in preventing cattle from using these and other areas. Cattle overgrazed west side riparian areas in the Hambone sheep allotment due to the lack of quality forage in the Toad Allotment.

After 1946 sheep grazing declined rapidly due to low economic demand for wool. A sheep allotment continued at Hambone. Sheep were based at a ranch and grazed the wet meadow systems in the southern third of the watershed. The ranch was later abandoned and the allotment became vacant for several years. In 1997 the Hambone Allotment was combined with the McCloud Allotment but no additional sheep were granted to the permittee due to poor land, rest requirements and other resource concerns. This big allotment allowed for a mobile grazing system that enabled the permittee to rest his pastures every other year. With the reduction in grazing conditions improved on riparian areas in the Hambone McCloud Sheep Allotment. Range conditions in the meadows are steadily improving and elk and deer use of the meadows is increasing.

4.2 Species and Habitats

4.2.1 Wildlife Species and Habitats: Pre-1850

Little is known about the conditions of habitats or populations of wildlife species in the watershed prior to 1850. Due to the lack of pre-historical wildlife and vegetation information the following information is speculative in nature.

Frequent fires made openings in dense old growth forest habitats for abundant predator prey bases. Grizzly bear, black bear, wolves and wolverine likely were present in greater numbers prior to European settlement. Species that utilized special habitats such as cavity nesters and bats were probably also more numerous. Spotted owls occupied buttes and ridges near meadows. Tadpole shrimp inhabited intermittent lakes and survived extensive fire, droughts, grazing and predation

The watershed was grazed by herds of deer and elk. Forage was maintained by ranged fires that occurred at approximately 5-year intervals. The fires contributed to the maintenance of high quality forage by preventing conifer encroachment and maintaining natural openings. Secondary forage was also maintained frequent fire in forested areas.

4.2.2 Vascular Plants, Bryophytes, Fungi and Lichens of Special Interest: 1850 to Present

Vascular Plants

Prior to 1850, habitat for the plants of special concern may have been more abundant due to the regularity of wild fires and the absence of domestic livestock. Three of the plants listed in Chapter 3: Long-haired star tulip (*C. longebarbatus var. longebarbatus),* Baker's globe mallow (*I. bakerii*) and Columbia yellow cress (*R. columbiae*) are disturbance dependant species, and in the past, fire was the main disturbance. Wild fires maintained the meadows, vernal pools and natural openings by killing shrubs and trees, which through natural succession would move into these openings. These fires also burned off dry grasses and forbs that left behind ashes containing phosphorus, carbon and other minerals necessary for growth and reproduction. Baker's globe mallow depended on fires to maintain openings and break seed dormancy. Fire was less important to the Talus collomia (*C. larsonii*) on Little Mount Hoffman since it is found at high elevations on talus slopes. However, since there were no human disturbances such as roads and foot traffic the population was probably much larger and individual plants less stressed. There may have been populations of Mountain lady slippers (*C. montanum*) and Salmon Mountain's wakerobin (*T. ovatum ssp. oettingeri*) along meadow edges before livestock grazing was introduced into the area. Sugar stick (*A. virgata*) may have been more wide spread before logging and road building. Although sugar stick can tolerate some disturbance, including light fire, it doesn't like too much. Sugar stick is a saprophyte that gets its nutrition from decaying humus. If the humus layer is destroyed, the plant cannot continue.

Another important natural disturbance came during years of high precipitation. The water table in meadows, lakes and vernal pools would raise killing young trees and shrubs that had sprouted up during a dry period. Since there were no roads, railroad grades, wells, ponds etc., there were no obstacles to the natural flow of water. This may have meant wetter meadows and better habitat for the long-haired startulip, mountain lady's slipper, Salmon Mountain's wakerobin and Columbia yellow cress. Long periods of flooding may have had a detrimental affect on Columbia yellow cress because it doesn't bloom until the vernal lake or pool has dried up.

Ethnobotanical Plants

Ancestors of the Pit River Tribe collected plants in the watershed. Willows and aspen, members of the *Salicaceae family,* were an important source of medicine for controlling fever and pain. Members of the *Salicaceae* family contain salicin. Salicin was found to contain salicylic acid which most of us now know as aspirin. All species of pine were important for nuts and oaks were important for acorns. Many shrubs provided fruit: serviceberries, western chokecherry, currents, gooseberries, Modoc plum and thimbleberries. Blue camas (*Camissia quamash*) and yampa (*Perideridia sp.*), both members of the lily family, were important food sources found in seasonally wet meadows throughout the watershed. Many species of fungi were also gathered as a food source. Small diameter pines were used for tipi poles.

Bryophytes

According to *Management Recommendations for Bryophytes, Version 2.*0 (UDSA/USDI, 1998), fire posses a major threat to Pacific fuzzwort (*Ptilidium californica*) because it grows on the base of trees. There would have been populations in riparian areas and at higher elevations where the right substrate was available and fire was less common. In the Porcupine Watershed, the substrate would be the bark of old growth white fir and Douglas fir trees with a fairly high (70%) canopy cover.
There would have been more snags and rotting logs that would have served as substrate in addition to the bark of living trees. Whether or not this would have meant more Pacific fuzzwort, is very hard to say.

Fungi

Parasitic fungi: These fungi are commonly found on living trees and shrubs, conks, shelf fungi etc,

causing heart and root rot. There may have been fewer of these because there was more species diversity and the forest would have been more open in many areas making it more difficult for these fungi to spread from one tree or shrub to another. During long periods of drought, there may have been more.

Saprophytic fungi: This group includes the "toadstool" type fungi along with morels and false morels etc. These fungi subsist on dead or dying material such as wood, humus, soil, grass, dung etc. Under the natural fire regime of frequent low to moderate intensity fires; there may have been less small woody debris and less dung. There may have been more grasses and large woody debris. Large snags and large, dying trees may have been more common.

Symbiotic or Mycorrhizal fungi: This group includes some of the Survey & Manage fungi found in the watershed such as the White Chanterelle (*Cantharellus subalbidus*) and *Cortinarius verrucisporus* and many of the fungi collected by mushroom pickers such as the Matsutaki. These fungi set up a mutually beneficial relationship with the rootlets of plants (mostly trees) called mycorrhiza. The mycelium forms a sheath of hyphae around the rootlets of the host and an exchange of nutrients takes place. With less soil disturbance, there may have been more of this type of fungi. Some fungi were collected by Native Americans, but not at the rate they are today.

Lichens

With more habitat diversity, there would have been more hardwoods especially black oak in the watershed. This may have meant more variety in the kinds of lichen found in the watershed.

Noxious Weeds

Noxious weeds are non-native, invasive species. Most of the noxious weeds present in the watershed today were not present at this time. A few species may have been brought into the area by the early explorers and fur trappers from England, Russia and Spain. Most weedy species were brought in after 1870.

4.2.3 Wildlife Species and Habitats: 1850-Present

Land Use Impacts to Wildlife

After 1880 land-use activities introduced by European settlers began to change wildlife habitats in the watershed. Intense railroad logging occurring between 1910-40 denuded large areas of the watershed. 1944 air photos show that large portions of the watershed had been railroad logged. Railroad logging resulted in large concentrations of logging slash that fueled large wildfires that burned about 80% of the watershed. The 1944 photos indicate that both logging and fires devastated old growth areas and the species dependent upon them, but also created good early seral habitats for deer and elk.

The 1944 photos indicate that late-successional habitat was associated with major tributaries to the McCloud River and high elevation red fir zones. The remaining landscape consisted of open forested habitats (<60% canopy closure) primarily of ponderosa pine with shrub or herbaceous understories, with conifer, oak, aspen and chaparral habitats mixed in. Because of the open nature of most of the landscape, late successional species would have been restricted to unlogged mountains in this watershed. Humans and most wild game avoided lava areas with scattered Ponderosa pine, brush and grass. Most game concentrated in southern meadows, lake basins, and spring meadows for water.

Timber harvest increased in the watershed following the development of second growth stands. Developing late-successional habitat was fragmented by new entries in the northern portion of the

watershed. Fragmentation of forest habitat would have impacted late-successional species, but the effect is unknown as no surveys occurred before harvest activities. Despite the lack of surveys, the northern section of the watershed had late-successional habitat adequate for the Northern spotted owl, and two buttes were included as LSR. Other late-successional habitat occurs in relict remnants outside the LSR, mainly on buttes, high elevation red fir, and near meadows.

In addition to second growth harvest clearcuts or brushy areas were tilled, creating large openings of early seral habitat. These areas were generally not utilized by wildlife because tillage or herbicides killed forage and trees were inedible. Site preparation by windrowing, rototilling and cultivating changed soil structure in many areas. This reduced bioactivity and thus productivity, and removed most desirable plants for grazing animals. These activities also removed the small mammal and bird prey base for predators, creating a simple ecosystem of very low value to wildlife on almost all plantations and throughout most of the watershed.

The condition of riparian forage declined as a result of conifer encroachment, fire suppression and grazing. Heavy grazing removed ground cover and created areas favorable for the establishment of pine and fir seedlings. Cattle competed with wildlife for grazing of riparian forage. Populations of deer, elk and bear declined due to competition from cattle. Cattle continued to impact meadow and riparian habitats until effective grazing controls were initiated in the 1960s.

Fire suppression reduced populations of deer, snag-dependent, and other species that utilize early seral habitats (Smith & Murphy, 1980). Fire suppression may have expanded distribution of a few late-successional species, but logging likely reduced it. Increased human activity through road construction/use and timber harvesting reduced habitat use by some species (deer, elk, bear) due to disturbance and exposure (Smith & Murphy, 1980). Many waterholes and springs were developed for sheep grazing. When the market collapsed these provided waterholes for wildlife and were instrumental in deer herd recovery from 1950-70. Wildlife species that prefer human altered environments are more common today (e.g., coyotes, raccoons).

Road building increased dramatically in the mid-1900s. Roads eventually provided vehicle access to every water source used by wildlife in the watershed. Timber harvests increased road density from less than a mile per section to over three miles per section, including unroaded lava lands. If unusable lava land were eliminated from calculations, road densities would be about 5 miles per section. This contributes to stress on game, including poaching.

Water developments helped distribute livestock and deer. They provided alternate water sources when people camped at traditional water holes. They substituted fawning areas for deer and elk and diversified habitat for small birds and other species, but not enough to make a significant difference due to the small number of ponds and limited sites where ponds are possible. The ponds mitigated some effects of continuous meadow shrinkage from tree cover increase, but did nothing for increasing the total amount of quality forage. Reservoir type ponds, as opposed to dugout or well types, have failed due to excessively porous soils so bad that sealants were ineffective. Guzzlers successfully dispersed and maintained deer, but did not substantially increase fawning. All artificial and most natural water sources have been surveyed. Effective ponds last until August, and may be more effective than perennial ponds that attract cattle in late summer.

Wildlife Species of Concern

Four documents discuss historical wildlife population estimates, densities, distribution or presence within the watershed. One document, "A Land-use History of the McCloud River Region, California",

contained brief statements about the species present prior to the 1900's (Cranfield, 1984). The other documents "The Shasta Lake Elk Herd" (Smith & Murphy, 1980) and "A Habitat Management Plan for the Shasta Lake Elk Herd" (Dunaway, 1964) and its addenda, primarily discuss elk population levels and distribution from 1911 to 1980 with some mention of other game species. The McCloud Deer Herd Plan and associated studies contain some useful information. Information on wildlife not mentioned in the documents is projected based on the habitat regime, known European influences on the watershed, and wildlife sighting records from 1971 to 1995.

Threatened and endangered or old growth obligate species were probably at their lowest populations between 1900-1950. It is likely that widespread timber harvest and the large fires occurring before 1930 eliminated owls in this watershed. Habitat for the spotted owl is believed to have been marginal even prior to European settlement and it is likely that the watershed supported few pairs. Some threatened and endangered species such as wolves and grizzly bears became regionally extinct.

Because they were recently discovered in 1999, little is known about the tadpole shrimp populations in the watershed. Tadpole shrimp populations may have been adversely effected by modification of intermittent lake and spring habitats (i.e. development of water holes), cattle and sheep grazing, wildfires, timber harvest and compaction from roads. The continued presence of tadpole shrimp in the watershed indicates that the species was capable of persisting through all of the disturbances noted above.

Professional judgment would indicate that many populations of species of concern declined due to logging. Most riparian species declined because cattle grazing pressure increased on meadows. Goshawk populations increased until 1975 and declined severely in the 1990's. Marten, wolverine, great gray owls, and willow flycatchers were uncommon and remain so.

Survey and manage species and sensitive species were also likely at their lowest populations due to ecosystem simplification from extensive logging, grazing, market hunting, and other human activity. Survey and manage and sensitive species have likely declined since 1960, but the actual amount is unknown. Survey and manage animal species remain uncommon due to specialized habitat preferences.

Game species were hunted to low populations and their habitats were economically exploited until 1930. Some refuge areas remained where logging or grazing was not profitable. Game species apparently peaked in the 1950-1960's, but have returned to prehistoric levels. The peak was recognized all over the West, the result of fires in 1910-30. With increased human pressure for resource extraction, recreation, and hunting, deer populations will likely never equal abundance of the 1950's.

4.2.4 Vascular Plants, Bryophytes, Fungi and Lichens of Special Interest: 1850 to Present

Vascular Plants

Plants requiring riparian habitats such as streams, seasonally wet meadows or vernal pools, including Mountain lady's slipper, Long haired startulip, Columbia cress and Salmon Mountain wakerobin began to loose ground in 1870 when heavy livestock grazing began. The Mountain lady's slipper and Salmon wakerobin do not tolerate heavy livestock grazing. The long-haired startulip and the Columbia cress have maintained a presence even with grazing.

After passage of the Endangered Species Act in 1973, management of diverse habitats that could or did contain Threatened, Endangered or Sensitive (TES) animal species became mandatory. Fortunately,

many of the habitats to be protected for TES animal species, were also habitats for many TES plants. Management strategies protecting these habitats from grazing by livestock such as reduced numbers and days allowed on grazing allotments and fencing of meadows helped to reduce the loss of habitat for sensitive plants. The Northwest Forest Plan (1994) provided further protection and management strategies for vascular plants, bryophytes, fungi and lichens.

The last 50 to 60 years brought many changes in the natural fire regime due to improved methods of fighting wild fires. This in turn brought changes in habitat diversity and stand structure. The once open, grassy forests, with its mosaic of meadows, shrub fields, aspen and black oak stands, shallow lakes, vernal pools and natural openings, became closed with a thick understory of young trees and shrubs. Meadows and other natural openings were reduced by conifer and shrub encroachment. Stands of black oak and aspen were lost due to logging, grazing and fire suppression.

Some dry meadows and other open habitat types, where Baker's globe mallow may have been found, were reduced further when some "under-stocked stands" were turned into ponderosa pine plantations during the 1980's. The building of the Little Mount Hoffman Lookout and the road going up to it reduced the population of the talus collomia. The road, just below the look out, divided the main body of the population in two destroying whatever plants were in the roadway. In 1995, Little Mount Hoffman was made available to rent by the public. This has caused a decline in the health and number of plants due to foot traffic.

Bryophytes, Fungi and Lichens

Intensive logging, road building and other management practices throughout the watershed have left hardly an acre of ground untouched by human management practices. Logging and other associated activities tend to cause extensive disturbance to soils. This soil disturbance tends to be very hard on symbiotic or mychorrizal fungi because it separates the fungi from its host. It would be reasonable to say that there was a decline in mychorrizal fungi during this period. Saprophytic fungi can tolerate some disturbance so their numbers may be more or less the same. The parasitic fungi may have increased do to a monoculture of ponderosa pine.

Logging, fire suppression and grazing have greatly reduced the amount of hardwood habitat, and this may have meant a reduction in bryophytes, fungi and lichens. Many bryophytes, fungi and lichens are closely associated with hardwoods. Logging and wild fires may have reduced the number of populations of Pacific fuzzwort.

Noxious Weeds

After 1870, livestock grazing brought in numerous exotic species such as annual cheatgrass (*Bromus tectorum*), bull thistle (*Circium vulgare*), dandelion (*Taraxacom officinale*) and woolly mullin (*Verbascum thapsus*). Meadows were planted with exotic grass species such as Kentucky bluegrass (*Poa pratense*), orchard grass (*Dactylis glomerata*), redtop (*Agrostis stolonifera)* and timothy (*Phleum pratense*) to improve forage for livestock. Most of these forbs and grasses were brought in from Europe and Eurasia. Many clovers were also imported from Europe and Eurasia to improve forage values for livestock. The planting of non-native grasses and forbs displaced many native species in meadows and other openings.

4.3 Vegetation

Overview

This section discusses changes to both vegetation types and seral stages over time as a result of human influence and natural disturbance.

- **Vegetation Types (Section 4.3.1)** - This section focuses on changes to the amount and condition of the various vegetation types within the watershed.
- **Seral Stages (Section 4.3.2)** – This section focuses on changes to the amount and condition of the various seral stages within the watershed. Seral stages are useful in describing the amount and distribution of habitat within the watershed.
- **Late-successional forest (Section 4.3.3)** – This section focuses on changes to the amount and condition of late-successional forest forest in the watershed. Late-successional forest is discussed separately because it includes additional attributes that cannot be identified solely by tree size and density classifications - such as age and decadence.

This section provides a reference for comparison with current conditions described in Chapter 3.

Pre-1850

The disturbance factors that shaped the forest under pre-European settlement conditions were mainly fire and drought. Fire disturbance was widespread and relatively frequent. Drought was periodic and infrequent.

Both Native Americans and lightning were sources of fire disturbance. Native Americans burned the forest regularly as indicated from recorded accounts (Lewis 1973). However, research on fire modeling based on long-term climatic data including lightning frequency suggests that much of the early fire history can be explained by lightning occurrence alone (Van Wagtendonk 1972).

The general pattern of forest types probably existed then, as they do today, and under the specific characteristics of each of these types, the stocking levels differed and were not necessarily static. A general model of the disturbance regimes affecting stocking levels is that the ponderosa pine stands at lower elevations had a short interval fire regime and open stands. The fir stands at higher elevations had lengthened fire intervals and demonstrated a disturbance cycle with low to high stocking levels.

Wildfires were generally low-intensity surface fires. Ecosystems maintained by surface fires such as ponderosa pine and drier mixed conifer types are a result of fire tolerant successional species that are generally shade intolerant. These regimes contain persistent successional species that generally are shade intolerant and have developed adaptations to survive fire and maintain a constant or fluctuating population in response to disturbance. In the absence of fire beyond the normal return interval, these fire-adapted species are replaced by late-successional species that are predominantly shade tolerant thus producing the development of fuel ladders that alter fire behavior and effects.

There is no evidence to suggest that drought conditions and effects under Pre-European Settlement Conditions were very dissimilar from current conditions. Rainfall records dating back to 1905 show periods of drought that are probably indicative of the pre-settlement climatic pattern. Such droughts probably created the same opportunity for insect infestation and caused a similar pattern of tree mortality as is seen today.

1850 to Present

Under historic conditions, disturbance regimes have been altered. Human influences affected natural disturbance regimes and began to shape the forest.

Alteration of the natural fire regimes has had several direct effects on forest health:

- It has permitted stands to attain much higher stocking levels than would be found under natural conditions. Stands have developed dense understories of shade tolerant species that contribute to vertical fuel continuity.
- It has fostered a shift in species composition in much of the watershed. Stands that were traditionally dominated by pine or mixed conifers are shifting in species composition to shade tolerant and fire intolerant species.
- It has reduced seral diversity among stands. Openings and early seral stages are reduced from pre-suppression conditions.

The introduction of logging as a disturbance factor has direct effects on Forest Health:

- It has changed stocking levels. Widespread logging opened mixed conifer stands and shifted the distribution of seral stages from a primarily old-growth composition with fewer stems per acre to a far greater proportion of early to mid-mature stages with greater stand densities.
- Logging has affected species composition through a prolonged practice of selecting the most valuable species for harvest. Sugar pine, ponderosa pine, and Douglas-fir were selected over incense cedar and white fir. Logging also maintained openings that permitted shade-intolerant species such as black oak to persist even in the absence of fire.
- Logging has affected the diversity of seral stages. The pre-settlement forest was dominated by older seral stages. Early logging caused a widespread shift to early seral stages. The second growth stands are now mostly mid-mature and, in some extensive areas, are homogenous in age and demonstrate little seral diversity.

Fire exclusion coupled with logging impacts has altered the current fire regime from a short interval, low intensity regime to one of moderate to high intensity at infrequent intervals. It appears that natural fire regimes may have been intact in the early 1800s, with fire intervals at 5-30 years. Fire intervals are now greater than 70 years, and the probability of catastrophic wildfire is greatly increased.

In historic times, fire suppression has allowed the incursion of white fir into the understory of mixed conifer and ponderosa pine stands. This phenomenon has added diversity within stands, in that it has created layering and a wider distribution of age classes. Diversity of seral stages was reduced by wildfire suppression as fewer and smaller openings were created. Clearcut logging added to the diversity of seral stages by creating openings.

The advent of aerial photography in 1944 provided the first accurate record of vegetation conditions throughout the Porcupine Watershed. Subsequent flights at five-year intervals documented vegetation changes for the next sixty years. Tables 4-1 and 4-2 display changes to vegetation types and seral stages over time in the watershed as observed from aerial photographs. The following sets of aerial photographs were used:

- 1944 – earliest available photo flight.
- 1975 – photo flight used in Forest database (LMP75)
- 1995 – latest available photo flight at start of project.

A column for 2003 was also included in the tables to display changes since 1995. This column reflects the results of management activities that have occurred since the 1995 photographs plus the anticipated results of projects that are currently being planned or implemented.

4.3.1 Vegetation Types

This section describes changes to the major vegetation types and their general distribution within the Porcupine Watershed.

Table 4-1: Changes to the acreage of vegetation types within the Porcupine Watershed from 1944 to 2003.

	Acres				Percent of Watershed			
Vegetation Type	**1944**	**1975**	**1995**	**2003**	**1944**	**1975**	**1995**	**2003**
Non-forested (lava, rock, etc.)	7747	7726	7723	7723	5.6	5.6	5.6	5.6
Open Conifers on Poor Sites	14825	14956	14828	14950	10.7	10.8	10.7	10.8
Mixed Conifer	51919	54174	51525	53376	37.5	39.1	37.2	38.5
Red Fir	9425	10463	10134	10134	6.8	7.6	7.3	7.3
Ponderosa Pine	11096	10409	11181	12601	8.0	7.5	8.1	9.1
Lodgepole Pine	4711	5005	4561	4552	3.4	3.6	3.3	3.3
Knobcone Pine	3419	4913	5369	5362	2.5	3.5	3.9	3.9
Plantation	10	15156	22600	19223	nom.	10.9	16.3	13.9
Brush	34176	14661	10019	10019	24.7	10.6	7.2	7.2
Meadows	1185	1050	574	574	0.9	0.8	0.4	0.4
Hardwoods *	-	-	-	-	-	-	-	-
Totals	138513	138513	138513	138513	100.0	100.0	100.0	100.0

* Hardwoods occur as a component of other vegetation types.

Non-Forested (unvegetated lava and rock)
Essentially, no change has occurred to the non-forested component of the watershed. A minor reduction in acres shown on Table 4-1 was the result of abandonment of a railroad line near Hambone - which later reverted to brush.

Open Conifer Forest on Sites with Low Productivity
Essentially, no change has occurred to this vegetation type. No significant management activities have occurred in this area and no catastrophic wildfires have occurred, due to the sparse vegetation.

Mixed Conifer Forest
There has been essentially no change in the acreage of mixed conifer forest in the watershed since 1944.

This component reflects the greatest transition due to the effects of grazing, logging, and fire suppression. Natural regimes were likely intact in the early 1800s; but, as the effects of long-term suppression were felt, changes in stand density, species composition, and seral diversity were manifested.

Under present conditions, it is in mixed conifer stands that the greatest drought-caused mortality is seen. With drought, white fir and to a lesser extent ponderosa pine are less able to fend off pathogenic insects and disease. High levels of mortality follow periods of drought. With the fire regime reaching an increasingly altered state, stocking levels have increased and competition for moisture has increased. The effects of drought are more severe in recent times in overstocked stands.

Red Fir
There has been essentially no change in the acreage of red fir forest in the watershed since 1944.

Higher elevations have probably experienced less transition in fuel profiles than midslopes. Fire history shows a pattern of lengthening fire intervals with increasing elevation. The large brush fields in this component may largely be attributed to pre-settlement fire events or residue from logging in the early

1900's which fueled stand-replacing wildfires. However, early logging essentially ignored the less valuable fir stands. Stocking levels in historic times have slowly increased with forest succession.

Ponderosa Pine

There has been essentially no change in the acreage of ponderosa pine forest in the watershed since 1944.

A variety of historical sources, including "Pines Across the Mountain" (Hanft 1971) and McCloud River Lumber Company records, describe the "McCloud Flats" as open, park-like stands dominated by ponderosa pine. Typical stocking levels were in the range of five to ten trees per acre as a result of natural, non-selective thinning by recurring, low-intensity surface fires.

The pine stands on this landscape component were the focus of early logging. Entire sections were logged and came back to "dog-hair" thickets of ponderosa pine reproduction. As the stands matured overstory stocking levels have decreased but white fir understories have developed.

Lodgepole Pine

There has been little change in the amount of lodgepole pine forest in the watershed since 1944 (see Table 4-1). Although there has been extensive conversion of lodgepole pine stands to plantations during the last thirty years, this reduction in acreage has been mostly offset by ingrowth from early seral stages. As a result, the net loss of lodgepole pine forest since 1944 is approximately 159 acres.

Between 1944 and 2003, approximately 645 acres of lodgepole pine forest had been converted to plantations. The majority of this conversion occurred near White Deer Lake, Toad Lake, Harris Spring, and Fisk Ridge. Additional lodgepole pine stands were lost during this same period due to the encroachment of shade tolerant conifers.

The loss of lodgepole pine described above has been offset by the development of new lodgepole pine stands. The most significant increase in the acreage of lodgepole pine is the result of the 1928 Stephens Pass Fire. Following the fire, large areas of brush had developed near Red Cap and Horse Peak. It is assumed that brushfields noted on 1944 aerial photography also contained a large amount of lodgepole pine saplings because these areas began to develop the lodgepole pine stands that occupy the site today.

Additional increases in the lodgepole pine forest were the result of lodgepole pine encroachment into meadows and open conifer forests.

Summary of gains and losses to the lodgepole pine forest type from 1944 to the present:

Decreases in amount of lodgepole pine forest:	
Conversion to plantations	645 acres
Natural progression to other conifer types	81 acres
Total decrease in area	726 acres
Increases in amount of lodgepole pine forest:	
Development from grass	32 acres
Development from brush (mostly the result of 1928 fire)	370 acres
Development from open conifer forest	165 acres
Total increase in area	567 acres

Knobcone Pine

There has been a 1,943 acre increase in the acreage of knobcone pine forest in the watershed since 1944.

Approximately 90% of the knobcone pine forest type occurs on productive soils, with the remaining 10% on lava flows and other areas of low productivity. Most of this decline has been the result of

conversion to plantation on areas with productive soils.

Plantations

The first plantation in the watershed was planted in 1936 near Hambone. This 10-acre plantation was still the only one recorded in the watershed in 1944.

Large brush conversion projects occurred in the northern and eastern portions of the watershed from 1959 to 1973. Approximately 10,000 acres of brush were cleared and converted to ponderosa pine plantations during this period. Large plantations were also established along the eastern edge of the watershed following a large wildfire in 1959. By 1975, 15,156 acres within the watershed were occupied by predominantly ponderosa pine plantations.

Reforestation activities in the 1980's focused on bringing understocked lands into full timber production. The conversion of open canopy conifer forests to plantations during this period increased the plantation acreage within the watershed to 22,600 acres by 1995.

Since 1995, many of the oldest plantations in the watershed have progressed in tree size and have been reclassified as mixed conifer or ponderosa pine vegetation types. As a result, approximately 3,377 acres have made the transition into conifer forest types with a subsequent reduction in plantation acreage to 19,223 acres by 2003.

Brush

There has been a loss of over 24,000 acres of the brush vegetation type in the watershed since 1944.

In 1944, 34,176 acres (24.7%) of the National Forest land in the watershed were occupied by the brush vegetation type. Extensive brushfields of manzanita and snowbrush occurred in the northern and eastern parts of the watershed. The lack of roads, skid trails, and stumps on aerial photographs indicates that the majority of these brushfields were the result of repeated wildfire rather than logging.

Large brush conversion projects in the 1960's and 1970's converted approximately 25,000 acres of brushfields to ponderosa pine plantations. The brush vegetation type was further reduced to approximately 10,019 acres (7.2%) by 1995.

Plantations that resulted from the brush conversion projects of the 1960's and 1970's developed a dense brush understory of manzanita and snowbrush. As a result, these plantations continued to provide habitat conditions similar to the brush conditions they replaced for several decades. In recent years, the development of dense conifer canopies and plantation thinning activities have resulted in a decline in the brush understory in these plantations.

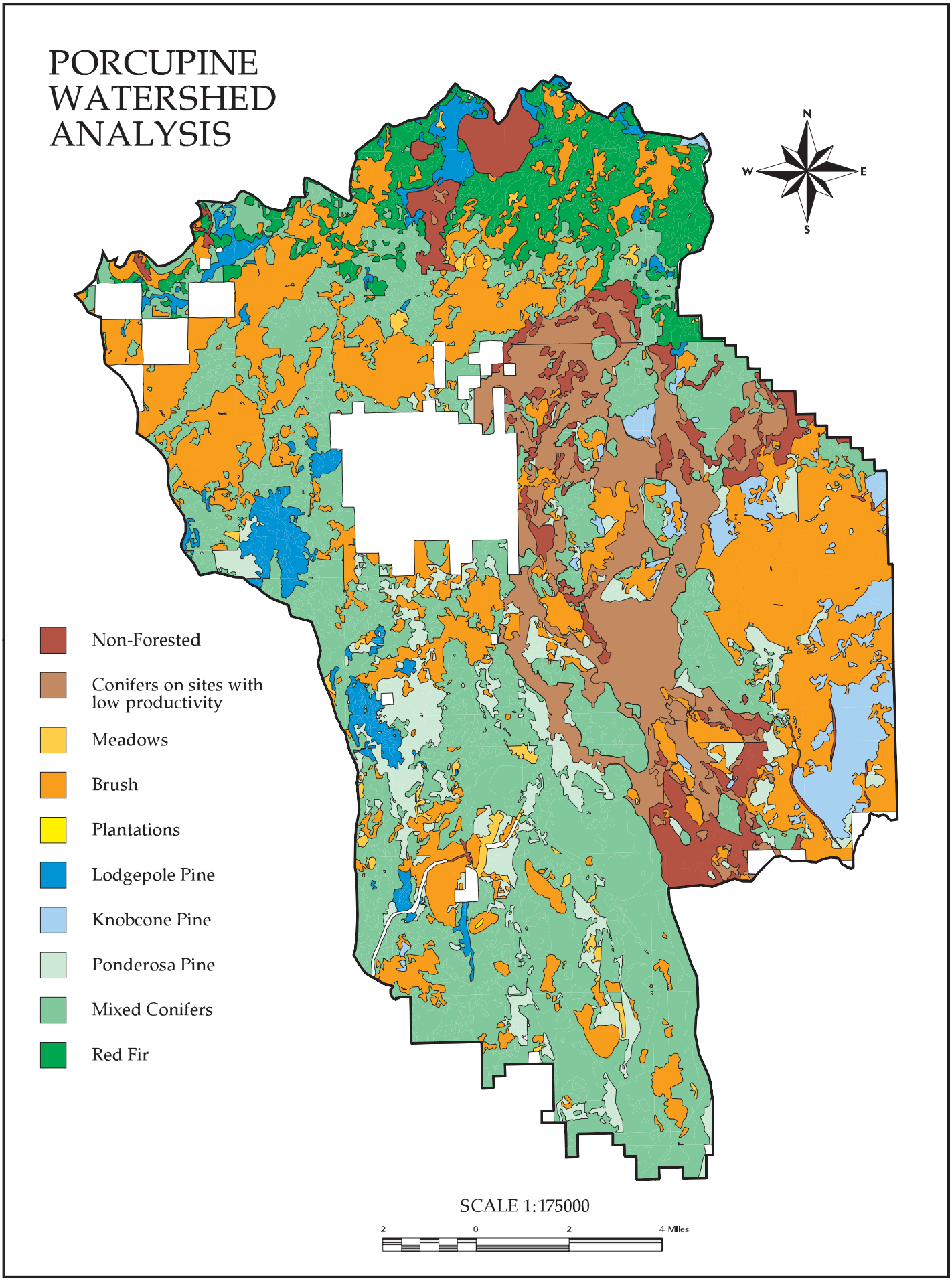
Meadow (grass and forbs)

There has been a loss of 611 acres of the meadow vegetation type in the watershed since 1944. This represents a 48.5% decline since 1944 to the current level of 574 acres. Of this decline, 347 acres are attributed to conversion to conifer plantation and 410 acres are due to natural conifer encroachment in the absence of fire. This is partially offset by a gain of 146 acres – mostly due to plantation failures that were purposely left to provide meadow habitat.

Most of the losses attributed to conifer encroachment have occurred in riparian meadows in the southern part of the watershed. Drier high-elevation meadows in the northern part of the watershed appear to be more stable and less susceptible to conifer encroachment.

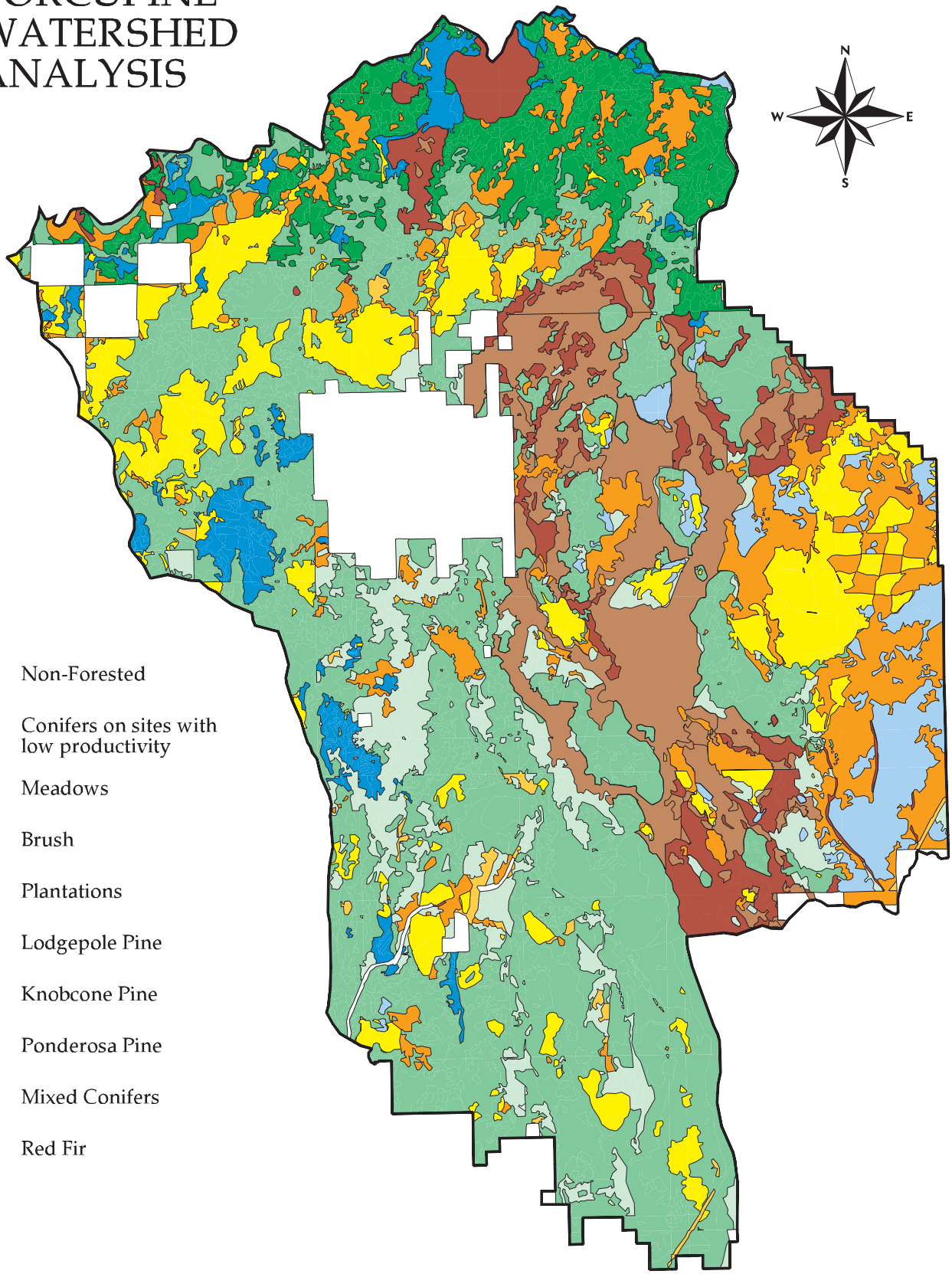
Hardwoods

The extent of hardwoods in the watershed is difficult to determine on early aerial photos. However,

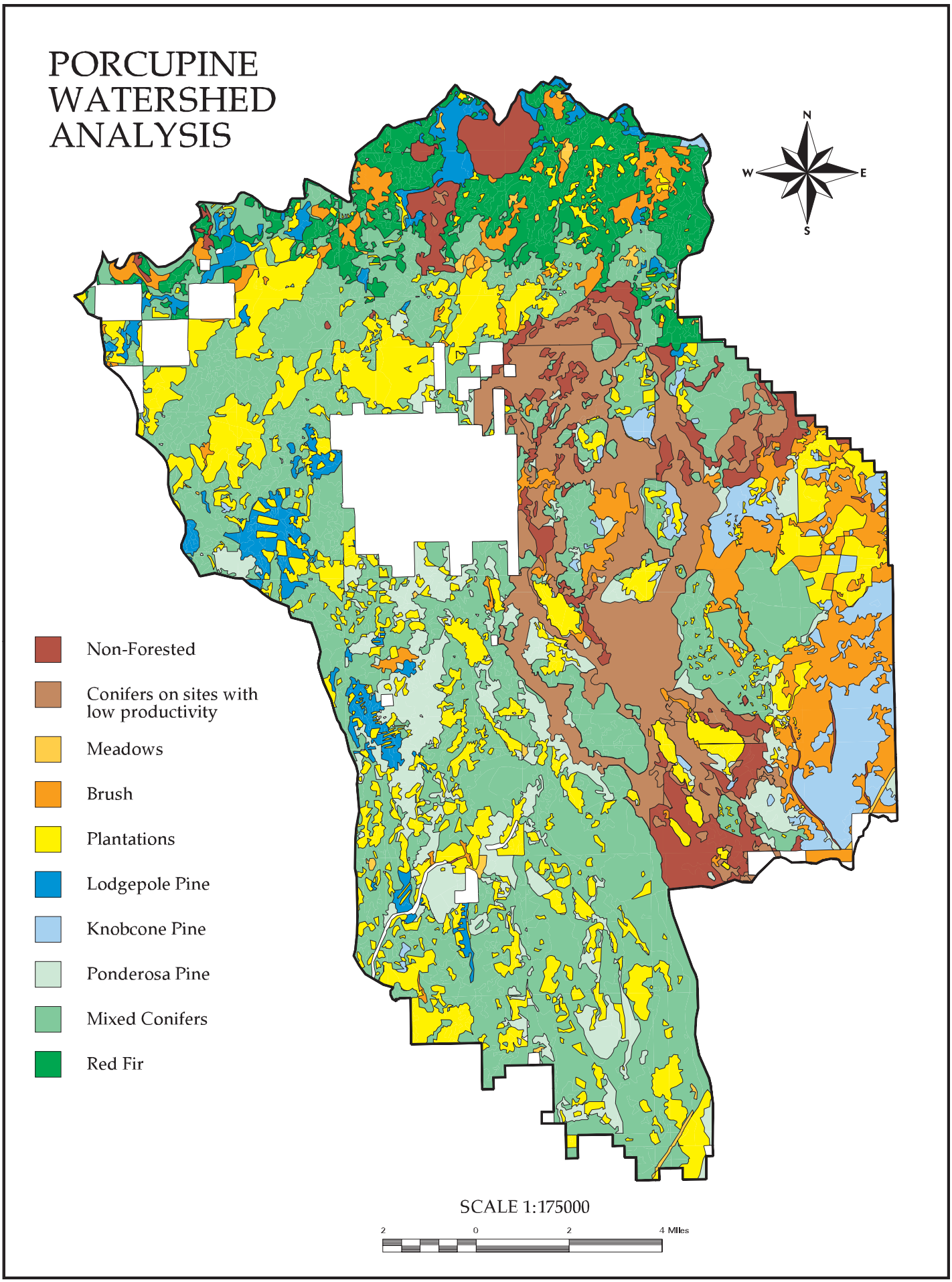


Map 17a. Vegetation Types - 1944

PORCUPINE WATERSHED ANALYSIS

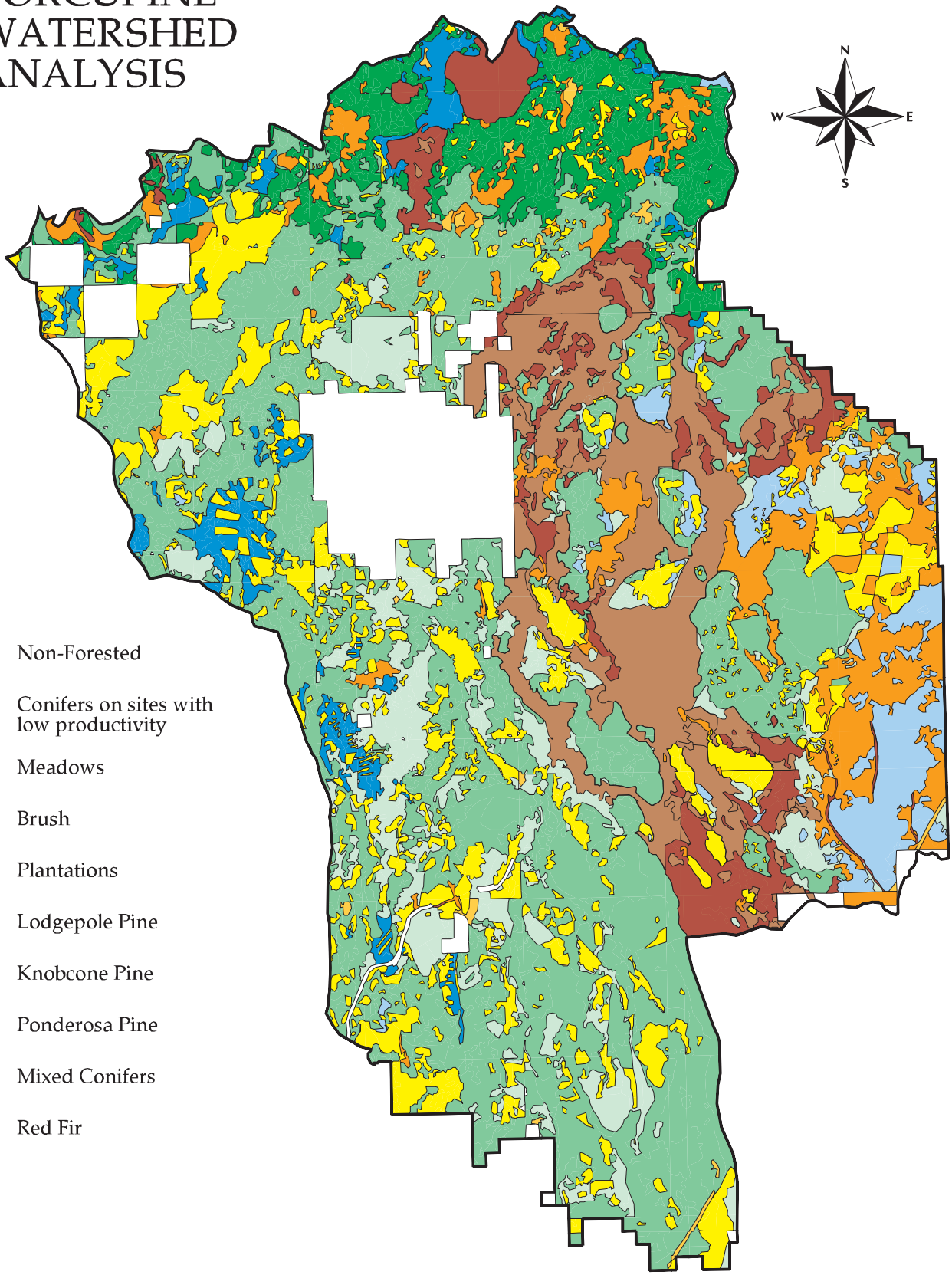


Map 17b. Vegetation Types - 1975

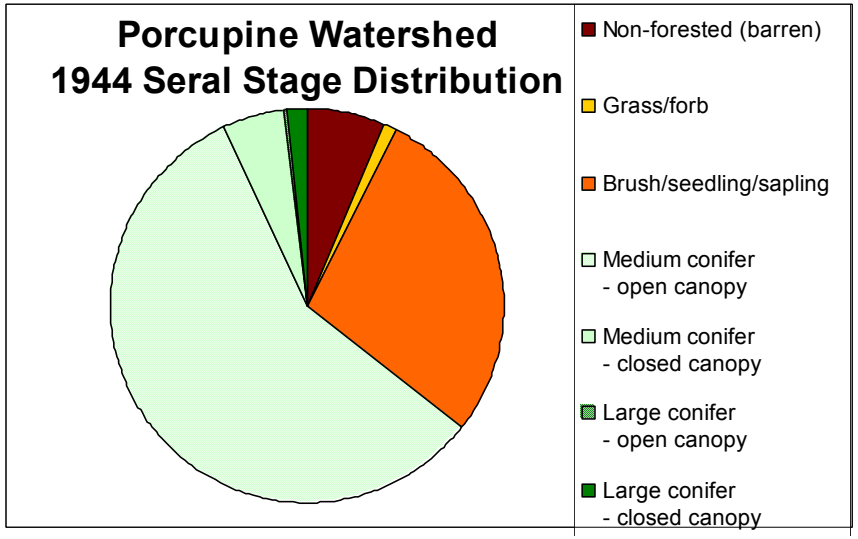


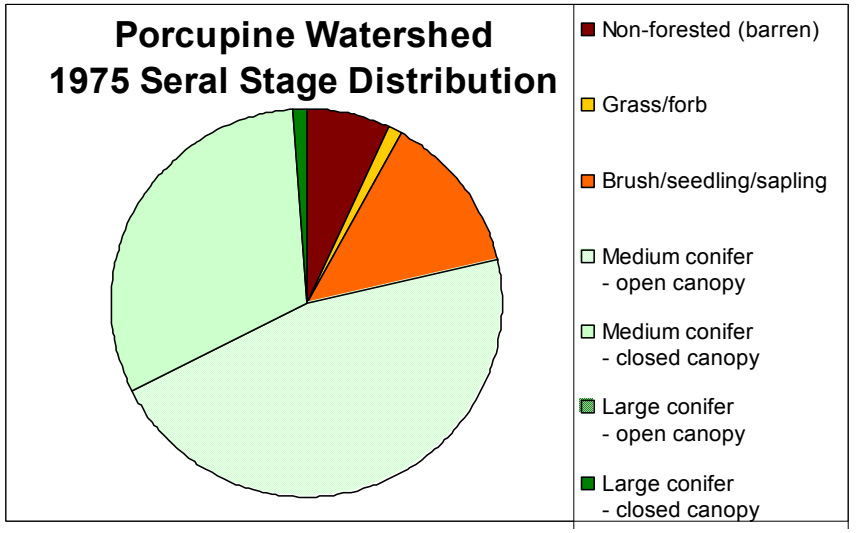
Map 17c. Vegetation Types - 1995

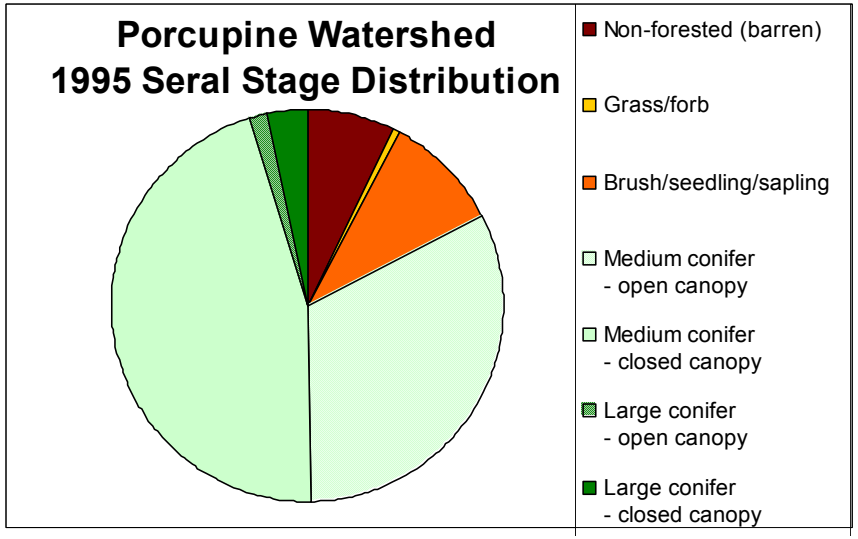
PORCUPINE WATERSHED ANALYSIS



Map 17d. Vegetation Types - 2003







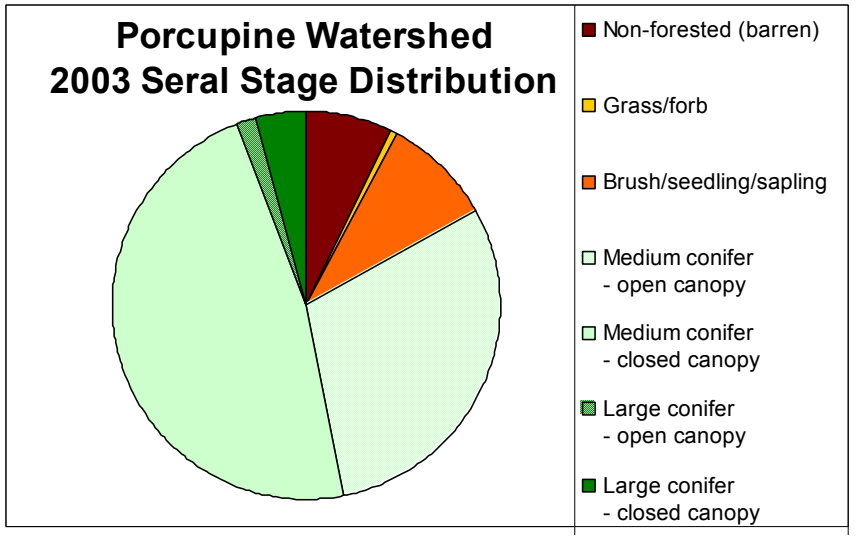


Figure 4-1 – Changes in seral stage distribution in the Porcupine Watershed from 1944 to 2003.

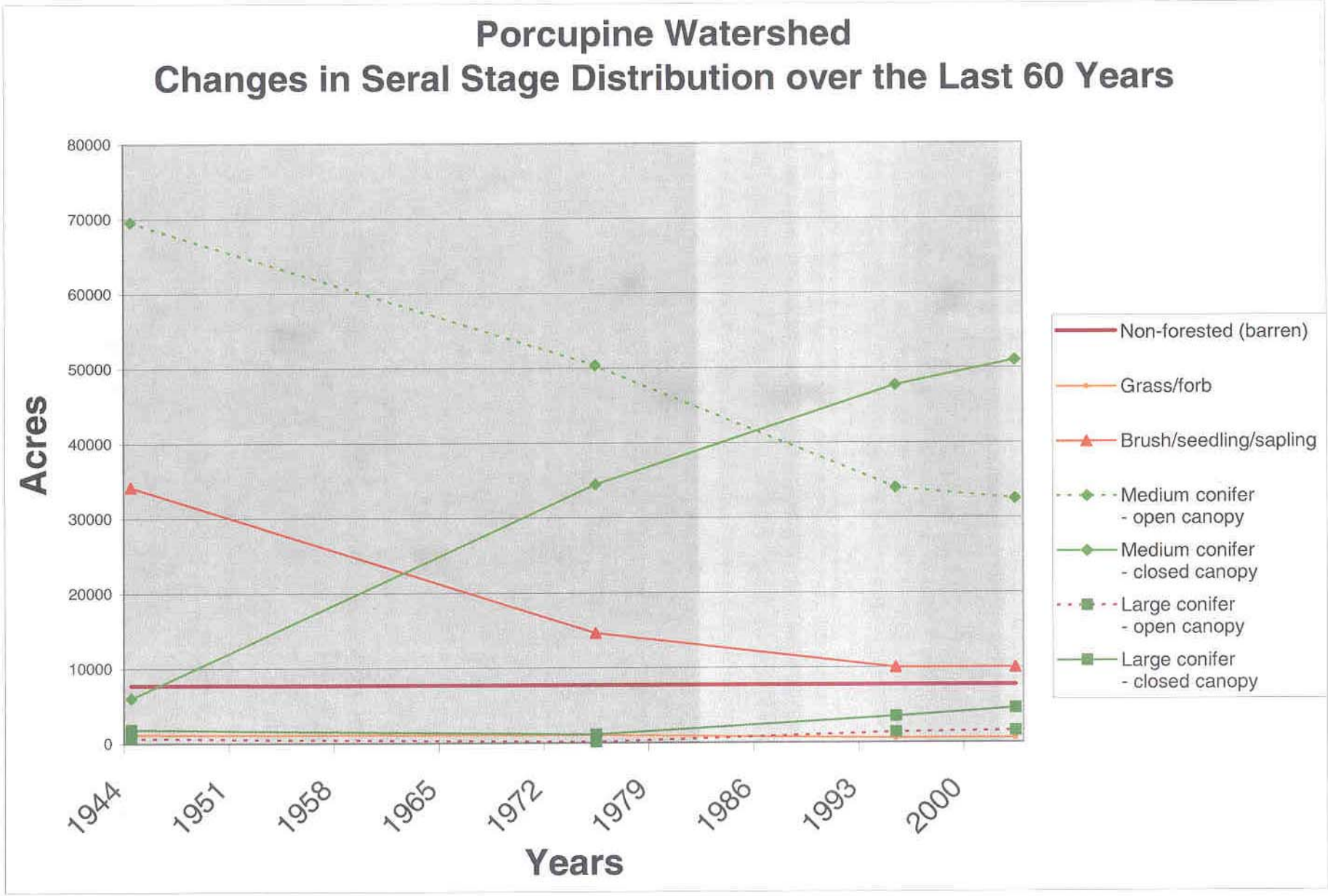


Figure 4-2 - Changes in seral stage Distribution in the Porcupine Watershed over the last 60 years.

features on the ground, such as snags and down logs, give evidence of the past condition and extent of hardwoods.

The occurrence of residual quaking aspen trees within young conifer stands indicates that aspen was once fairly common in the watershed when forest conditions were more open. The continuing decline of aspen due to conifer encroachment is continuing in both upland and riparian areas.

Field observations indicate that black oak has always been a component of the mixed conifer forest in the watershed, especially towards the southern part of the watershed and on the buttes. The abundance of oak within a particular stand would have varied over time relative to the density of the overtopping crown canopy and the availability of openings.

4.3.2 Seral Stages

This section describes changes to the major vegetation types and their general distribution within the Porcupine Watershed.

Table 4-2: Changes to seral stage distribution within the Porcupine Watershed from 1944 to 2003.

		Acres				Percent of Watershed			
Seral Stage		**1944**	**1975**	**1995**	**2003**	**1944**	**1975**	**1995**	**2003**
Non-forested		7747	7726	7723	7723	5.6	5.6	5.6	5.6
Grass/forb		1185	6566	7635	3741	0.9	4.7	5.5	2.7
Brush/seedling/sapling		34176	21169	17450	19110	24.7	15.3	12.6	13.8
Medium Conifer	open canopy	76683	51592	34283	32870	55.4	37.2	24.8	23.7
	closed canopy	16188	50157	66509	68900	11.7	36.2	48.0	49.7
Large Conifer	open canopy	671	156	1407	1570	0.5	0.1	1.0	1.1
	closed canopy	1854	1147	3506	4600	1.3	0.8	2.5	3.3
Totals		138513	138513	138513	138513	100.0	100.0	100.0	100.0

Non-Forested (unvegetated lava and rock)
Essentially, no change has occurred to the non-forested component of the watershed. A minor reduction in acres shown on Table 4-2 was the result of abandonment of a railroad line near Hambone - which later reverted to brush.

Grass/forb (WHR 1)
The grass/forb seral stage includes both a grass/meadow component and recent plantations less than 10 years old. Significant increases in the acreage of the grass/forb seral stage in 1975 and 1995 (see Table 4-3) are the result of the extensive conversion of large brushfields to pine plantations and the reforestation of large wildfires. A subsequent decline in 2003 is the result of many of these plantations advancing into later seral stages.

Table 4-3: Changes in the composition of the grass/forb seral stage within the Porcupine Watershed from 1944 to 2003.

	Acres				Percent of Seral Stage			
Component	**1944**	**1975**	**1995**	**2003**	**1944**	**1975**	**1995**	**2003**
Grass/meadow	1185	1050	574	574	100.0	16.0	7.5	15.3
Plantations (<10 yrs. old)	0	5516	7061	3167	0.0	84.0	92.5	84.7
Totals	1185	6566	7635	3741	100.0	100.0	100.0	100.0

The actual acreage of the grass/meadow component within this seral stage actually declines from 1185 acres in 1944 to 574 acres in 2003. This decline is due to conifer encroachment and conversion to plantations (see discussion in Section 4.3.1 – Meadow).

Shrub/seedling/sapling (WHR 2)

In 1944, the shrub/seedling/sapling seral stage was composed entirely of brush and occupied 34,176 acres – or 24.5% of the watershed. At this time, large brushfields of manzanita and snowbrush extended across the northern and eastern parts of the watershed – often 3 or 4 miles across. The size and distribution of these brushfields throughout the watershed in 1944 is displayed on Maps 17a and 18a. The lack of roads, skid trails, and stumps on aerial photographs indicates that the majority of these brushfields were the result of repeated wildfire rather than logging.

Table 4-4: Changes in the composition of the shrub/seedling/sapling seral stage within the Porcupine Watershed from 1944 to 2003.

	Acres				Percent of Seral Stage			
Component	1944	1975	1995	2003	1944	1975	1995	2003
Brush	34176	14662	10019	10019	100.0	69.3	57.4	52.4
Plantations (10-20 yrs.)	0	6507	7431	9091	0.0	30.7	42.6	47.6
Totals	34176	21169	17450	19110	100.0	100.0	100.0	100.0

Large brush conversion projects in the 1960's and 1970's converted many of the large brushfields to ponderosa pine plantations and significantly reduced the acreage of both the shrub/seedling/sapling seral stage and its brush component. Reductions in the brush component were partially offset as new plantations developed into the seral stage.

Plantations that resulted from the brush conversion projects of the 1960's and 1970's developed a dense brush understory of manzanita and snowbrush. As a result, these plantations continued to provide habitat conditions similar to the brush conditions they replaced for several decades. In recent years, the development of dense conifer canopies and plantation thinning activities have resulted in a decline in the brush understory in these plantations.

Pole/medium tree – open canopy (WHR 3a)

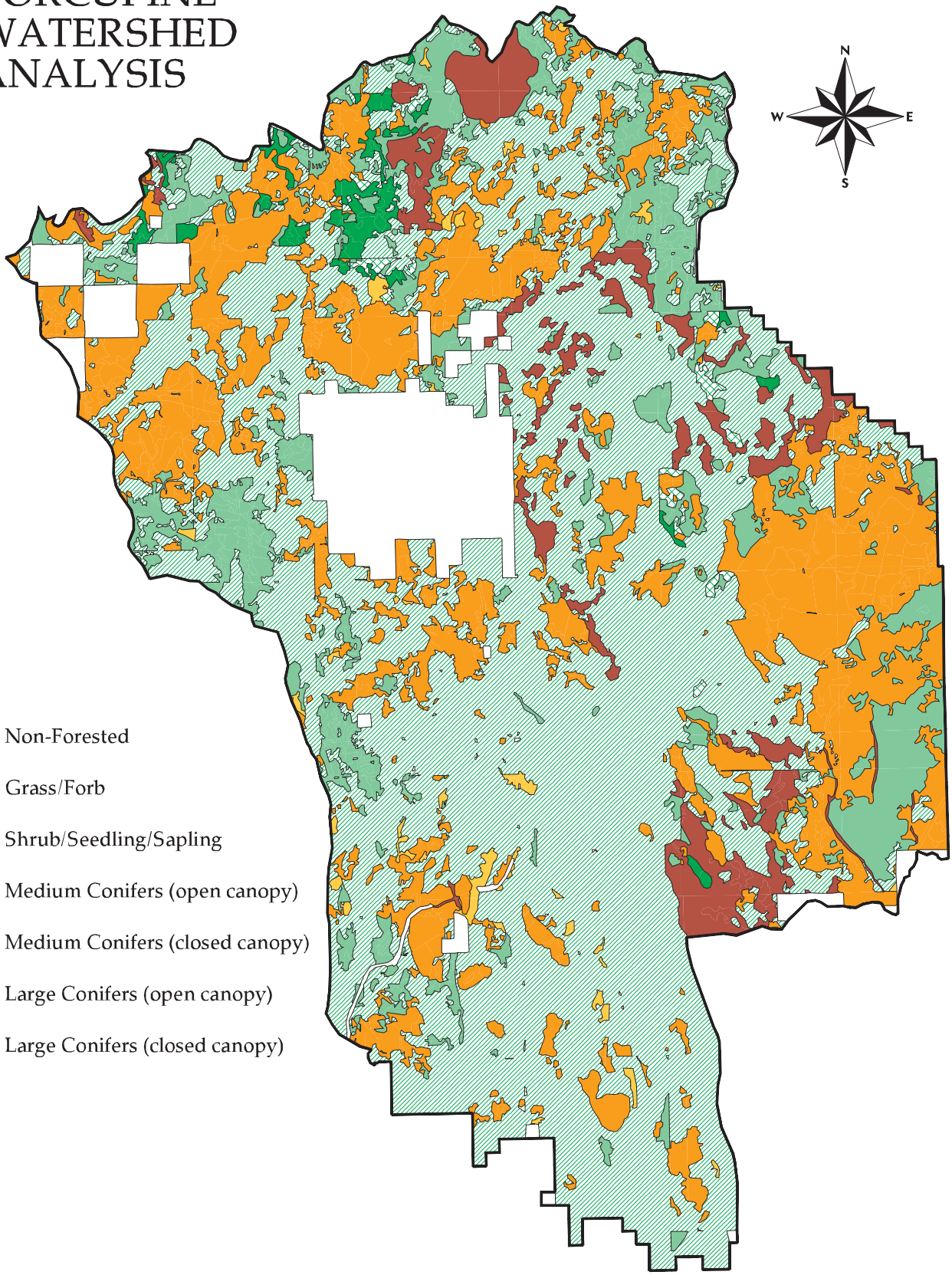
There has been a significant decline in the acreage of the "pole/medium tree – open canopy" seral stage since 1944 as tree sizes and densities increase and forest stands make the natural progression into other seral stages. This seral stage is currently at 43% of its 1944 level, with most of the loss accounted for by the development of stands into the "pole/medium tree – closed canopy" seral stage. These changes are displayed on Table 4-2 and on the charts in Figures 1 and 2.

Table 4-5: Changes in the acreage of the "pole/medium tree – open canopy" seral stage in areas of differing soil productivity within the Porcupine Watershed from 1944 to 2003.

	Acres				Percent of Seral Stage			
Site Productivity	1944	1975	1995	2003	1944	1975	1995	2003
Low site (lava and rocky areas)	14290	14344	14222	14222	18.6	27.8	41.5	43.3
High site (productive soils)	62393	37248	20061	18648	81.4	72.2	58.5	56.7
Totals	76683	51592	34283	32870	100.0	100.0	100.0	100.0

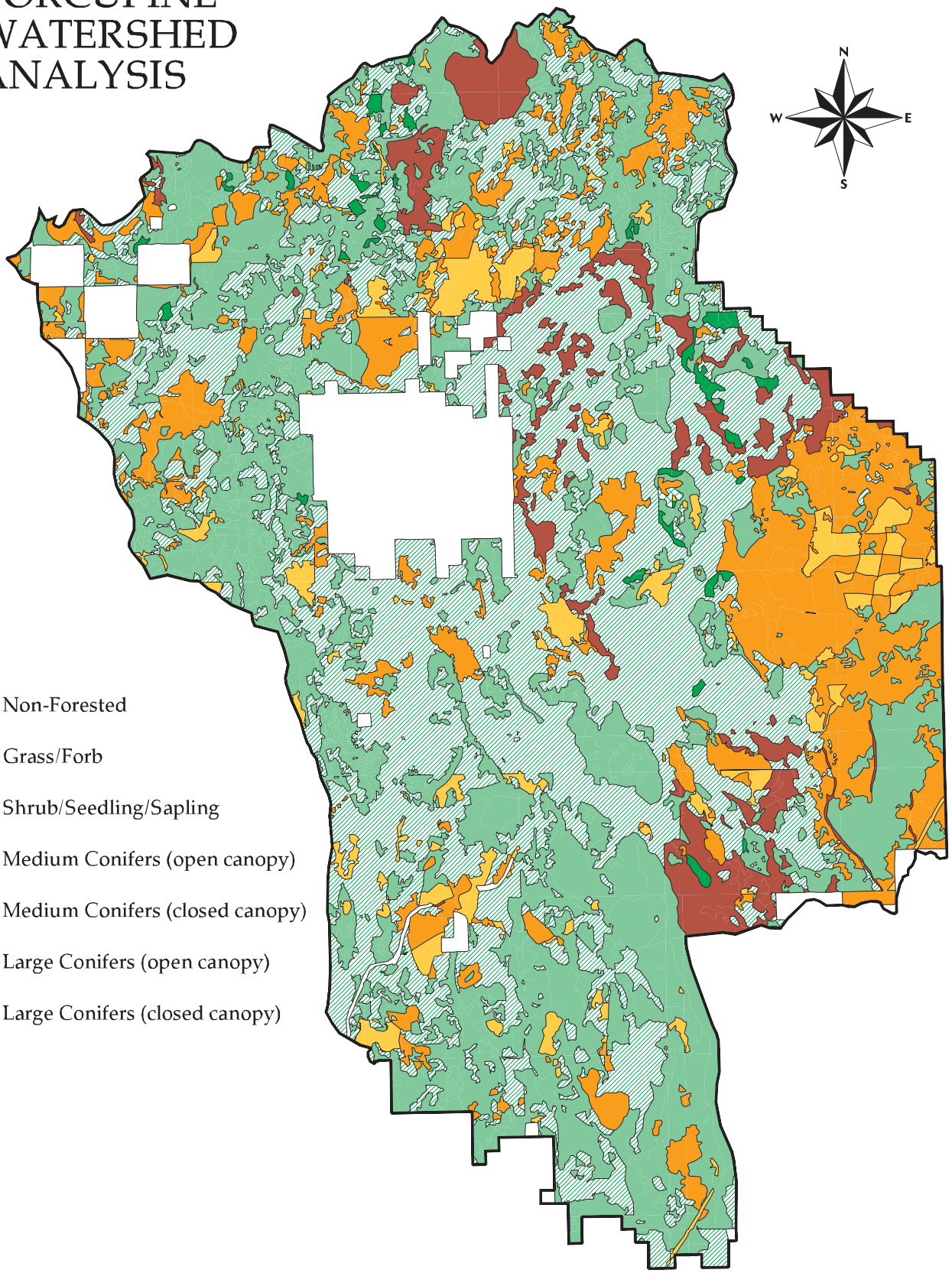
Low site - Essentially no change has occurred over time to that portion of the "pole/medium tree – open canopy" seral stage located in areas of low site productivity – such as large lava flows and rocky areas (see Table 4-5). Such areas are probably growing at the carrying capacity for the site and it is reasonable to assume vegetation has changed little in the past several hundred years. There have been very few management activities in these areas since 1944.

PORCUPINE WATERSHED ANALYSIS



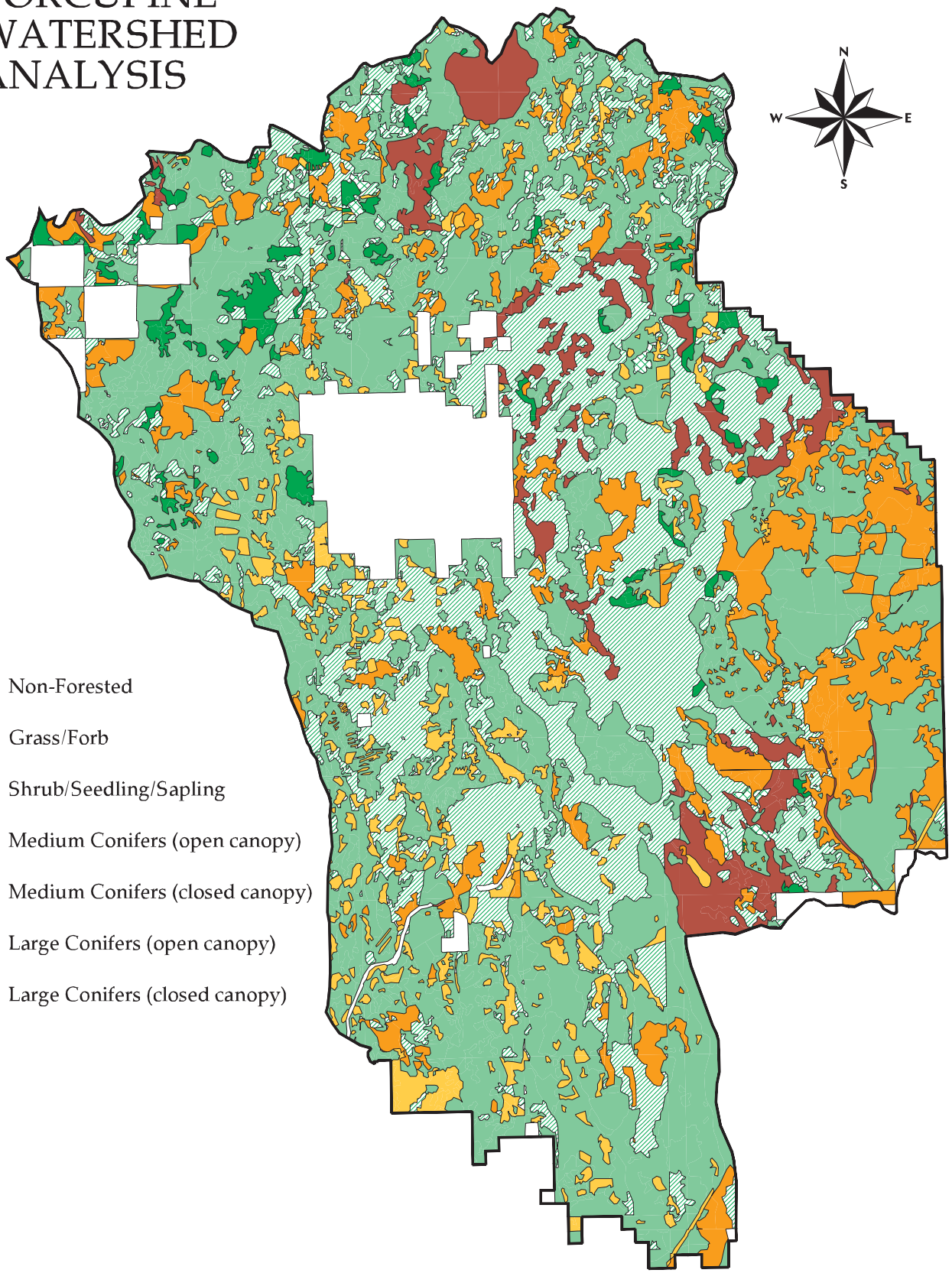
Map 18a. Seral Stages - 1944

PORCUPINE WATERSHED ANALYSIS



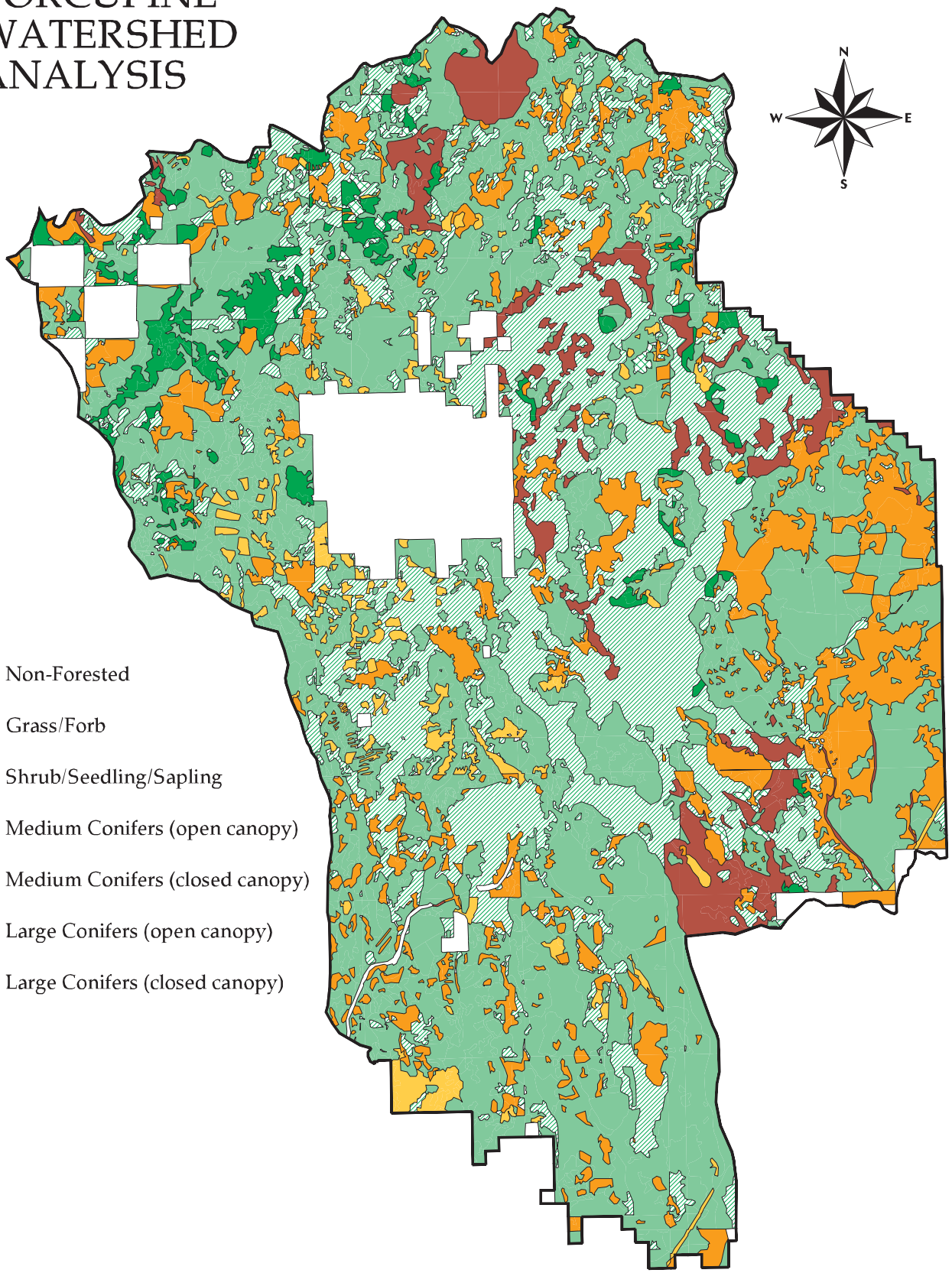
Map 18b. Seral Stages - 1975

PORCUPINE WATERSHED ANALYSIS



Map 18c. Seral Stages - 1995

PORCUPINE WATERSHED ANALYSIS



Map 18d. Seral Stages - 2003

High site - The acreage of the "pole/medium tree – open canopy" seral stage occurring on highly productive soils has declined steadily since 1944 (see Table 4-5). Most of this decline in acreage is due to forest stands making the transition into the "pole/medium tree – closed canopy" seral stage as stand densities, tree size, and crown canopies increase.

Pole/medium tree – closed canopy (WHR 3b, 3c)
There has been a significant increase in the acreage of the "pole/medium tree – closed canopy" seral stage since 1944 as tree sizes and densities increase and forest stands make the natural progression from other seral stages. The majority of this increased acreage is from stands developing from the "pole/medium tree – open canopy" seral stage. These changes are displayed on Table 4-2 and on the charts in Figures 1 and 2.

Large tree – open canopy (WHR 4a)
The acreage of the large tree seral stages declined greatly with the beginning of logging in the watershed. Logging activities are seen in early photographs and described in newspaper accounts, but an accurate record of changes across the landscape was not available until the first aerial photo flight was made in 1944.

There has been a gradual increase in the acreage of the "large tree – open canopy" seral stage since 1944. The majority of this increase is from the development of stands from the "pole/medium tree – open canopy" seral stage. Many of these stands developed in areas that were heavily logged during the period of railroad logging. Other stands developed in areas that were previously occupied by scattered smaller conifers over brush. Changes in acreage over time are displayed on Table 4-2 and on the charts in Figures 1 and 2.

Large tree – closed canopy (WHR 4b, 4c)
The acreage of the large tree seral stages declined greatly with the beginning of logging in the watershed. Logging activities are seen in early photographs and described in newspaper accounts, but an accurate record of changes across the landscape was not available until the first aerial photo flight was made in 1944.

Changes to the "large tree- closed canopy" seral stage since 1944 are displayed on Table 4-2 and on the charts in Figures 1 and 2. A decline of 707 acres from 1944 to 1975 was the result of logging in the northwest part of the watershed where large overstory trees were removed. Since 1975, the acreage of the "large tree- closed canopy" has increased at approximately 1,000 acres per decade as forest stands make the natural progression from other seral stages.

4.3.3 Late-Successional Forest

The acreage of the late-successional forest declined greatly with the beginning of logging in the watershed. Early wildfires probably also contributed to a loss of late-successional forest. Early photographs and newspaper accounts indicate that older trees and later successional stages were more common in the watershed. However, an accurate record of the extent of late-successional forest within the watershed was not available until the first aerial photo flight was made in 1944.

In 1975 the Shasta-Trinity National Forest Timber Management Plan resulted in a shift in timber emphasis towards the reforestation of understocked lands. As a result, there was less emphasis on regenerating older conifer stands and a subsequent increase in the acreage of late-successional forest.

4.3.1 Fire and Fuels: Pre-1850

Fire was a major disturbance factor in the Porcupine Watershed prior to European settlement. Fire drought disturbances controlled forest structure and composition and created a fire-adapted ecosystem that was dependent on recurring fire. Throughout North America native cultures often managed fire to meet several resource needs such as forage and general enhancement of wildlife procurement. Records indicate that several of these native tribes lived in environments with recurring frequent low intensity fire regimes. Lightning caused fire starts probably accounted for the majority of fire ignitions. Lightning caused fires could have easily accounted for large low intensity fire occurrence at 5-25 year intervals, as well as occasional smaller stand replacement fires characteristic of the watershed fire regime.

The process of stand development in pine forests is a result of shade intolerance of ponderosa pine species, sporadic years of adequate seed establishment, adequate precipitation, and frequent fire (Cooper 1960). Prior to 1850 the Porcupine watershed (at least 80%) was probably dominated by fire adapted Ponderosa Pine. Frequent low intensity fires burned understory vegetation keeping fuel concentrations low and maintaining open pine stands. Low intensity fires scarred but generally did not kill larger trees. There are also documented accounts of large free burning wildfires that generally did not burn the forest overstory. However, while recurring fire checked many shade tolerant species in the understory, early Ponderosa Pine forest still contained considerable understory vegetation. The forest understory probably was denser in the moist, high elevation mixed conifer stands.

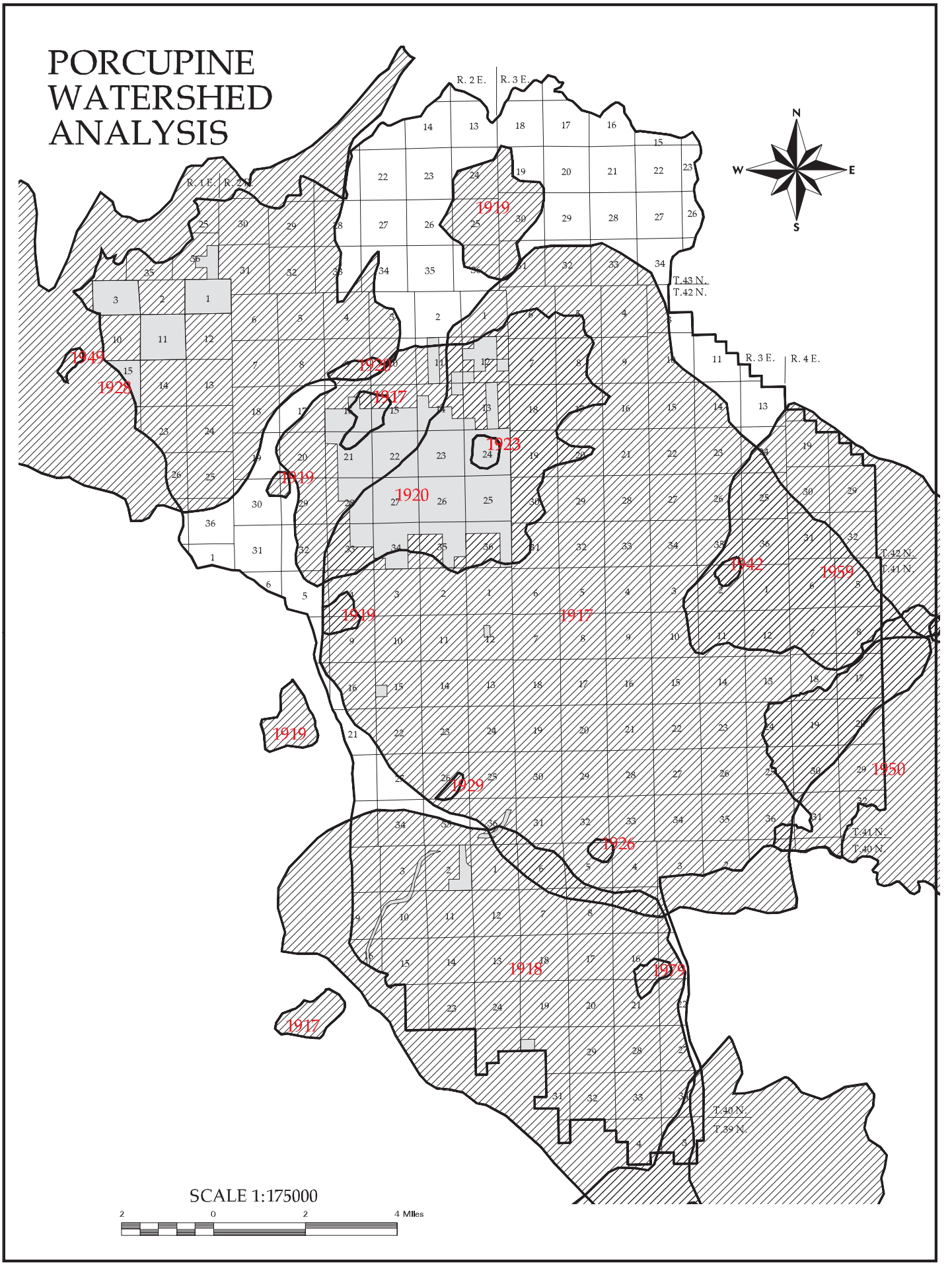
Grasses were the primary understory vegetation in the pine dominant forests of the watershed. There are several factors responsible for the decline of perennial grasses over time, the primary one being grazing that occurred in the settlement period. The typical fire in Ponderosa Pine forest likely only removed the cured component of herbaceous fuels above the ground. Bitterbrush was likely much less common across the watershed than it is today. It is also doubtful that large logs remained long on the forest floor in this regime to provide wildlife habitat as they were likely consumed after several years of frequent fires.

4.3.2 Fire and Fuels: 1850 to Present

Fire regimes in the watershed were altered following the arrival of European settlers. By the early 1900's logging was beginning to change the landscape in many western forests. The continued practice of removing the large overstory, leaving heavy amounts of fuels on the surface, and the development of surface to crown fuel ladders gradually contributed to this transition. The U.S. Forest Service established the Shasta National Forest in 1907, beginning a protection era that emphasized a strong suppression policy. While such policies had obvious good intentions to protect life and resources from the destruction of wildland fires, they also contributed to the complete exclusion of fire. The almost complete exclusion of fire in this fire-adapted ecosystem began to alter the way fires burned when ignited by natural ignitions sources.

Grazing also contributed to changes in the natural fire regime. Grazing changed regeneration patterns and added a new ignition source as herders periodically burned off favored grazing sites to maintain forage.

Numerous large fires occurred during the period that the watershed was being settled (see Table 4-6 and



Map 19. Large Fire History

Map 19). From 1917 to present approximately 16,400 acres were burned every decade - a total of 139,530 acres or 93% of the watershed area for the 85-year period. Developing suppression equipment and inadequate forces were partly responsible for the large acreage burned during the settlement period. The majority of the large fires occurred in southern 80% of the watershed within the Ponderosa/lodgepole pine fire regime that had experienced the greatest change. The largest fires burned in 1917 and 1928 in the Dry Lake/Hambone area and the Stevens Pass area. Such fires were typical of early fires that burned for several months, likely only being extinguished by seasonal rains or burning into natural fuel barriers.

Year	Acres Burned
1917	65,000
1918	17,280
1919	2,420
1920	16,160
1923	450
1926	150
1928	22,000
1929	150
1942	200
1950	3,840
1959	10,880
1977	650
1979	350
Total	139,500 Acres

Table 4-6: Porcupine Watershed Large Fire History.

The influence of these large fires on forest structure can be seen when the fires areas are overlain on a map showing recent vegetation types. Large areas of Lodgepole Pine were established in the area of the 1917 fire of 65,000 acres in the central portion of the watershed. Large areas of brushfields, as well as tree plantations follow the perimeter of the 1950 and 1959 fires in the eastern portion of the watershed.

4.4 Riparian Reserves

4.4.1 Pre-1850

Very little is known about the condition of Riparian Reserves in the Porcupine Watershed prior to European settlement. Reference conditions for Riparian Reserves are believed to be very similar to current conditions with respect to the locations and types of hydrologic features found in the watershed. Vegetation types present within wet meadow and near other hydrologic features probably were different due to the influence of large wildfires that periodically burned much of the watershed during the summer months. Because most intermittent lakes, stream channels, springs and wet meadow complexes were dry by mid-summer, vegetation within these areas was probably consumed by large fires. Wet meadows were probably more open with more grasses and forbs present.

The amount of water available for wildlife, vegetation and human uses was probably limited from August through October in most years. Large wildfires that removed vegetation and reduced evapotranspiration may have increased the duration of water availability from springs, intermittent streams, and intermittent lakes for short periods of time after the disturbance. Table 4-7 lists the water

sources that are believed to have been reliable on a consistent basin during late summer. These water sources were undoubtedly very important for Native Americans and wildlife. Archaeological evidence and site visits over the past several decades indicate that these sources had the greatest potential of being perennial. Other sites that may have been perennial, but for which no information was available, are not included in this list.

Natural Water Sources	Description
Tamarack Lake	Tamarack Lake is believed to have been a perennial spring prior to being developed in the mid-1900s. The spring consisted of a small swampy depression that was excavated in order to provide water for dust abatement on roads during timber harvest operations. Since being excavated Tamarack Lake has never been known to dry out.
Bear Spring	Bear Spring was developed for grazing and fire suppression in the early 1900's. The spring box holds water throughout the year but surface water is absent by July in most years. The large Native American site located at the spring suggests that the spring was a perennial source of water prior to being developed.
Harris Spring	Harris Spring was a perennial source of water prior to being developed for grazing and the Harris Guard Station.
Pumice Stone Lake	Pumice Stone Lake was originally a small swampy depression that is believed to have had standing surface water year round. A well was installed in the pond in the early 1900's and the depression was dug out to form a larger pond in the 1980's.
Toad Lake	Toad Lake was originally believed to be a wet depression that was deepened and dammed by the railroad in the 1920's.
Lost Spring	Lost Spring is believed to have been a perennial spring. The spring was developed in the late 1980's in order to provide water for fire suppression and grazing.
Lost Iron Well	Lost Iron Well was a spring that was developed for water use for fire suppression. The large Native American site at the spring indicates that spring flow was probably perennial.
Lava Crack Spring	Lava Crack Spring is similar to Lost Iron Well and also has a substantial Native American site.
Ponds in Lava (Porcupine Lake, Willow Ponds and others.	Approximately 4 lava ponds occur naturally in the watershed. These ponds usually contain water, and along with caves represent the only water sources in the Porcupine Watershed that have never been developed.
Caves	Small caves scattered throughout the northern half of the watershed contain pools of water fed by melting ice.
Other suspected sources	Perennial water sources may have also been available at Caribou Well, Hambone Pump and Mud Well.

Table 4-7: Natural, perennial water sources in the Porcupine Watershed prior to 1850.

4.4.2 1850-Present

From 1850 to present the natural condition of Riparian Reserves was altered by land-use activities. European settlers introduced new land-use practices in the watershed including timber harvest and road construction, grazing, suppression of wildfire, woodcutting and recreation activities including camping, hunting and caving. All of these uses required the development of water sources. The effects of each of these activities on Riparian Reserves are described below.

Riparian Reserve impacts from land-use activities need to be considered within the context of the types of riparian features found in the Porcupine Watershed. For instance most of the intermittent stream channels, intermittent lakes and wet meadow complexes were most likely dry while land-use activities such as timber harvest and road construction were taking place. Even when flowing most intermittent streams were not considered to have any riparian values (no riparian vegetation, no aquatic species, etc.) and were viewed as temporary runoff pathways rather than channels or riparian features.

Cattle and sheep grazing may have had the greatest effect on riparian areas in the watershed. Grazing impacts were widespread throughout the watershed in the early 1900's. Impacts to riparian areas from cattle and sheep grazing included trampling of riparian vegetation, denudation of meadows (particularly in small riparian areas associated with springs), introduction of non-native species and soil disturbance that allowed conifer seedlings to become established in meadows. The denudation of ground vegetation was encouraged by the Forest Service in order to minimize the risk of large fires. Riparian areas were especially hard hit by early grazing practices. Cattle and sheep preferred riparian forage and concentrated in and around riparian areas due to the available water. In addition to riparian impacts cattle and sheep also competed with native wildlife for the limited forage in the watershed. Another by-product of early grazing management was the creation of numerous dugout ponds that were developed to supply water for cattle and sheep during late-summer and early fall. Grazing impacts around the ponds were probably severe; however the ponds may have benefited wildlife after the decline of grazing by providing additional sources of water in mid-summer. Impacts from cattle and sheep grazing declined dramatically following 1924 when the wool market collapsed and sheep grazing was no longer profitable. Grazing continues to be a problem in the White Deer Lake, Bear Springs and Toad Lake riparian areas.

The construction of railroad grades and roads impacted many intermittent stream channels in the watershed, with most of the impacts occurring in the early 1900's. The effects of road and railroad grade construction on riparian areas are unknown, however it is suspected that the greatest impacts were associated with the disruption of intermittent stream courses. Many road and railroad grades were located adjacent to the fault scarps in the valley bottoms and closely paralleled intermittent stream courses. Impacts to riparian or riparian dependent species may have occurred, but may have been minimal due to the scarcity of the riparian features and the general scarcity of species dependent on these habitats.

Timber harvest was the major land-use activity occurring in the watershed over the past 100 years. Impacts from timber harvest consisted of removal of conifers adjacent to meadows and intermittent streams, construction of roads and skid trails within and adjacent to Riparian Reserves and silvicultural activities (tractor planting) within Riparian Reserves. Temporary logging camps may have also affected riparian areas throughout the watershed.

Most of the impacts occurred in Riparian Reserves surrounding intermittent stream courses that were not protected because they only flowed for short periods of time and the spring and lacked the attributes normally associated with riparian areas. Much of this disturbance occurred between 1970-1987. During this period timber harvest activities were focused on regenerating understocked conifer stands in the watershed. Intermittent stream courses and their terraces running parallel to the fault scarps generally contained sparse stands of conifers due to presence of coarse, alluvial soils deposited during the Pleistocene epoch. The coarse soils favored the development of an east side pine forest, characterized by sparse, widely spaced stands of Ponderosa Pine with a bitterbrush understory. Because these areas were viewed as understocked stands, silvicultural activities targeted them for conifer regeneration. The

few conifers present in the grabens were removed and plantations were established. Due to the lack of observable surface flow occurring in the summer, many of the intermittent stream channels included within the plantations.

Fire suppression activities also affected Riparian Reserves. Inspection of 1944 aerial photography indicates that the watershed was more open and largely composed of early seral vegetation due to the influence of timber harvest and large wildfires of the early 1900's. Fire suppression activities, which were being effectively implemented by 1930, limited natural wildfires and allowed vegetation to advance to later seral and successional stages in and around Riparian Reserves. The lack of large wildfires also may have resulted in a net increase of water loss from evapotranspiration thereby shortening the duration of surface water availability in riparian areas. Wet meadow systems may have been particularly affected by the combination of grazing and fire suppression, both of which encouraged conifer encroachment. The loss of wildfire also affected the quality of herbaceous forage in the meadows that required periodic burning to be sustained.

Over the past 100 years numerous water sources have been developed in order to supply water for grazing, road dust abatement, wildlife, fire suppression and recreation. Water tanks and wells were developed in the late-1900's to supply water for fire suppression activities. Most of the tanks were cement tanks constructed outside of Riparian Reserves and had no effects on Riparian Reserves. Many of the tanks supply water to troughs for cattle and wildlife. The Forest Service and California Department of Fish and Game constructed numerous dugout ponds to supply water for wildlife and livestock. The ponds were constructed within wet meadow complexes, intermittent lakes and intermittent streambeds. Some of the more reliable water sources, such as Mud Well, Rattlesnake, Hambone Pump, and the Powerline Ponds were constructed in the 1950's by CDFG. While not initially intended as ponds, numerous soil burrow pits in the southern third of the watershed also contain water through mid-summer. Numerous guzzlers were also installed throughout the northern watershed in order to provide additional water sources to wildlife.

Recreation activities had a minimal impact on Riparian Reserves. Impacts occurring to riparian reserves from recreation activities included damage to cave resources and impacts to the most heavily used dispersal areas.

Riparian areas were also affected by woodcutting. Woodcutting activities were concentrated within lodgepole pine stands located in and adjacent to wet meadows, springs and intermittent lakes. Historically woodcutting did not negatively impact riparian areas. Some minor problems have occurred in the more recent past including rutting of meadows and intermittent lakebeds in the spring. Woodcutting also benefited some riparian areas by removing large concentrations of dead lodgepole pine.

Chapter 5

Synthesis and Interpretation

The purpose of this chapter is to compare existing and reference conditions of specific ecosystem elements and to explain significant differences, similarities, or trends and their causes. The interaction of physical, biological, and social processes is identified. The capability of the system to achieve key management plan objectives is also evaluated.

This chapter addresses the issues and core topics listed in Chapter 2. Issues are addressed in two formats. The first format discusses each issue within the context of each applicable core topic. Additional topics that are not related to the issues are also addressed here if they are deemed to be important for guiding future management direction for the watershed, or will result in a recommendation. Conversely, some topics addressed in Chapters 3 and 4 are not addressed in Chapter 5 because they are not related to the issues and are not currently important for the development of recommendations. Conclusions are only provided if they address a management concern identified by the ID team that will lead to a recommendation in Chapter 6. Applicable core questions from the *Federal Guide for Watershed Analysis* are restated at the beginning of each section and are used to guide the analysis.

In the second format the key questions developed for each issue in Chapter 2 are addressed in the form of a narrative summary. Influences and relationships between human uses and natural processes are discussed within the context of each issue. Key questions are answered where possible and data gaps and information needs are identified.

Core topics addressed in this chapter are:

- Human Uses
- Vegetation
- Species and Habitat
- Riparian Reserves (includes Erosion Process, Hydrology, Stream Channels Water Quality)

Issues are addressed within the core topics shown in parentheses.

1. Vegetation and Wildlife Habitat Diversity (Species and Habitat, Vegetation, Riparian Reserves)
2. Forest Health (Vegetation, Species and Habitats)
3. Riparian Area Management (Riparian Reserves, Species and Habitats, Vegetation, Human Uses)

5.1 Human Use

Core Questions (from WA Guide):

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

Present Condition	Causal Mechanisms	Trends	Conclusions
Timber Management			
Timber harvest provides local employment and supports the local economy.	Demand for wood products. Current management direction.	Trend is relatively static (i.e. no significant change in timber harvest activities is expected to occur.)	Harvest of wood fiber products from private ar public lands in the watershed is expected to continue at current levels.
Firewood and commercial mushroom harvest are becoming increasingly popular uses in the watershed. The impacts of commercial mushroom harvest have not been analyzed.	Matsutaki mushroom. Increased mushroom harvest due to depletion of Matsutaki mushroom resource on adjacent forests. Abundance of firewood.	Firewood collection should continue at current level. Mushroom harvesting may continue at current level provided that the resource is not depleted.	There is a need to analyze the impacts of commercial mushroom harvest in the watershed.
Native Americans are concerned with how vegetation management practices impact biodiversity and plants of traditional interest. Gathering edible bulbs in meadow areas has declined due to fewer and smaller bulbs.	Timber harvest activities Lack of aspen management Fire exclusion, past and present grazing practices, lack of vegetation management in riparian reserves. Competition from non-traditional gathers for personal and commercial use.	Medicinal forbs found in late successional habitats may increase as more areas move from a mid seral to a late seral stage. Some plants may decline depending on the amount of ground disturbance from timber harvest activities. An increase in bulb gathering activity may increase as management of meadows increases. As the herbal and craft industries grow, there may be an increase in non-traditional gathering of native and non-native plants.	There is a need to analyze the impacts of ground disturbing activities on late seral understory plants, the impact of timber harvest activities on berry producing shrubs, willows and aspen. There is a need for meadow management especially the re-introduction of fire and confer removal.
Road Management			
High road densities are present in parts of the watershed.	Timber harvest. Access to utilities (power line, gas pipeline, railroad). Landownership patterns (access to private land).	Road densities are expected to remain at current levels	Road access needs will continue for commodities removal, private land access, recreation, fire suppression and other management activities.

Present Condition	Causal Mechanisms	Trends	Conclusions
Range Management			
One cattle and one sheep allotment are located partly within the watershed. Allotment management plans for both allotments are obsolete and have not been updated to comply with the Aquatic Conservation Strategy.	Lack of funding for allotment plan revisions.	Revision of allotment management plans continues to be postponed. Indications are that the sheep allotment may be abandoned within the next 10 years.	There is a need to emphasize revision of Allotment Management Plans to update the plans to include compliance with the Aquatic Conservation Strategy.
Riparian and meadow areas are in a partly degraded condition. Aspen reproducing poorly under current management practices.	Fire exclusion, herbivory by wildlife, past and present grazing practices, roads, lack of vegetation management in riparian reserves and water developments.	Continued degradation and loss of meadow habitat, including lakeshores and ponds. Continued decline in aspen.	Future grazing management plans need to address and mitigate cattle and sheep impacts to riparian reserves and meadows. Vegetation management projects need to include meadows.
Grazing animal diseases and weeds.	Introduced by cattle and/or ranch vehicles.	Declining as range use declines.	Need to continue range monitoring.
Recreation Management			
Recreation use is mainly associated with dispersed camping and hunting.	Popularity of hunting in watershed.	The level of recreation management in the watershed is expected to remain static over the next decade.	Recreation activities are limited and dispersed over the watershed.
Caves and other geologic special interest areas are attracting spelunkers and other sightseers. Some conflicts exist between public use and protection of cave resource.	Presence of significant caves and other geologic resources.	Cave use is expected to increase.	There is a need to analyze the extent of conflicts between sensitive cave resources and human use of the caves.
Recreation traffic is heavy in the watershed.	Modoc Volcanic scenic byway. The Medicine Lake Highlands and Lava Beds National Monument are located just north of the watershed.	Recreation traffic is expected to increase.	Recreation traffic is concentrated on two major travel routes. Recreation use and impacts along the corridors should be monitored.
The Powder Hill and Harris Springs Roads could be used for yearlong industrial access.	Geothermal leases existing within the watershed. Geothermal development adjacent to the watershed.	Geothermal exploration and development is expected to increase.	The Forest Service should monitor the impacts of geothermal use on the Porcupine Watershed.
Heritage Resources			
A portion of the Medicine Lake Traditional Cultural Properties District is within the watershed. A management plan is being developed for the District.	Presence of traditional cultural values.	Increasing awareness of the values of this area for traditional values.	The Porcupine Watershed Analysis should incorporate management direction from the management plan when it is completed.

Present Condition	Causal Mechanisms	Trends	Conclusions
Geologic Special Interest Areas			
Many lava caves exist on the Giant Crater Lava Flow yet only two are included in consideration for GSIA; Jot Dean Ice Cave and Roadside Cave Complex. The Forest Service is required to determine the significance of caves on public lands by the Federal Cave Resource Protection Act of 1988.	Not enough is known about the caves in the watershed to invite the public to visit them. Many of the caves have are biologically or archaeologically sensitive. Many are not safe.	With the Scenic Byway and increasing recreational pressures, mapping, interpretation and presentation of the caves will become more important.	The cave inventory described in Chapter 3 needs to be continued to comply with the Protection Act. As more is known more caves might be added to those deemed suitable for public use.
The LMP designated the Giant Crater Lava Tube system as a GSIA. However, the LMP map does not depict the main lava tubes accurately.	After the publication of the LMP, no further work has been done in mapping or interpreting the geologic interests of the area.	With the Scenic Byway and increasing recreational pressures, mapping, interpretation and presentation of the GSIAs will become more important.	There is a need to remap and redefine the Giant Crater GSIA, the Paint Pot Crater /Little Glass Mt. GSIA and the Burnt Lava Flow/Deep Crater GSIA.
The LMP calls for evaluation of three sites within the Porcupine Watershed as possible GSIAs: Tilted Rock Lava Flow, Burnt Lava Flow and Papoose Hill.	Before the LMP was released, not enough was known about these features to make the decision about their status.		These features should be recognized as GSIAs and they should be included with the Paint Pot Crater /Little Glass Mt. GSIA, the Burnt Lava Flow/Deep Crater GSIA and the Giant Crater GSIA respectively.
GSIAs are identified as discrete features. They are better presented to the public as thematic areas.	The LMP did not devote very much analysis to this issue.	With the Scenic Byway and increasing recreational pressures, mapping, interpretation and presentation of the GSIAs will become more important.	The GSIAs in the Porcupine Watershed need to be redefined into three thematic areas.
The GSIAs are not presented on any maps except the LMP maps which are not generally available to the public. The Medicine Lake Volcano features many areas of geologic interest on three National Forests and one National Monument. Few interpretive resources exist for these features.	The Forests have not been working together to offer to the public the opportunities afforded by these features.	With the Scenic Byway and increasing recreational pressures, mapping, interpretation and presentation of the GSIAs will become more important.	The three Forest and the Park Service need to cooperate on a single Medicine Lake Geologic Visitor's Guide. The guide should have accurate information on access, facilities and GSIAs for the entire area.

5.2 Vegetation

Core Questions (from WA Guide):

- What are the natural and human causes of change between historical and current vegetative conditions?
- What are the influences and relationships between vegetation and seral patterns and other ecosystem processes in the watershed?

Present Condition	Causal Mechanisms	Trends	Conclusions
5.2.1 Vegetation Types			
Conifer Forests (MC, RF, PP) Stands with high stocking levels are susceptible to insect attack during periods of extended drought.	Fire exclusion. Climate. Lack of management activities to control stocking.	Increase in the absence of management action.	There is a need to maintain stocking levels and species composition appropriate to conditions at the site (annual rainfall, soils, etc.)
There is a shift towards shade tolerant species – especially in the understories. Shade tolerant species tend to be less drought tolerant.	Fire exclusion. Lack of management activities to control stocking.	Shade tolerant species will continue to develop in the absence of management activities.	
Red fir stands are vulnerable to windthrow.	Dense crown canopies. Climate. Topography.	Increased susceptibility to windthrow as young red fir stands develop.	There is a need to manage stand densities in young red fir stands.
There is a high potential for wildfire due to high fuel loads and vertical fuel ladders.	Fire exclusion. Overstocked stand conditions	Fuel loads and fuel ladders will continue to increase in the absence of management activities.	There is a need to reduce fuel loads and remove fuel ladders where these conditions exist.
Lodgepole Pine Many stands are infected by gall rust and dwarf mistletoe. Adjacent forest stands and plantations are being infected.	Fire exclusion. Lack of management activities to control disease.	Infected stands will continue to deteriorate in the absence of management activities.	There is a need to sanitize or regenerate diseased stands, especially those stands in close proximity to existing or proposed ponderosa pine plantations.
Large contiguous areas of high fuel loading occur in the lodgepole pine forest.	Fire exclusion. Mortality and breakage related to disease problems.	Fuel loads will continue to increase in the absence of management activities or fire.	There is a need to reduce fuel loading in lodgepole pine forest, especially where other resource values are threatened (LSR, etc.)
There is a shift towards shade tolerant species – especially in the understories.	Fire exclusion. Soil and climate. Lack of management activities to control stocking (thinning, underburning, etc.).	Species shift will continue in areas where soil and microclimate conditions are suitable.	The need to alter the shift in species composition will be evaluated on a case-by-case basis depending on management objectives and resource needs.

Present Condition	Causal Mechanisms	Trends	Conclusions
Knobcone Pine There is high natural mortality– especially in stands over 50 years in age.	Even-aged character of knobcone pine stands. Short life-expectancy of the species.	High mortality will continue and probably increase in older knobcone pine stands as they continue to mature and reach the normal life-expectancy of the species.	There is a need to remove decadent knobcone pine stands and reduce fuel loads on productive sites and convert to less fire prone vegetation types. Conversion of knobcone pine on poor or rough sites needs to be considered relative to the need to protect facilities and other resources (powerlines, LSR, etc.).
Heavy fuel loads (both standing and down dead trees) with fuel ladders of brush and saplings.	High mortality in older knobcone pine. Natural succession of shade tolerant understory species.	High fuel loads will continue and probably increase in older knobcone pine stands as they continue to mature.	
Plantations Regeneration is difficult on high elevation sites on pumice soils.	Soils. Climate.	Difficulty in regeneration will continue; however, changes in resource values (Medicine Lake Highlands Cultural District) may de-emphasize regeneration treatments.	There is a need to evaluate other regeneration options on deep pumice soils.
Pine plantations at high elevations are susceptible to snow damage.	Topography. Climate.	Snow damage to high elevation plantations would be expected to continue; however, changes in resource values (Medicine Lake Highlands Cultural District) may de-emphasize regeneration treatments.	There is a need to evaluate other regeneration options at higher elevations.
Many older plantations have brush understories and closed crown canopies which result in continuity of fuels.	Site preparation and planting methods. Reestablishment of brush in former brush-fields.	The amount and continuity of fuels will continue to increase in the absence of management activities.	There is a need to continue thinning and brush reduction in older plantations.
Brush Brush is becoming decadent. Value as forage is declining.	Fire exclusion.	Continuing decadence in the absence of fire or management activities.	There is a need to rejuvenate brushfields.
Montane brush type has high potential for fire due to the amount and continuity of fuels.	Fire exclusion.	Continuing increase in the amount and continuity of fuels in the absence of fire or management activities.	There is a need to reduce the amount and continuity of fuels in the montane brush type.
Montane brush type is declining due to conifer encroachment.	Fire exclusion. Natural succession. High site productivity.	There would be a continuing conifer encroachment in the absence of fire or management activities.	There is a need to control conifer encroachment in all brush types on Prescription VI lands.
Meadows Wet meadows are decreasing in size and total acreage.	Conifer encroachment.	There would be a continuing conifer encroachment in the absence of fire or management activities.	There is a need to control conifer encroachment in wet meadows and to reduce fuel loading around meadow perimeters.
Small trees around the edge of wet meadows are creating fuel ladders into adjacent conifer stands.			

Present Condition	Causal Mechanisms	Trends	Conclusions
Hardwoods Quaking aspen is declining in the watershed due to conifer encroachment.	Fire exclusion. Past management practices (leaving patches of mixed fir and aspen in plantations) Natural succession.	There will be a continuing decline in the amount of quaking aspen in the absence of fire or management action.	There is a need to continue or expand current aspen rejuvenation projects. There is a need to remove competing conifers from reserve patches within plantations that contain aspen.
Black oak declines in conifer stands as the crown canopy closes.	Fire exclusion. Past management practices.	Cyclical – black oak increases under open canopy; decreases under closed canopy.	There is a need to maintain appropriate stocking levels and openings in conifer stands to maintain oaks.
5.2.2 Seral Stages			
Grass/Forb Plantations make up 85% of the grass/forb seral stage but there will be a significant decline in the next decade as plantations develop.	Natural development of plantations to later seral stages.	Overall trend: decreasing Rapid decrease in plantation acreage. As a result, the grass/forb seral stage will decline from 2.7% to 1.0% of the watershed in the next decade. Desired level is 5%.	There is a need to consider the role of plantations in maintaining openings and providing early seral habitat in the watershed.
Wet meadow habitat is declining due to conifer encroachment.	Fire exclusion. Natural succession.	Wet meadows will continue to decline in the absence of fire or management action.	There is a need to control conifer encroachment in wet meadows.
Shrub/Seedling/Sapling Plantations make up 48% of the shrub/seedling/sapling seral stage but there will be a significant decline in the next decade as plantations develop.	Natural development of plantations to later seral stages.	Overall: decreasing Rapid decrease in plantation acreage. As a result, the shrub/seedling/sapling seral stage will decline from 13.8% to 9.1% of the watershed in the next decade. Desired level is 5%.	There is a need to consider the role of plantations in maintaining openings and providing early seral habitat in the watershed.
Montane brush		Gradual decrease due to conifer encroachment.	
Large Tree >40% The large tree/closed canopy seral stage is limited and occurs on 3.3% of the watershed.	Past management activities. Fire history.	Overall trend: increasing Gradual increase over the last several decades is expected to continue.	There is a need to allow the acreage of the large tree/closed canopy to continue to increase in the watershed. Management of understories may be needed to maintain healthy forest conditions and reduce potential for intense fire.
Stands exhibiting old growth characteristics are uncommon in the watershed.	Past management activities. Fire history.	Gradual increase over the last several decades is expected to continue.	

Present Condition	Causal Mechanisms	Trends	Conclusions
5.2.3 Late-Successional Forest			
Late-Successional Forest Late-successional forest occupies 34.2% of capable land in the watershed.	Natural succession. Past management activities. Fire history.	Overall trend: increasing The current level of late-successional forest is expected to increase at a moderate rate as younger conifer stands develop.	Current levels of late-successional forest exceed the "15% or less" standard at LMP 4-63; therefore, retention of late-successional stands is not required.
Many late-successional stands are at risk of insect attack or wildfire due to increasing stand densities and the development of fuel ladders.	Past management history. Fire history. Soils. Climate.	Forest health problems are expected to increase as stocking levels and fuel loads increase.	There is a need to control stocking levels and manage fuels in late-successional stands to reduce the risk of catastrophic loss – especially in those parts of the watershed with low annual precipitation and low soil waterholding capacity.
• **Mature Forest** The mature forest component of late-successional forest occupies 32.3% of capable land in the watershed.	Natural succession. Past management activities. Fire history.	Overall trend: increasing The mature forest component of late-successional forest is expected to increase at a moderate rate as younger conifer stands develop.	The mature forest component of late-successional forest exceeds both desired and required levels.
• **Mature Forest** The old-growth component of late-successional forest occupies 1.8% of capable land in the watershed..	Natural succession. Past management activities. Fire history.	Overall: increasing The old-growth forest component of late-successional forest is expected to increase gradually as current mature stands develop old-growth characteristics.	Although late-successional forest meets minimum standards, the desired condition is to allow the old growth component to develop naturally over time to 5% or greater in the watershed.

5.3 Species and Habitats

Core Questions (from WA Guide):

- 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?

Present Condition	Causal Mechanisms	Trends	Conclusions
Old growth seral stage below desired levels.	Past timber harvest Past fires history	Acres of old growth will increase slightly with present land management policies.	Need to design harvest to maintain all present and produce more closed-canopy old growth.
The distribution and size classes of snags in the watershed is unknown.	Lack of survey.	Unknown.	There is a need to conduct snag inventories and correlate snag distribution and numbers with land type associations.
Spotted owl and goshawk habitat is limited.	Dry climate, poor soils, noncapable sites. Watershed at eastern edge of species range. Timber harvest. Cattle grazing riparian.	Slight increase in habitat through growth. Possibly static.	Need to analyze where moderately capable owl nesting and foraging habitat occurs, and where it can be maintained or improved.
Tadpole shrimp habitat is limited.	Pine overgrowth and encroachment. Cattle grazing. Roads on lakebeds. Drought with trees transpiring groundwater.	Decreasing habitat area and quality. Annual water, climate a prominent factor.	Need to improve shrimp habitat. Causes have been analyzed in BA.
Marten are present in riparian associated habitats.	Timber harvest. Cattle grazing riparian. Dry climate, poor soils, noncapable sites. Present management.	Static (riparian associated) at low levels.	Need to analyze where moderately capable breeding and corridor habitat occurs, and where it can be maintained or improved.
Management Indicator Species habitat present.	Timber harvest. Cattle grazing riparian. Dry climate, poor soils, noncapable sites. Fire exclusion.	Unknown: No reliable or cost-effective methods to count animals.	Need to analyze where practical or potential breeding and/or corridor habitat occurs, and where it can be maintained or improved.
Limited or unique cave species.	Recreational disturbance in caves. Altered bat foraging habitat (e.g., grazing).	Static to declining.	Need to analyze where practical or potential breeding or foraging habitat occurs, and where it can be maintained or improved.
Three sensitive plant species, two plants of special concern, one S&M bryophyte and	Fire exclusion. Conifer encroachment. Trampling by people and road to Little Mt. Hoffman Lookout. Existing roads in riparian reserves Timber management practices.	Populations are static to declining.	Need to maintain and enhance populations of sensitive plants through reintroduction of fire to meadows, removal of conifers from meadows, education of people renting Little Mt. Hoffman Lookout and relocating of roads.
Sensitive plant species (Bakers Globemallow, Talus Collomia, Columbia Cress and Long-hair Star Tulip) exist within the watershed.	Fire exclusion. Conifer encroachment. Trampling by people and cattle grazing. Existing road through White Deer Lake.	Populations static to declining.	Need to maintain and enhance populations of sensitive plants.

5.4 Riparian Reserves

Core Questions (from WA Guide):

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

Present Condition	Causal Mechanisms	Trends	Conclusions
Riparian Reserves in the Porcupine Watershed are very scarce. Almost no Riparian Reserves exist in the northern two-thirds of the watershed. Riparian Reserves are more common in the southern third of the watershed.	Geologic and climatic controls.	Static.	Due to their scarcity and the competition for limited water, there is a need to develop guidelines for managing different Riparian Reserve types (i.e. wet meadows, intermittent streams, springs, etc.).
Surface water is extremely scarce in the northern 2/3 of the watershed. Surface water is more abundant in the southern third of the watershed during spring snowmelt but is also scarce in mid and late summer. Surface water is almost completely absent from the entire watershed from mid-June through November.	The distribution of surface water is limited by natural geologic controls. Soil permeability is high and numerous fractures, faults and lava tubes facilitate rapid drainage and infiltration of surface water.	The natural distribution of surface waters is static.	Surface water supplies will continue to be extremely scarce in the watershed. Excavated ponds and guzzlers can extend the availability of surface water into the summer in some areas of the watershed.
The number and the duration of available surface water sources have increased since 1850. Almost every reliable surface water source has been developed. Natural surface water features are limited to several pools located within lava cracks, such as ice caves or ponds.	Extensive water development of springs, intermittent streams and wet meadows. Water developments were pursued for grazing of cattle and sheep, railroads and roads, dust abatement, recreation, wildlife, human consumption and fire suppression.	Water source development was very active during the 1900's. The trend is one of declining water source development.	The potential for development of additional surface water sources is limited. Natural surface water sources will remain limited. There is a need to evaluate potential restoration opportunities in riparian areas that were disturbed by surface water developments.
Water availability has diminished in some riparian areas and increased in others.	Water developments for administrative use have diminished water supplies at springs. Dugout ponds, guzzlers have increased water availability for wildlife and range. Perennial dugout ponds have reduced tadpole shrimp habitat.	Static. No recent developments.	The effects of water withdrawals and additions on riparian areas associated species need to be assessed.

Present Condition	Causal Mechanisms	Trends	Conclusions
Many of the wet meadows occurring in the southern third of the watershed are in a degraded condition. Early seral stage forests are slowly replacing meadow habitats. Vegetation in some meadows is undergoing a gradual conversion from grasses and forbs to unpalatable weedy species. This trend has been documented in studies of changing vegetative composition at Toad Meadows.	**Fire suppression** has encouraged conifer encroachment into meadows. **Grazing** has resulted in soil disturbance enabling conifers to establish themselves in heavily grazed areas. **Dugout ponds** have been excavated in and adjacent to meadows. Excavated material from dugout ponds is providing footholds for conifer establishment. **Roads** occurring within wet meadows are fragmenting meadow habitats.	The trend over the past 20 years has been continued deterioration of wet meadow habitats. This trend will continue unless actions are taken to reverse the decline of wet meadow habitats.	There is a need to develop a restoration and preservation strategy for wet meadows complexes in the southern third of the watershed.
Intermittent streams occurring along fault scarps but outside of wet meadows are in a degraded condition. Road construction and plantations have affected the flowpaths of intermittent stream channels. Plantation access roads are often aligned with the beds of intermittent channels. Mechanical preparation of the soil for planting has eliminated all traces intermittent channels in some locations (example: Hambone Well area).	Timber harvest activities and road construction undertaken for the purpose of regenerating understocked stands resulted in the conversion of many grabens to plantations. Many intermittent stream channels flowing in the grabens adjacent to scarps were not protected because surface flow was very limited in duration. Surface flow in these channels only occurs for 1-2 months prior to the completion of spring snowmelt.	The trend for the condition of intermittent streams is static. Intermittent streams located within plantations will remain in a degraded condition. Undisturbed intermittent streams are protected.	Intermittent streams have been identified and ground verified in the watershed. There is a need to identify silvicultural prescriptions for plantations located within intermittent stream Riparian Reserves.
Riparian areas are important for multiple uses that include natural uses (water for wildlife and vegetation) and human uses (fire suppression, dust abatement, human consumption). Competition for use of the limited riparian areas is very high.	Scarcity of riparian areas and limited water availability for wildlife. Good access to riparian for hunting, camping, woodcutting and fire suppression activities.	Competition for limited water sources is expected to increase.	There is a need to consider user impacts to riparian areas during project planning. Opportunities may exist to manage roads and vegetation to control the levels and types of uses occurring in riparian areas.

Present Condition	Causal Mechanisms	Trends	Conclusions
Intermittent lake habitats are being affected by land-use activities. The endangered tadpole shrimp has been found to occur in White Deer and Whitlow Lakes.	Woodcutting activities are influencing intermittent lake shorelines. Cattle grazing activities are affecting intermittent lake vegetation and degrading water quality. Cattle grazing and trampling are adversely affecting tadpole shrimp habitat. Dugout ponds in intermittent lakebeds may be harboring introduced fish that feed on tadpole shrimp. Vehicle use on intermittent lakebeds may be affecting habitat for the Tadpole Shrimp. Fire suppression and cattle grazing have created condition favorable for the establishment of dense lodgepole pine forests around and within intermittent lakebeds.	The trend is for improvement of intermittent lake habitat as management activities targeted at restoring and preserving lake habitats are implemented.	There is a need to continue to develop and implement and monitor vegetation management projects and other restoration activities to restore and preserve intermittent lake habitats.

Chapter 6

Recommendations

The purpose of this chapter is to bring the results of the previous steps to conclusion, focusing on management recommendations that are responsive to the issues and watershed processes identified in the analysis. Monitoring activities are identified that are responsive to the issues and key questions. Data gaps and limitations of the analysis are also documented.

This chapter is organized by focusing on needs and opportunities identified in the "Conclusions" sections at the end of each item in Chapter 5.

Part 2 of Chapter 6 presents a list of potential projects developed from the analysis.

6.1 Human Uses

Topic: Grazing Management

Recommendations: Develop new range management analyses and plans for existing allotments to ensure consistency with Aquatic Conservation Strategy and to provide increased protection of Riparian Reserves and riparian-dependent species. Adjust term permit for the Toad Allotment to under 100 cows and an 8/1-10/30 season. Remove dry north upland areas from the Toad Allotment and adjust boundaries to practical grazing areas. If these actions do not result in improved riparian conditions, further reduce or eliminate grazing as per LMP 4-55. Continue sheep grazing activity in the Hambone McCloud Allotment or allow grazing to end.

Related Core Topic(s): Human Use, Vegetation, Species and Habitats, Riparian Reserves

Rationale/Objective: Current range analyses and plans are obsolete. Range management plans need to be updated to meet ACS objectives.

Protection of TES and S&M species from grazing impacts will enhance TES and S&M habitat. Proper grazing management would improve riparian conditions and allow riparian areas to function for a variety of wildlife species. Proper grazing management would also increase the productivity of the allotment for both wildlife and cattle.

Moving the starting date for the allotments to August 1st will eliminate cattle competition with game and other wildlife species, allow elk and deer exclusive use of the meadows during fawning season, allow sensitive plants to bloom before grazing, allow certain

mushrooms to propagate, allow for aspen reproduction and allow endangered shrimp in intermittent lakes to breed unharmed.

Sheep grazing has had no observable negative effects to riparian habitats. Sheep grazing concentrates on older plantations and avoids riparian areas. Sheep grazing benefits older tree plantations by reducing competition.

Grazing activities on National Forest lands in the Porcupine Watershed have a low economic worth. A higher economic value is placed on game species than cattle. Grazing has very low value as a resource use when compared with other resource values adversely affected by grazing. The grazing program costs five times more to manage than grazing fees collected to manage the program.

Topic: Mushroom Management

Recommendation: In coordination with the Klamath and the Modoc National Forest, develop a strategy for management of the mushroom resource in the watershed. Limit the number of commercial permits issued until more information is available to assess the impacts of picking to the mushroom population. Establish areas of mushroom gathering exclusion for comparison with impacted areas. Conduct data search and request research on the impacts of mushroom gathering on populations and wildlife that use them as food source.

Related Core Topic(s): Species and Habitats, Human Uses

Rationale/Objective: There is a need to develop a coordinated plan for managing mushroom harvest in the Medicine Lake Highlands. Mushroom harvest levels have increased in recent years. The impacts of mushroom harvest on soils and S&M species should be evaluated. Little is known of the value of mushrooms for deer and small mammal forage, and more analysis is needed.

Topic: Management of Plants Used for Enthnobotanical Purposes

Recommendation: Develop a management plan for plants gathered primarily by Native Americans for traditional uses including foods, spiritual and medicinal. This plan should include a list of preferred plants and gathering places. Include in this plan other plants not used traditionally by Native Americans, but gathered for personal or commercial use by wildcrafters for use in herbal medicines and crafts.

Related Core Topic/Issue(s): Human Use, Species and Habitats, Riparian Reserves

Rationale/Objective: Meet the need of Native Americans to be involved in their traditional way of life. Many substances used in herbal medicine come from species growing in the watershed. Many of these species are introduced weedy species such as mullin and St. John's wort. Many plants are collected for craft purposes such as mosses,

ferns, and pine cones. Populations of introduced weedy species may be reduced by working with local wildcrafters.

Topic: Roads Management

Recommendation: Develop a Roads Analysis for all classified and unclassified roads in the watershed. Develop blanket forest order to cover all seasonal road closures.

Related Core Topic/Issue(s): Human Use, Species and Habitats, Riparian Reserves

Rationale/Objective: Meet Roads Analysis Requirement. Develop management strategy for roads. Identify closure and decommissioning opportunities. Enforce existing closures.

Recommendation: Reduce road density to 1.5 miles per section where practical. Efforts should be concentrated on riparian areas, meadows, high water table areas, and especially surface water sources where possible. Reduce surplus roads, especially those in drainages and Riparian Reserves.

Related Core Topic(s): Species and Habitats, Human Uses, Riparian Reserves

Rationale/Objective: There is a need to reduce road density in the Porcupine Watershed. The Forest must provide reasonable access to adjacent landowners and must respect existing right-of-way and cost share agreements. Wildlife populations may be suppressed by excessive road density, particularly game animals such as elk, bear, and deer. Roads that access riparian areas or ponds may have particularly adverse effects for wildlife.

Recommendation: Upgrade and maintain the following roads the primary transportation network in the Porcupine Watershed.

FA 15	Harris Springs
FA 49	Powder Hill (upgrade to ML 4)
FA 03	Mayfield
FA 13	Pilgrim Creek
FA 24Y	Tom Young
42N32	Harris Mountain
41N23	Mud Well
43N11	Dale's Trail
41N03	Obsidian
40N38	Whitlow

Maintain a transportation system that will provide adequate access for timber harvest and other management activities as well as fire suppression. Roads that provide access to private land or are included in rights-of-way and cost share agreements will remain open. Improve management of the Powder Hill Road as the main public access from Highway 89

to Medicine Lake. Identify safety hazard areas for public traffic and recommended improvements.

Related Core Topic(s): Human Uses

Rationale/Objective: The Forest must provide reasonable access to adjacent landowners and must respect existing right-of-way and cost share agreements. Upgrading of the Powderhill Road is needed to provide for public safety.

Topic: Geologic Special Interest Areas

Recommendation: Redefine the boundaries of the Giant Crater Geologic Special Interest Areas to include three distinct areas.

Area	Geologic Features Included
Little Glass Mt/Paint Pot Crater	Little Mt. Hoffman, Little Glass Mt., Pumice Stone Well, Pumice Stone Mt., Paint Pot Crater, Tilted Rock Lava Flow
Giant Crater	Giant Crater, Spatter Cones, Shastine Crater, Papoose Hill, Chimney Crater, Jot Dean Ice Cave, Breached Crater, Roadside Cave Complex
Burnt Lava Flow/Deep Crater	Burnt Lava Flow, Triad Craters, Deep Crater

Work with the Modoc and Klamath National Forest to revise the Medicine Lake Visitor's Guide for Geological Special Interest Areas.

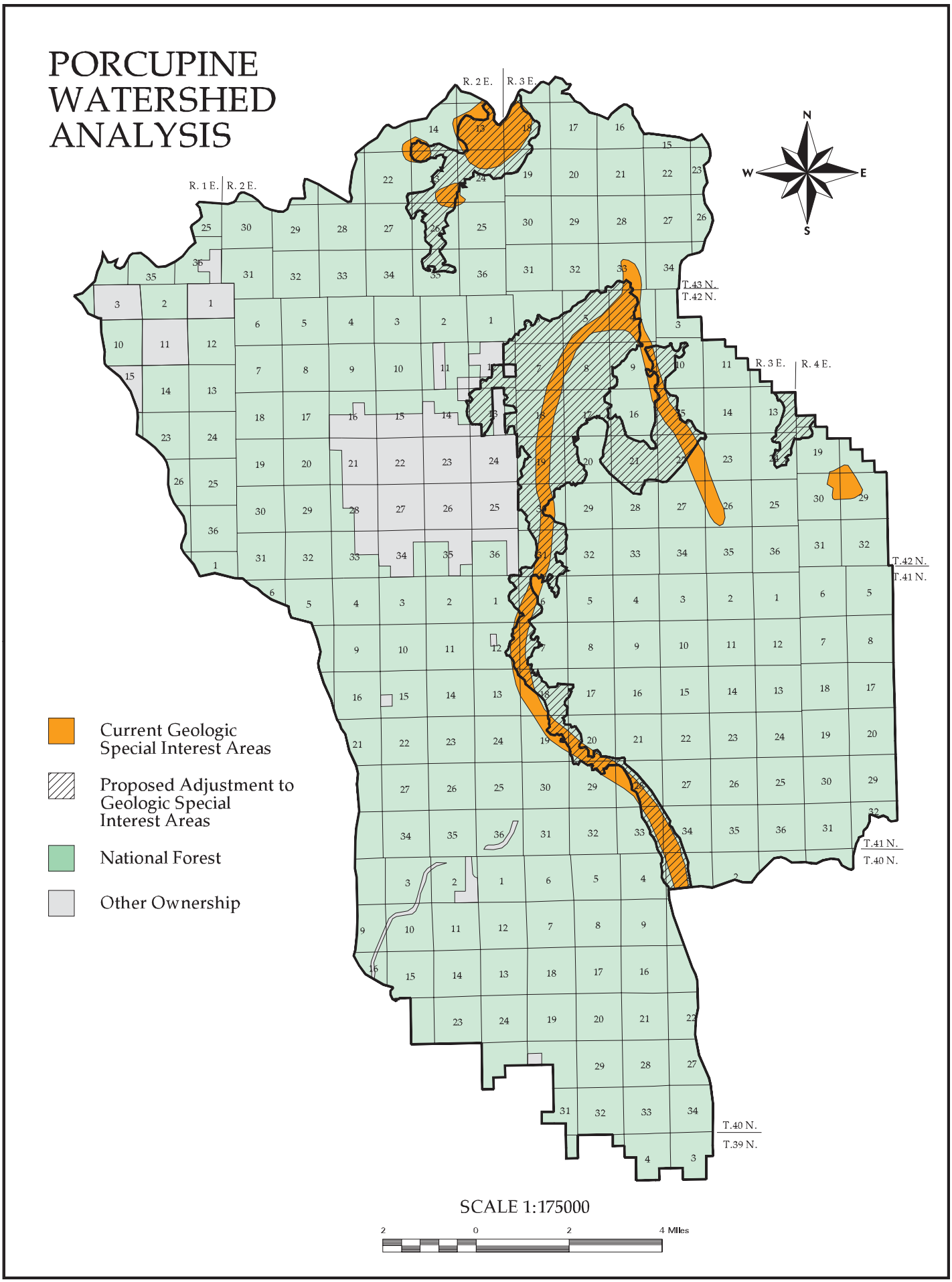
Related Core Topic/Issue(s): Human Uses

Rationale/Objective: The current map of the GSIA is not accurate and excludes several notable geologic features.

Recommendation: Develop a cave management strategy for the Medicine Lake Highlands in cooperation with the Klamath and Modoc National Forests. Improve management and public awareness of the need to protect cave resources. Use informal and formal surveys, determine amount of and trends in human use of caves in the watershed.

Related Core Topic(s): Species and Habitats, Human Uses

Rationale/Objective: There is a need to develop a plan for managing cave resources in the watershed that considers human use and protection of sensitive species of bats. More information is needed on the amount of recreational use occurring in caves and the



Map 20. Proposed Adjustment to Geologic Special Interest Areas

distribution of sensitive bat species throughout the watershed. A cave management plan is needed to meet the intent of the Cave Management Act and to provide for public safety.

6.2 Vegetation

Topic: Overstocked Conifer Forest

Present Condition

- Overstocked forest stands in the watershed are susceptible to insect attack and disease.
- Overstocked forest stands have a high potential for wildfire due to heavy fuel loads and the presence of vertical fuel ladders.
- Young red fir stands with dense canopies appear to be susceptible to windthrow.
- There is a shift towards shade tolerant species – especially in the understories.

Recommendations:
Continue to promote healthy stocking levels throughout the watershed through an aggressive thinning program consistent with management direction in the LMP.

Where higher stocking levels are desired to meet other resource needs, consider the location in the watershed relative to the following environmental factors:

- Annual precipitation – is there adequate annual precipitation to support dense conifer stands?
- Water holding capacity of soil – can the soils provide adequate moisture to support dense conifer stands?
- Species composition of the stand – are the conifer species in the stand (esp. white fir) capable of withstanding increased inter-tree competition for moisture during extended drought periods?
- Potential for wildfire -

Where higher stocking levels are desired to provide nesting and foraging habitat for goshawks (or other species), manage larger acreages for a mosaic of conditions rather than protecting small nest groves with no trearment.

Related Core Topic(s): Species and Habitats, Human Uses.

Rationale/Objective:
In the absence of fire, many conifer stands in the watershed are developing very high stocking levels in areas that have very low annual precipitation and on soils that have low water holding capacity. Inter-tree competition for limited moisture and nutrients increases as stand densities increase. Extended drought periods increase tree stress to levels where

Topic: Disease Control in Lodgepole Pine

Present Condition

- Western gall rust and dwarf mistletoe are common in the lodgepole pine forest within the watershed.
- Both western gall rust and dwarf mistletoe can also infect ponderosa pine, especially when ponderosa pine plantations have been established in close proximity to infected lodgepole pine stands.
- Current lodgepole pine forests in the watershed are maturing

Recommendations:
Sanitize…

Regenerate portions of the existing lodgepole pine forest back to lodgepole pine.

Related Core Topic(s):

Rationale/Objective:
Regenerating older lodgepole pine forests will accomplish two objectives:

- promote a diversity in age classes within the lodgepole pine forest.
- create openings areas of early seral stage.

Topic: Fuel Conditions in Knobcone Pine

Present Condition

- There is very high natural mortality in older (generally >50 years) knobcone pine stands and the trend is expected to continue.
- There is a high risk of wildfire due to the amount and arrangement of fuels in knobcone pine stands.

Recommendations:
Remove older (generally >50 years) knobcone pine stands on productive sites.

Retain younger knobcone pine stands on productive sites if they are not showing high levels of mortality.

On rough, rocky sites - break up the continuity of fuels in dense knobcone pine forests, especially near the powerline corridors.

Related Core Topic(s):

Rationale/Objective:

Topic: Quaking Aspen

Present Condition
Quaking aspen stands are limited in the watershed and are declining due to conifer encroachment.

Recommendations:
Continue and expand the current program of restoring and rehabilitating existing quaking aspen stands.

In areas that are predominantly aspen, remove all encroaching conifers and initiate activities to promote sprouting (such as underburning or discing).

Where aspen is a minor component in conifer stands, incorporate measures into timber harvest prescriptions to maintain the health and vigor of individual aspen trees by reducing conifer competition.

Existing plantations need to be evaluated for opportunities to maintain or enhance quaking aspen. Islands of advanced natural regeneration were often centered around concentrations of aspen. Conifers can be removed from these islands to enhance the development of aspen. Individual aspen trees in plantations can be released from competition during precommercial thinning activities.

Related Core Topic(s):

Rationale/Objective:
Quaking aspen provides a unique and important habitat in the Porcupine Watershed. The acreage of quaking aspen is very limited and has been declining for several decades due to conifer encroachment. In the absence of natural fire, management activities will be needed to maintain aspen and prevent further declines.

Topic: Early Seral Habitat

Present Condition

- The grass/forb seral stage is currently at 2.7% of the watershed and expected to decrease to 1.0% in the next decade.
- The shrub/seedling/sapling seral stage is currently at 13.8% of the watershed and expected to decrease to 9.1% in the next decade.
- Plantations have been a significant component of early seral stages for the last forty years, but the acreage of plantations is declining rapidly as they develop into conifer stands.

Recommendations:
Implement management activities to maintain or increase the amount of early seral habitat in the watershed. Consider the role of plantations in providing early seral habitat.

Related Core Topic(s):

Rationale/Objective:

Topic: Late-Successional Forest

Present Condition

- Late-successional forest occurs on 38,528 acres – or 34.1% of capable land within the watershed. This acreage is gradually increasing over time.
  - mature late-successional forest occurs on 36,538 acres – or 32.3% of capable land within the watershed.
  - old-growth late-successional forest occurs on 1,990 acres – or 1.8% of capable land within the watershed.
- There are adequate developing forest stands in the watershed to provide for future replacement of late-successional forest.
- Many late-successional stands are at risk of insect attack - especially where high stocking densities occur in areas of low precipitation and soils with low waterholding capacity.
- Many late-successional stands are at risk of wildfire due to heavy fuel loads and the development of understory vegetation.

Topic: Late-Successional Forest

Recommendations:
Control stocking levels and fuel loads in late-successional forest stands by manipulating understory vegetation through thinning and fuel treatments.

During thinning of younger conifer stands, retain any residual old growth trees to provide for structure, decadence, large snags, and large down logs in the future.

Related Core Topic(s):

Rationale/Objective:
Late-successional forest stands in the watershed are susceptible to catastrophic loss to insect attack or wildfire when dense understory vegetation is allowed to develop. In the absence of fire, there is a need to control understory densities and reduce fuel loads through management activities.

6.3 Species and Habitats

Recommendation: Develop a management plan for the Tadpole shrimp.

Related Core Topic(s): Species and Habitats, Riparian Reserves, Human Uses, Vegetation

Rationale/Objective: Isolated populations of Tadpole shrimp (endangered species) may be impacted by several management practices including logging, grazing, vehicles and fire exclusion. A BA for grazing has identified some impacts to Tadpole shrimp.

Recommendation: Develop guidelines for Goshawk management for Shasta-McCloud Management Unit. Manage larger acreages for a mosaic of conditions rather than protecting small nest groves with no treatment.

Related Core Topic(s): Species and Habitats, Vegetation, Human Uses

Rationale/Objective: Goshawk nest groves are in a deteriorated condition due in part to lack of management and past harvest practices.

Topic: Habitat Improvement for Plant of Special Concern

Recommendation: Develop a management plan for Collomia larsenii, Talus collomia, at Little Mt. Hoffman. Change traffic patterns for vehicles and people. Develop interpretative information about sensitive plant protection in this area.

Related Core Topic(s): Species and Habitats, Human Use, Road Management

Rationale/Objective: The Little Mt. Hoffman lookout is a very popular place to rent during the summer season. The road up to the lookout is a favorite place for making a receiving cell phone calls. Also, many visitors like to drive up to the lookout to look at the wonderful view. Poor road is design and foot traffic from visitors have resulted in degraded habitat and lowered the number and vigor of individual plants. If a management plan is not put into place, this population will eventually be lost.

Topic: Habitat for TES/S&M Plants

Recommendation: Improve habitat for Sensitive plant species. Include the *Iliamna bakerii* population in the prescribed fire plan. Move more vegetation toward a late seral/old growth habitat type to improve habitat for S&M fungi and bryophytes. Known sites need to be managed according to S&M protocols. For recommendations regarding *Calochortus longebarbatus* var. *longebarbatus,*see Riparian Area Management; Topic: Meadow habitat Restoration. For recommmmendations for *Rorippa columbiae*, see Riparian Management; Topic: Intermittent Lake (Vernal Pool) Habitat Restoration.

Related Core Topics: Species and Habitats,Vegetation Management,Fire,Grazing,Road Management, Riparian Reserves

Rational/Objective: *Iliamna bakerii* is a fire dependent species. Mechanical disturbance can be beneficial to some degree, but fire works best for over-all habitat improvement and seed germination. The biggest threat to this population has been the alteration of the natural fire regime. There are several S&M fungi known sites in the watershed and a couple of known sites for the S&M bryophyte, *Ptilidium californicum*. S&M species need late successional habitat to survive.

Topic: Dispersal Habitat

Recommendation: Maintain dispersal habitat in watershed.

Related Core Topic(s): Species and Habitats, Vegetation, Riparian Reserves

Rationale/Objective: Dispersal habitat is usually provided by Riparian Reserves however less than 1% of the watershed contains Riparian Reserves. Other strategies should be developed to manage for dispersal given the lack of riparian corridors. Meadow and pond systems can be connected or linked to improve dispersal. Waterholes should be considered as a means to promote access by riparian associated species, such as turkey and marten.

Topic: Habitat Elements

Recommendation: Manage snag levels in watershed on project basis.

Related Core Topic(s): Vegetation, Species and Habitats.

Rationale/Objective: Current snag levels in the watershed are unknown. Snag distribution is not uniform across the landscape (Snag distribution may be correlated with landtype associations). Snag surveys for existing and past projects (BE and BA documents) indicate that snag levels are lower than Forest Plan minimums.

6.4 Riparian Area Management

Topic: Riparian Reserve Corridor Management Approach

Recommendation: Employ a corridor approach for management of riparian features in southern third of the watershed. Riparian features such as springs, wet meadows, intermittent lakes, intermittent streams and some perennial ponds often occurred in combination with one another along north-south trending faults in the southern third of the watershed. Management activities should provide for the maintenance, restoration or enhancement of a variety of riparian habitat types ranging from terrestrial (e.g. intermittent streams flowing through scattered Ponderosa Pine) to aquatic (e.g. wet meadows and lodgepole swamps along intermittent streams). Future management activities should focus on maintaining a mosaic of habitats along and within the riparian corridors shown on Map 16 – Riparian Reserves.

Related Core Topic(s): Vegetation, Species and Habitats, Riparian Reserves, Human Uses

Rationale/Objective: Wildlife and habitat diversity will improve by managing for different vegetation types that benefit a variety of wildlife species within each riparian corridor. See the following recommendations for management options for each riparian habitat type.

Topic: Intermittent Stream Corridor Restoration

Recommendation: Restore degraded intermittent stream channels associated with faults in the southern third of the watershed. Re-establish a channel bed within plantations that have been tilled. Designate Riparian Reserve buffers and manage plantations within the buffers with the objective of establishing the appropriate natural vegetation type (i.e. dispersal habitat) around the stream channel. Where disturbed intermittent channels are associated with faults the DFC for vegetation will most likely be an open pine forest on the graben. Evaluate opportunities to thin and create openings in dense stands of lodgepole along intermittent stream channels that were formally meadow habitats prior to pine encroachment. Emphasize lodgepole treatments in areas where aspen are being suppressed by lodgepole. Build 0.1-acre ponds along corridors to provide extended-season surface water for riparian associated wildlife, including game species and small mammals[1].

Related Core Topic(s): Vegetation, Species and Habitats, Riparian Reserves, Human Uses

Rationale/Objective: Most intermittent stream channels that are not associated with wet meadows lack any distinguishable riparian or aquatic characteristics. Because these channels usually are dry by May and lack aquatic/riparian characteristics they were often not afforded protection from management activities. Intermittent channels of this type have been rototilled and converted into plantations and the channels have been completely obliterated. Some channel beds are actually used as roads in the summer. While it is true that these channels posses few aquatic attributes they are important when considered in the context of riparian corridor management. Restoring riparian areas will benefit forest diversity in a watershed largely devoid of riparian habitat. Many of the intermittent stream channels proposed for restoration link other riparian habitats (springs and wet meadows) along the faults in the southern third of the watershed. The integrity of intermittent stream channels should be restored to insure that the timing and delivery of snowmelt runoff to downstream areas is not altered and to restore the integrity of the stream corridor. Increasing the size of waterholes and extending the duration of available water will make these corridors more functional to riparian associated wildlife. Expansion of waterholes will help some species that need water for denning and support nesting territories but may not provide benefits to smaller prey base species. All local cavity nesting neotropical birds have riparian associations, and many need surface water during the spring nesting season.

Topic: Intermittent Lake (vernal pool) Habitat Restoration

Recommendation: Restore intermittent lake habitat at White Deer Lake and assess the need for restoration of intermittent lake habitat at Whitlow Lake. Use commercial and/or

[1] The ID team did not reach consensus on the need to build additional ponds. The majority of ID team member disagree with the need for additional ponds in the watershed. This issue should be resolved on a project level basis during the NEPA process.

noncommercial harvest to remove dense lodgepole and Ponderosa pine thickets that have established themselves on the intermittent lakebeds. Use prescribed fire to burn residual slash and meadow forbs and grasses. Decommission roads on intermittent lakebeds. Remove excavated pond mounds from the lakebed (mounds serve as foothold for invading conifers). Save non-lodgepole trees over 16-inch dbh for snag habitat. Thin stands to create a 3G-4G type stand of mixed conifer around the perimeter of the White Deer and Whitlow Lakes. Emphasize removal of lodgepole and white fir to achieve spacing required in to develop old growth characteristics. Replace diseased or decadent lodgepole pine areas with prehistoric mixed conifer type dominated by ponderosa pine. Save existing aspen, ponderosa, and Douglas fir whenever possible and ponderosa pines only if above the high water line of the lakes. Fill in excessively deep dugout ponds with pond mounds so that ponds become basins for extended-season shrimp habitat. A second basin could be dug in southern Whitlow Lake. Over-deep ponds with mounds occur at Toad, South White Deer, and Dry Lake.

Related Core Topic(s): Vegetation, Species and Habitats, Riparian Reserves, Human Uses

Rationale/Objective: Intermittent lake (vernal pool) habitat at White Deer Lake is disappearing rapidly due to conifer encroachment. Fire exclusion and cattle grazing have encouraged conifer encroachment on the shores and within the lakebed. Habitat for Tadpole shrimp and Columbia yellow cress is disappearing along with the open portion of White Deer Lake. Intermittent lakes are a very unique habitat feature in the Porcupine Watershed and should be preserved. Lodgepole established on the lakebed is killed off periodically during wet winters. While the die-off of lodgepole is beneficial to maintaining lake habitat it has also resulted in heavy wood cutting use and vehicle traffic in the lakebed during mid to late summer. Removal of the lodgepole 'fuelwood' resource at White Deer Lake should reduce vehicle impacts to the lakebed and benefit tadpole shrimp and Columbia yellow cress.

Topic: Meadow Habitat Restoration

Recommendation: Restore riparian meadow habitats throughout the Porcupine Watershed. Restore open space in meadows by removing encroaching conifers through the use of prescribed fire or timber harvest. Use prescribed fire or timber harvest to thin selected areas around meadows if treatments will move the stand towards late-successional conditions. Promote good grass cover on meadows by controlled burning to remove pine duff and seedlings. Reduce road density within and adjacent to wet meadows where practical. Priority areas for meadow restoration include all wet meadows in the southern 1/3 of the watershed.

Related Core Topic(s): Vegetation, Species and Habitats, Riparian Reserves, Human Uses

Rationale/Objective: Riparian meadow habitats in the Porcupine Watershed are slowly disappearing due to conifer encroachment. Fire exclusion and cattle grazing have resulted

in a decline in the quality of riparian meadow habitat. Riparian meadows are a unique habitat type that should be maintained to provide a diversity of habitats in the Porcupine Watershed. Restoring meadow habitats will improve habitat for the Long-haired star-tulip by improving soil fertility and removing competing vegetation. Improving meadow habitat will also improve the health and vigor of plants important to local Native Americans. Lily bulbs, Blue camas and Yampa were important food sources in the past. Collecting roots and bulbs was stopped because there was a decrease in the number of plants and the bulbs and roots become too small due to a lack of fire, an increase in competing vegetation, decrease in available water and past livestock grazing.

Waterhole construction should be considered where consistent with ACS objectives. This is regarded as acceptable where it does not promote cattle grazing or where cattle are already controlled so no overgrazing occurs in riparian areas[2].

Topic: General Riparian Reserve Management Guidelines

Recommendation: Actively manage Riparian Reserves to meet Aquatic Conservation Strategy Objectives and to move Reserves towards desired future conditions. Appropriate management activities for Riparian Reserves include those activities that restore and preserve Riparian Reserves, are consisted with the Aquatic Conservation Strategy and move the reserves towards a Desired Future Condition. Examples of management activities include commercial or noncommercial harvest of encroaching conifers, prescribed or natural fire, removal of excavated pond spoils (used as a foothold for encroaching conifers), grazing control and road decommissioning.

Related Core Topic(s): Vegetation, Species and Habitats, Riparian Reserves, Human Uses

Rationale/Objective: Active management of Riparian Reserves will be required to restore, preserve and maintain riparian and riparian-associated vegetation. Conifer encroachment must be controlled in order to preserve wet meadow habitats. Fire should be reintroduced to Riparian Reserves to allow for reproduction of grasses, forbs and early seral vegetation. Roads can be decommissioned to reduce fragmentation in Riparian Reserves.

Recommendation: Maintain Riparian Reserve widths as established in the Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl (ROD, 1994).

Related Core Topic(s): Riparian Reserves

[2] The ID team did not reach consensus on the need to build additional ponds. The majority of ID team member disagree with the need for additional ponds in the watershed. This issue should be resolved on a project level basis during the NEPA process.

Rationale/Objective: Riparian Reserves in the Porcupine Watershed are limited to isolated springs, intermittent streams, intermittent lakes and seasonally wet meadows. The riparian areas associated with the Reserves are generally devoid of riparian and aquatic flora and fauna. Most of the Riparian Reserves are located in gently sloped to flat terrain and have minimal to no erosion problems. While they lack riparian and aquatic attributes, Riparian Reserves in the Porcupine Watershed are also very scarce, occupying little more than 1 percent of the total watershed area. Because of their rarity it is appropriate to manage Riparian Reserves according to the widths established in the Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl (ROD, 1994). Riparian Reserves meet the intent of the ROD by providing habitat corridors and linkages necessary for wildlife dispersal. This direction is consistent with the Land Management Plan for the Shasta-Trinity National Forest and subsequent Forest direction to retain the interim Riparian Reserve widths and to conduct management activities within Riparian Reserves if they are consistent with Aquatic Conservation Strategy objectives.

Topic: Water Source Inventory

Recommendation: Given the multiple uses and benefits provided by both natural water sources and water developments it would be useful to update existing water source inventories in order to identify the total distribution of water sources (both natural and engineered) within the watershed. The biologist created a photo and narrative logbook of about 240 surface waters on the east side of the district, which has not been updated. More small 0.1-acre ponds would substantially increase a large variety of local wildlife.

Related Core Topic(s): Human Uses, Riparian Reserves.

Rationale/Objective: The distribution map could be used to identify areas where additional water sources are needed, areas where excess water developments could be removed and areas where existing sources could be more effectively and efficiently utilized. Opportunities for restoration of Riparian Reserves could also be identified.

Appendix A: Possible Management Practices

WA Recommendation	Possible Management Practices	Linkages	NEPA
A. Land Management			
1a. Restore intermittent lake habitat.	Prescribed fire. Removal of lodgepole pine. Mechanical fuel treatments. Collection and seeding of native grasses. Removal of pond berms and partial filling of artificial ponds.	1b, 2c	EA
2a. Restore meadow habitats.	Prescribed fire. Removal of lodgepole pine encroaching on meadows. Non commercial thinning within meadows. Non commercial and commercial thinning adjacent to meadows within riparian reserves. Evaluate opportunities to close, stormproof or decommission roads in wet meadows.	1b, 1c, 2c	EA
3a. Restore degraded intermittent stream Riparian Reserves.	Re-establish channel with defined flowpath within tilled plantations. Manage plantations for DFC of open pine stands typical of grabens adjacent to faults in the southern third of the watershed. Remove plantation access roads that run up the beds of intermittent streams.	4a, 1c, 2c	EA/CE
4a. Preserve and promote aspen growth and existing aspen stands throughout the watershed.	Thin conifers competing with aspen. Priority areas include:	1b	EA
B. Watershed Planning			
1b. Revise Grazing Management Plan.	Adjust grazing management plan according to recommendations to increase protection of TES species and riparian habitats. Maintain a productive functioning riparian ecosystem.	1a, 2a, 3a, 4a	EA?
2b. Prepare Mushroom Management Plan	Complete a mushroom management plan for Medicine Lake Highlands.		EA?
C. Research Inventory and Monitoring			
1c. RA and WIN Inventory.	Transportation plan for watershed identifying maintenance and road decommissioning opportunities.	1a, 2a, 3a	NA
2c. S&M Surveys	Survey for S&M species and identify potential species occurring in the Porcupine	All of the above.	NA

	Watershed.		

NA - No Environmental Assessment required.
EA - Environmental Assessment required.
CE - Categorical Exclusion is probably adequate.
EA/CE - Scope of the project will determine which documentation is appropriate.
LSRA - LSR Assessment required.

Appendix B: Management Direction

Management direction for the Porcupine Watershed is provided by the Shasta-Trinity National Forests Land and Resource Management Plan (LMP) which incorporates direction from the Record of Decision (ROD) for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl.

Land Allocation

The ROD identifies four land allocations within the Porcupine analysis area (see Map B-1):

- Late-Successional Reserves (LSR)
  Late-Successional Reserves are identified with an objective to protect and enhance conditions of late-successional and old-growth forest ecosystems, which serve as habitat for late-successional and old-growth forest related species including the northern spotted owl. Limited stand management is permitted, subject to review by the Regional Ecosystem Office (ROD A-4).
- Administratively Withdrawn Areas
  Administratively Withdrawn Areas are identified in current Forest and District Plans or draft plan preferred alternatives and include recreation and visual areas, back country, and other areas where management emphasis precludes scheduled timber harvest (ROD A-4).
- Riparian Reserves (RR)
  Riparian Reserves provide an area along streams, wetlands, ponds, lakes, and unstable and potentially unstable areas where riparian-dependent resources receive primary emphasis. Riparian Reserves are important to the terrestrial ecosystem as well, serving, for example, as dispersal habitat for certain terrestrial species (ROD A-5).
- Matrix
  The matrix consists of those federal lands outside the three categories of designated areas listed above (ROD A-5).

Management Prescriptions

Management Prescriptions apply a management theme to specific types of land. Within the general framework of the Forest Standards and Guidelines, they identify specific activities that are to be emphasized or permitted on that land and their associated standards and guidelines.

The LMP identifies six Management Prescriptions in the Porcupine analysis area (see Map B-2):

- III Roaded Recreation
  - The purpose of this prescription is to provide for an area where there are moderate evidences of the sights and sounds of humans (LMP 4-64).
  - This prescription emphasizes recreational opportunities associated with developed road systems and dispersed and developed campsites (LMP 4-64).
  - This prescription applies to the Matrix land allocation.

- VI Wildlife Habitat Management
  - The primary purpose of this prescription is to maintain and enhance big game, small game, upland bird game and non-game habitat (LMP 4-66).
  - While this prescription does not emphasize those wildlife species dependent on late seral stages, habitat favorable to these species will occur within this prescription (LMP 4-66).
  - This prescription applies to the Matrix land allocation.
- VII LSRs and Threatened, Endangered, and Selected Sensitive Species
  - The purpose of this prescription is to provide special management for LSRs and Threatened and Endangered species (LMP 4-43).
  - This prescription emphasizes retention and enhancement of sensitive plant species, old-growth vegetation, and hardwoods (LMP 4-43).
  - This prescription applies to the Late-Successional Reserve land allocation.
- VIII Commercial Wood Products Emphasis
  - The purpose of this prescription is to obtain optimum timber yield of wood fiber products from productive forest lands within the context of ecosystem management (LMP 4-67).
  - Timber stands will be managed to obtain optimum growth and yields using cultural practices which control competing vegetation, obtain stocking control, and minimize mortality (LMP 4-67).
  - This prescription applies to the Matrix land allocation.
- IX Riparian Management
  - The purpose of this prescription is to maintain or enhance riparian areas, wildlife and fisheries habitat, and water quality by emphasizing streamside and wetland management (LMP 4-59).
  - Multiple resource uses and activities will occur in support of, and to the extent that they do not adversely affect the maintenance of riparian area dependent resources (e.g., fish, wildlife, water quality) (LMP 4-59).
  - This prescription applies to the Riparian Reserve land allocation and is unmapped in the LMP.
- XI Special Area Management
  - The purpose of this prescription is to provide for protection and management of special interest areas and research natural areas (LMP 4-49).
  - This prescription applies to the Administratively Withdraw land allocation.
- XI Heritage Resource Management
  - The primary theme of this prescription is to protect designated cultural resource values, interpret significant archaeological and historical values for the public, and encourage scientific research of these selected properties (LMP 4-50).
  - This area is unmapped and applies to all land allocations.

Management Areas

Supplemental management direction for specific units of land is provided in the LMP under Management Area Direction (LMP - Chapter 4 - Section G). A management area is a contiguous unit of land with separate, distinct management direction in response to localized issues and resource opportunities.

The LMP identifies two Management Areas in the Porcupine analysis area (see Map B-2). Supplemental management direction that applies to the Porcupine Watershed is summarized as follows:

- Porcupine Butte (#1) (LMP - 4-77)
    - Protect Grasshopper Flat as a cultural resource.
    - Interpret archaeological sites in areas of high visitor use.
    - Conduct a long term thematic study of the prehistoric archaeological sites in the Medicine Lake Highlands.
    - Manage for bitterbrush in selected areas mapped as Prescription VI.
    - Allow fire to play its natural role through natural ignitions.
    - Maintain the existing and planned fuelbreak system to a level which will result in wildfires generally not exceeding 40 acres in size.
    - Plan for geothermal and common minerals development.
    - Maintain Tilted Rock Lava Flow, Burnt Lava Flow and Papoose Hill in their current conditions until they can be evaluated for suitability as SIAs.
    - Maintain caves and lava tubes for increased visitor interpretation, sensitive habitat protection, and public safety.
    - Manage for old-growth pine stands along the Modoc Scenic Byway.
    - Locate, develop, and maintain water sources.
    - Emphasize seasonal vehicle closures for wildlife management in the East McCloud Road Management Area. Reduce road density and rejuvenate browse species to enhance big game species habitat.
    - Develop forest stands that are resistant to epidemic insect or disease attack.
    - Maintain and enhance a sustainable level of wood fiber production.
    - Consider and evaluate regulation of tentatively suitable land presently allocated to withdrawn or reserved areas.
    - Evaluate opportunities to enhance elk populations and habitat.
    - Emphasize management of hardwoods including aspen as a stand component where they exist.

- McCloud Flats (#2) (LMP - 4-81)
    - Survey for additional populations of long-haired star tulip, Salmon Mountains wake robin, and Columbia cress. Pending completion of conservation strategies, identify key habitat for the three plants and manage these areas for maintenance or enhancement of the species.
    - Implement a thematic study of the archaeological sites representing the McCloud River Lumber Company operations.
    - Conduct an evaluation program at archaeological sites in heavily used dispersed recreation areas such as Toad Well. If sites are eligible for the National Register, carry out protection measures such as fencing and public education.
    - Manage the non-timbered portion of Toad Lake primarily for earlier seral stage vegetation.
    - Manage for bitterbrush in selected areas mapped as Prescription VI.
    - Rehabilitate Atkins Meadow as part of a riparian restoration project.
    - Regulate the collection of edible mushrooms to a level compatible with sustaining viable populations.
    - Develop forest stands that are resistant to epidemic insect or disease attack.
    - Maintain and enhance a sustainable level of wood fiber production.

- Consider and evaluate regulation of tentatively suitable land presently allocated to withdrawn or reserved areas.
- Locate, develop, and maintain water sources.
- Evaluate opportunities to enhance elk habitat management.
- Consider expanding the East McCloud Road Management Area to emphasize seasonal vehicular closures for wildlife management. Reduce road density and rejuvenate browse species to enhance big game species habitat.
- Emphasize management of hardwoods including aspen as a stand component where they exist.

The above Supplemental Management Direction consists only of those excerpts from the LMP that apply to the Porcupine Watershed. Refer to the LMP (Chapter 4 - Section G) for a complete list of supplemental management direction.

Appendix C: Species List

List of Wildlife Species Possibly Occurring in the Porcupine Watershed.
Species Listed by Guild Association.

HABITAT TYPES

- MCN Mixed Conifer
- PPN Ponderosa Pine
- EPN Eastside Ponderosa Pine
- LPN Lodgepole Pine
- BBR Bitterbrush
- MRI Montane Riparian
- RIV Riverine

GUILD(S)

- AQSL Areas of slow water required, either lacustrine or riverine habitat
- C/C Cliffs and caves
- CHAP Chaparral communities
- DEAD/D Dead and down material (logs, stumps, slash, litter, duff)
- HDWD Hardwoods
- LATE Late seral stages (4a, 4b, 4c) and multi-layered
- OPEN Meadows, open areas, seral stages 1, 2, and 3a
- OPEN-GRASS Seral stage 1; mutually exclusive from OPEN-SHRUB
- OPEN-SHRUB All forested habitat types; openings, seral stages 2 and 3a
- RIPAR Associated with riparian vegetation
- SNAGCAV Tree cavity dependent species found in snags or live trees
- T/R Talus and rocks

WHRI Wildlife Habitat Relationship ID code

STATUS

- S&M Survey and Management species listed in Appendix R of the Shasta-Trinity LMP, 1995
- CSC CDF 'Species of Special Concern' (Special 8/94)
- CaE California State-listed Endangered (TES&P 1/95)
- CaT California State-listed Threatened (TES&P 1/95)
- FS Forest Service Sensitive (TES&P Animals of the Pacific Southwest Region 1/95)
- FT Federally Listed Threatened (Endangered and Threatened Animals of Calif. 1/95)
- FE Federally Listed Endangered (Endangered and Threatened Animals of Calif. 1/95)

NT Neotropical Migratory Birds

Wildlife Species Possibly Occurring in the Porcupine Watershed

and Associated with Habitat Types MCN, PPN, LPN, EPN, BBR, MRI, and RIV.
Canopy Closure 0-100% and Seral Stage seedling to mature (<1" to 24" DBH)

GUILD(S)	WHRI	COMMON NAME	OBSERVED	STATUS	NT
AQSL	A003	LONG-TOED SALAMANDER	✓		
	A006	ROUGH-SKINNED NEWT	✓		
	A032	WESTERN TOAD	✓		
	A039	PACIFIC TREEFROG	✓		
		TADPOLE SHRIMP		FE	
	B079	MALLARD	✓		
C/C	B108	TURKEY VULTURE	✓		✓
	B126	GOLDEN EAGLE	✓	CSC	✓
	B131	PRAIRIE FALCON		CSC	✓
	B343	CLIFF SWALLOW			✓
	B344	BARN SWALLOW			✓
	M021	LITTLE BROWN MYOTIS	✓		
	M023	YUMA MYOTIS			
	M025	LONG-EARED MYOTIS		S&M	
	M026	FRINGED MYOTIS		S&M	
	M027	LONG-LEGGED MYOTIS		S&M	
	M028	CALIFORNIA MYOTIS		CSC	
	M032	BIG BROWN BAT			
	M037	TOWNSEND'S BIG-EARED BAT	✓	CSC	
	M038	PALLID BAT	✓	CSC, S&M	
CHAP	B319	GRAY FLYCATCHER			✓
	B482	GREEN-TAILED TOWHEE			✓
	M038	PALLID BAT	✓	CSC, S&M	
	M088	GREAT BASIN POCKET MOUSE			
	M119	BRUSH MOUSE			
	M149	GRAY FOX			
	M181	MULE DEER	✓		
	R023	SAGEBRUSH LIZARD	✓		
	R054	STRIPED WHIPSNAKE			
DEAD/D	A003	LONG-TOED SALAMANDER	✓		
	A012	ENSATINA			
	M117	DEER MOUSE			
	M151	BLACK BEAR	✓		
	M154	AMERICAN MARTEN	✓	CSC, FS	
	M155	PACIFIC FISHER		CSC, FS	
	M157	LONG-TAILED WEASEL	✓		
	R046	RUBBER BOA			
	R058	COMMON KINGSNAKE			
	R059	CALIFORNIA MOUNTAIN KINGSNAKE			
HDWD	B116	COOPER'S HAWK		CSC	✓
	B251	BAND-TAILED PIGEON			✓
	B303	DOWNY WOODPECKER	✓		
	B362	WHITE-BREASTED NUTHATCH	✓		
	B418	WARBLING VIREO			✓
	M077	WESTERN GRAY SQUIRREL			
	B117	NORTHERN GOSHAWK	✓	CSC, FS	✓
	B134	BLUE GROUSE	✓		
	B270	NORTHERN SPOTTED OWL	✓	FT	

	B304	HAIRY WOODPECKER	✓		
	B305	WHITE-HEADED WOODPECKER	✓		
	B306	BLACK-BACKED WOODPECKER	✓		
	B308	PILEATED WOODPECKER	✓		
	B309	OLIVE-SIDED FLYCATCHER	✓		✓
	B317	HAMMONDS' FLYCATCHER			✓
	B345	GRAY JAY	✓		
	B346	STELLER'S JAY	✓		
	B356	MOUNTAIN CHICKADEE	✓		
	B357	CHESTNUT-BACKED CHICKADEE	✓		
	B361	RED-BREASTED NUTHATCH	✓		
	B363	PYGMY NUTHATCH	✓		
	B364	BROWN CREEPER	✓		✓
	B375	GOLDEN-CROWNED KINGLET			✓
	B390	VARIED THRUSH			✓
	B415	SOLITARY VIREO	✓		✓
	B438	HERMIT WARBLER	✓		✓
	B539	RED CROSSBILL			
	B546	EVENING GROSBEAK			
	M012	TROWBRIDGE'S SHREW	✓		
	M030	SILVER-HAIRED BAT		S&M	
	M034	HOARY BAT			
	M079	DOUGLAS' SQUIRREL	✓		
	M080	NORTHERN FLYING SQUIRREL	✓		
	M151	BLACK BEAR	✓		
	M154	AMERICAN MARTEN	✓	CSC, FS	
	M155	PACIFIC FISHER		CSC, FS	
	B108	TURKEY VULTURE	✓		✓
	B126	GOLDEN EAGLE		CSC	✓
	B140	CALIFORNIA QUAIL	✓		
	B141	MOUNTAIN QUAIL	✓		
	B264	WESTERN SCREECH OWL	✓		
	B265	GREAT HORNED OWL	✓		
	B276	COMMON NIGHTHAWK	✓		✓
	B277	COMMON POORWILL			✓
	B281	VAUX'S SWIFT		CSC	✓
	B289	CALLIOPE HUMMINGBIRD	✓		✓
	B350	CLARK'S NUTCRACKER	✓		
	B354	COMMON RAVEN	✓		
	B366	ROCK WREN	✓		✓
	B380	WESTERN BLUEBIRD	✓		✓
	B489	CHIPPING SPARROW			✓
	B494	VESPER SPARROW			✓
	B505	SONG SPARROW			✓
	B512	DARK-EYED JUNCO	✓		✓
	B542	PINE SISKIN	✓		✓
	B543	LESSER GOLDFINCH	✓		✓
	M021	LITTLE BROWN MYOTIS	✓		
	M025	LONG-EARED MYOTIS		S&M	
	M026	FRINGED MYOTIS		S&M	
	M028	CALIFORNIA MYOTIS		CSC	
	M032	BIG BROWN BAT			
	M049	SNOWSHOE HARE		CSC	
	M051	BLACK-TAILED HARE	✓		
	M145	PORCUPINE			

	M146	COYOTE	✓		
	M151	BLACK BEAR	✓		
	M156	ERMINE			
	M162	STRIPED SKUNK			
	M165	MOUNTAIN LION	✓		
	M166	BOBCAT	✓		
	M181	MULE DEER	✓		
	R022	WESTERN FENCE LIZARD	✓		
	R042	NORTHERN ALLIGATOR LIZARD	✓		
OPEN-GRASS	B123	RED-TAILED HAWK	✓		✓
	B124	FERRUGINOUS HAWK			✓
	B125	SWAINSON'S HAWK			✓
	B127	AMERICAN KESTREL	✓		✓
	B131	PRAIRIE FALCON		CSC	✓
	B333	WESTERN KINGBIRD	✓		✓
	B389	AMERICAN ROBIN	✓		✓
	B411	EUROPEAN STARLING			
	B537	CASSIN'S FINCH	✓		✓
	M018	BROAD-FOOTED MOLE			
	M070	BELDING'S GROUND SQUIRREL			
	M072	CALIFORNIA GROUND SQUIRREL	✓		
	M084	WESTERN POCKET GOPHER	✓		
	M113	WESTERN HARVEST MOUSE	✓		
	M133	MONTANE VOLE	✓		
	M136	LONG-TAILED VOLE			
	R036	WESTERN SKINK	✓		
	R051	RACER	✓		
	R057	GOPHER SNAKE	✓		
OPEN-SHRUB	B287	ANNA'S HUMMINGBIRD	✓		✓
	B318	DUSKY FLYCATCHER	✓		✓
	B360	BUSHTIT			
	B376	RUBY-CROWNED KINGLET			✓
	B382	TOWNSEND'S SOLITAIRE	✓		✓
	B426	NASHVILLE WARBLER			✓
	B435	YELLOW-RUMPED WARBLER	✓		✓
	B436	BLACK-THROATED GRAY WARBLER			✓
	B471	WESTERN TANAGER	✓		✓
	B477	LAZULI BUNTING	✓		✓
	B483	RUFOUS-SIDED TOWHEE	✓		✓
	B504	FOX SPARROW	✓		✓
	B510	WHITE-CROWNED SPARROW	✓		✓
	B536	PURPLE FINCH			✓
	M055	YELLOW-PINE CHIPMUNK	✓		
	M057	ALLEN'S CHIPMUNK			
	M075	GOLDEN-MANTLED GROUND SQUIRREL	✓		
	R039	WESTERN WHIPTAIL			
	A039	PACIFIC TREEFROG	✓		
	B115	SHARP-SHINNED HAWK		CSC	✓
	B299	RED-BREASTED SAPSUCKER			✓
	B311	WESTERN WOOD-PEWEE	✓		✓
	B339	TREE SWALLOW	✓		✓
	B340	VIOLET-GREEN SWALLOW	✓		✓
	B369	HOUSE WREN	✓		✓
	B370	WINTER WREN			
	B385	SWAINSON'S THRUSH			✓

	B386	HERMIT THRUSH	✓		✓
	B430	YELLOW WARBLER	✓		✓
	B460	MACGILLIVRAY'S WARBLER			✓
	B461	COMMON YELLOWTHROAT	✓		
	B475	BLACK-HEADED GROSBEAK			✓
	B506	LINCOLN'S SPARROW			✓
	M003	VAGRANT SHREW			
	M052	MOUNTAIN BEAVER			
	R061	COMMON GARTER SNAKE	✓		
	R062	WESTERN TERRESTRIAL GARTER SNAKE			
	B127	AMERICAN KESTREL	✓		✓
	B263	FLAMMULATED OWL	✓		✓
	B264	WESTERN SCREECH OWL	✓		
	B267	NORTHERN PYGMY OWL	✓		
	B270	NORTHERN SPOTTED OWL	✓	FT	
	B274	NORTHERN SAW-WHET OWL	✓		
	B281	VAUX'S SWIFT		CSC	✓
	B294	LEWIS' WOODPECKER			✓
	B299	RED-BREASTED SAPSUCKER			✓
	B300	WILLIAMSON'S SAPSUCKER			✓
	B303	DOWNY WOODPECKER			
	B304	HAIRY WOODPECKER			
	B305	WHITE-HEADED WOODPECKER			
	B306	BLACK-BACKED WOODPECKER			
	B307	NORTHERN FLICKER			✓
	B308	PILEATED WOODPECKER			
	B339	TREE SWALLOW	✓		✓
	B340	VIOLET-GREEN SWALLOW			✓
	B356	MOUNTAIN CHICKADEE	✓		
	B357	CHESTNUT-BACKED CHICKADEE			
	B361	RED-BREASTED NUTHATCH	✓		
	B362	WHITE-BREASTED NUTHATCH	✓		
	B363	PYGMY NUTHATCH	✓		
	B380	WESTERN BLUEBIRD	✓		✓
	B381	MOUNTAIN BLUEBIRD			✓
	B411	EUROPEAN STARLING			
	M077	WESTERN GRAY SQUIRREL			
	M079	DOUGLAS' SQUIRREL	✓		
	M080	NORTHERN FLYING SQUIRREL	✓		
	M155	PACIFIC FISHER		CSC, FS	
T/R	B366	ROCK WREN			✓
	B367	CANYON WREN			
	M043	PIKA	✓		

Appendix D: Literature Cited

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