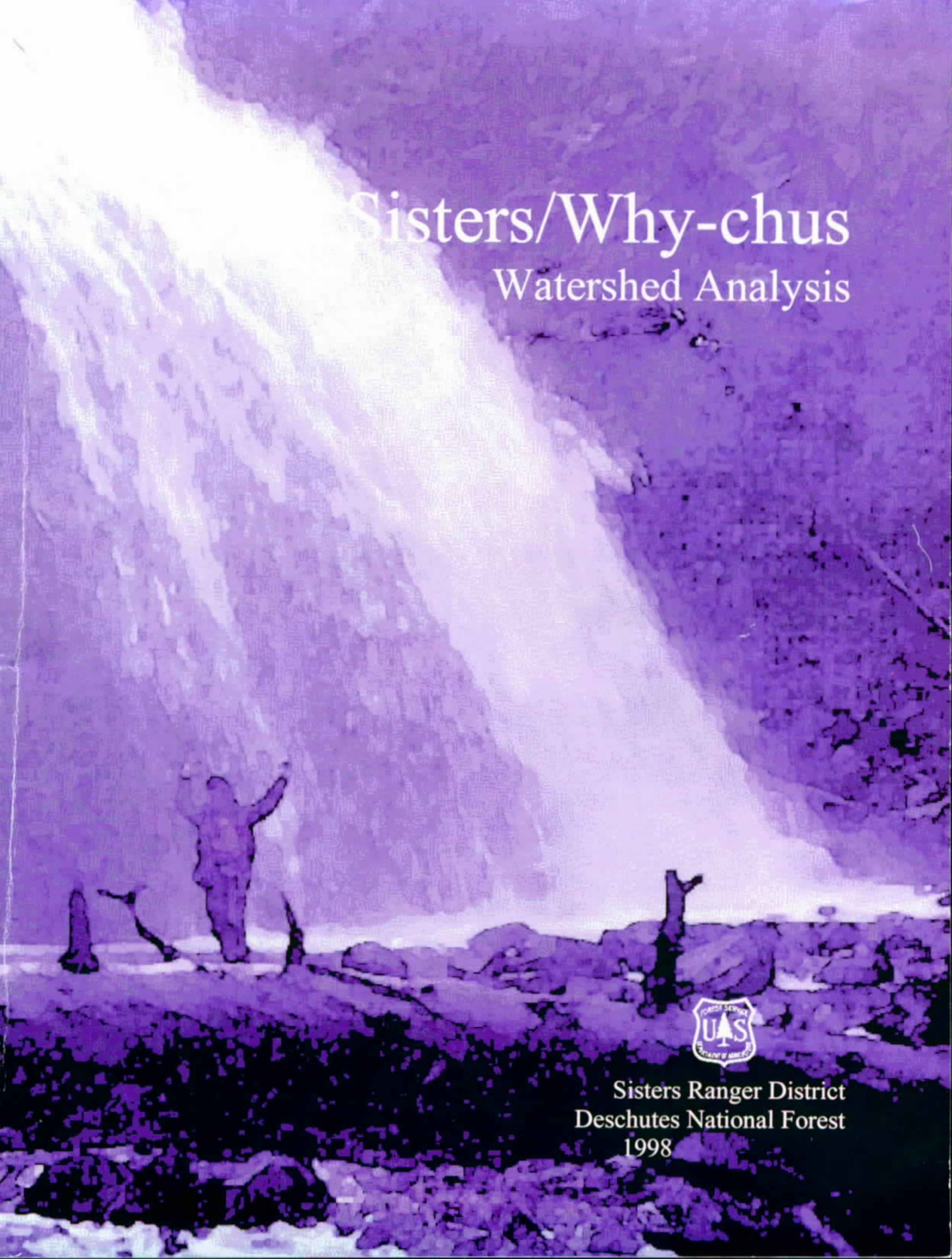
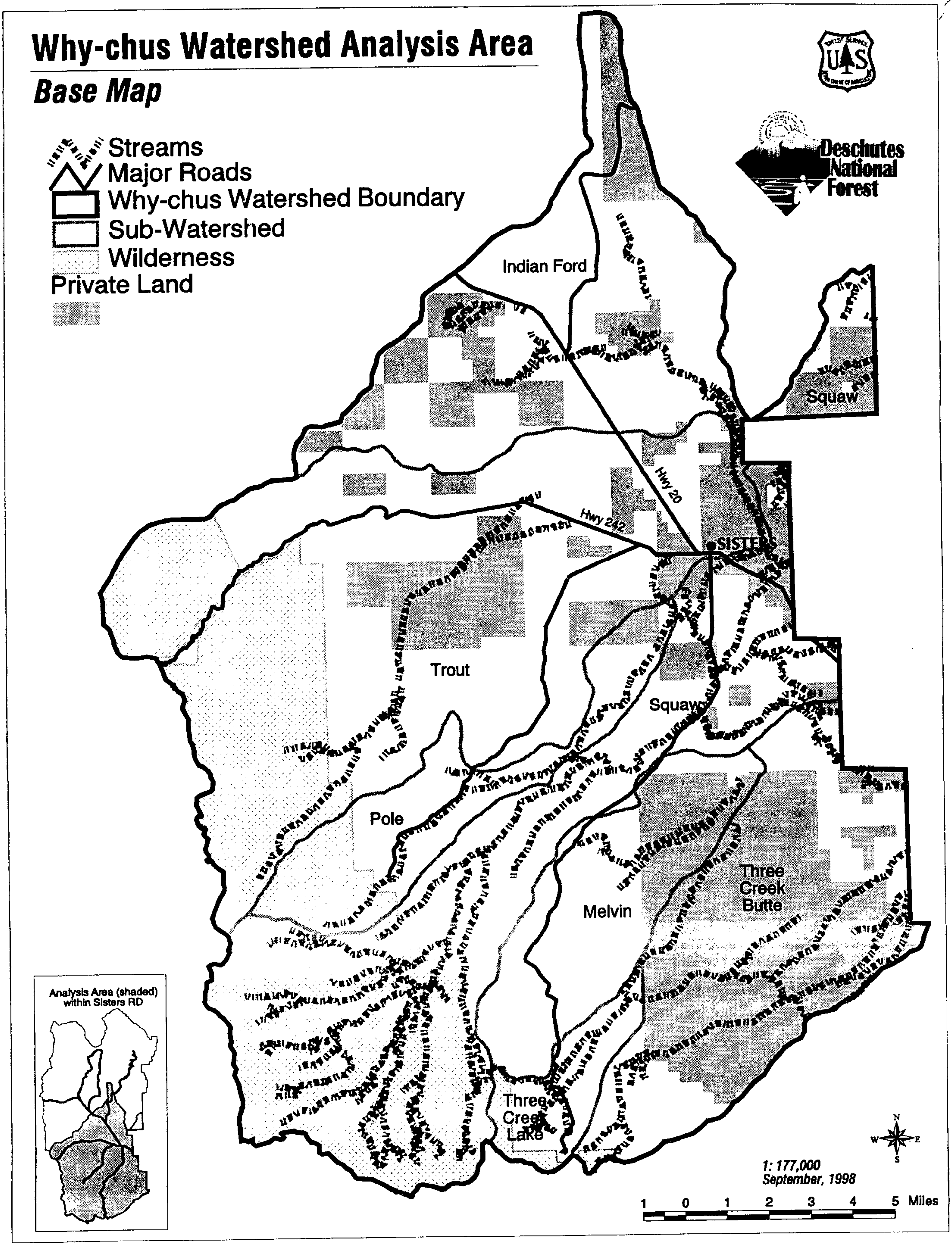
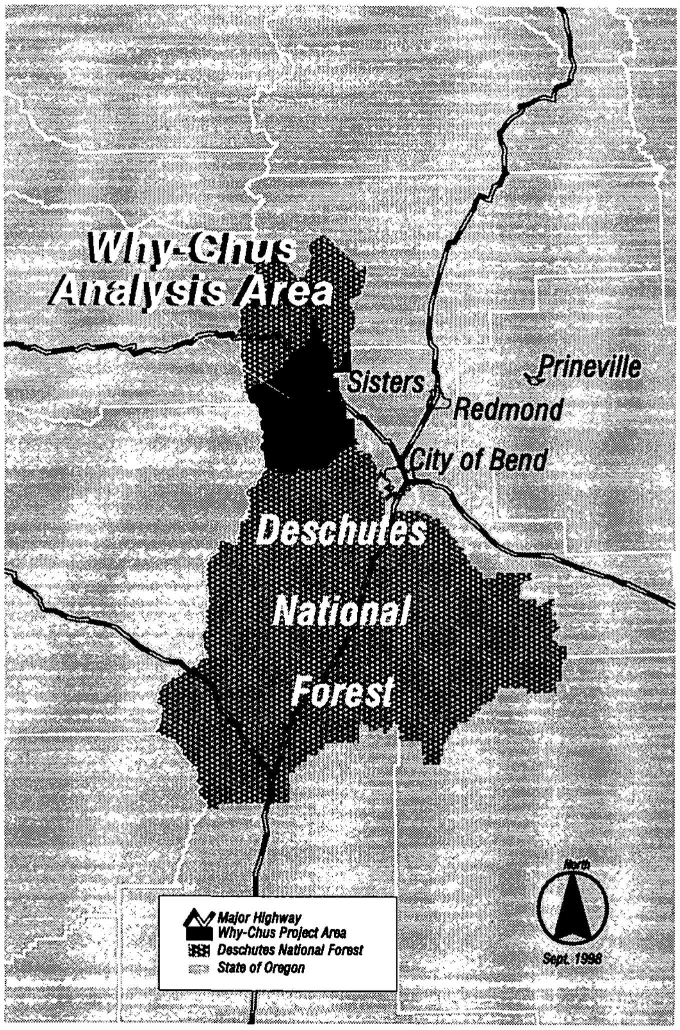


Sisters/Why-chus
Watershed Analysis

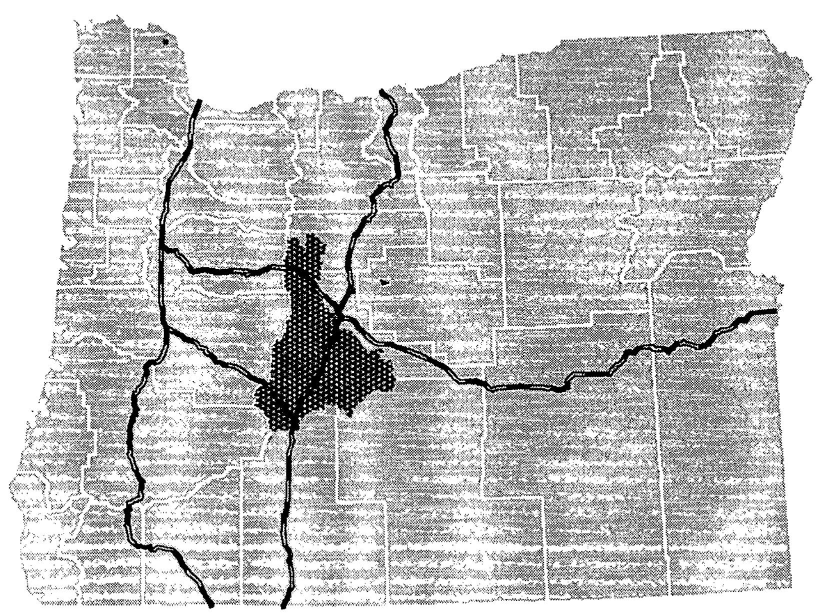
Sisters Ranger District
Deschutes National Forest
1998


Why-chus Watershed Analysis Area
Base Map
Streams
Major Roads
Why-chus Watershed Boundary
Sub-Watershed
Wilderness
Private Land
Deschutes National Forest
Indian Ford
Squaw
Hwy 20
Hwy 242
SISTERS
Trout
Squaw
Pole
Melvin
Three Creek Butte
Three Creek Lake
Analysis Area (shaded) within Sisters RD
N
W
E
S
1: 177,000
September, 1998
1 0 1 2 3 4 5 Miles



Deschutes National Forest
Sisters Ranger District

Locator Map- Why-Chus Watershed Assessment with Deschutes National Forest and State of Oregon



State of Oregon with Deschutes National Forest

Artists:

Rueben Anderson- inside cover , pg 7, 187, 187, 214

Glen Corbett- Team page, pg 126, 159

Anne Noel- pg 52, 127

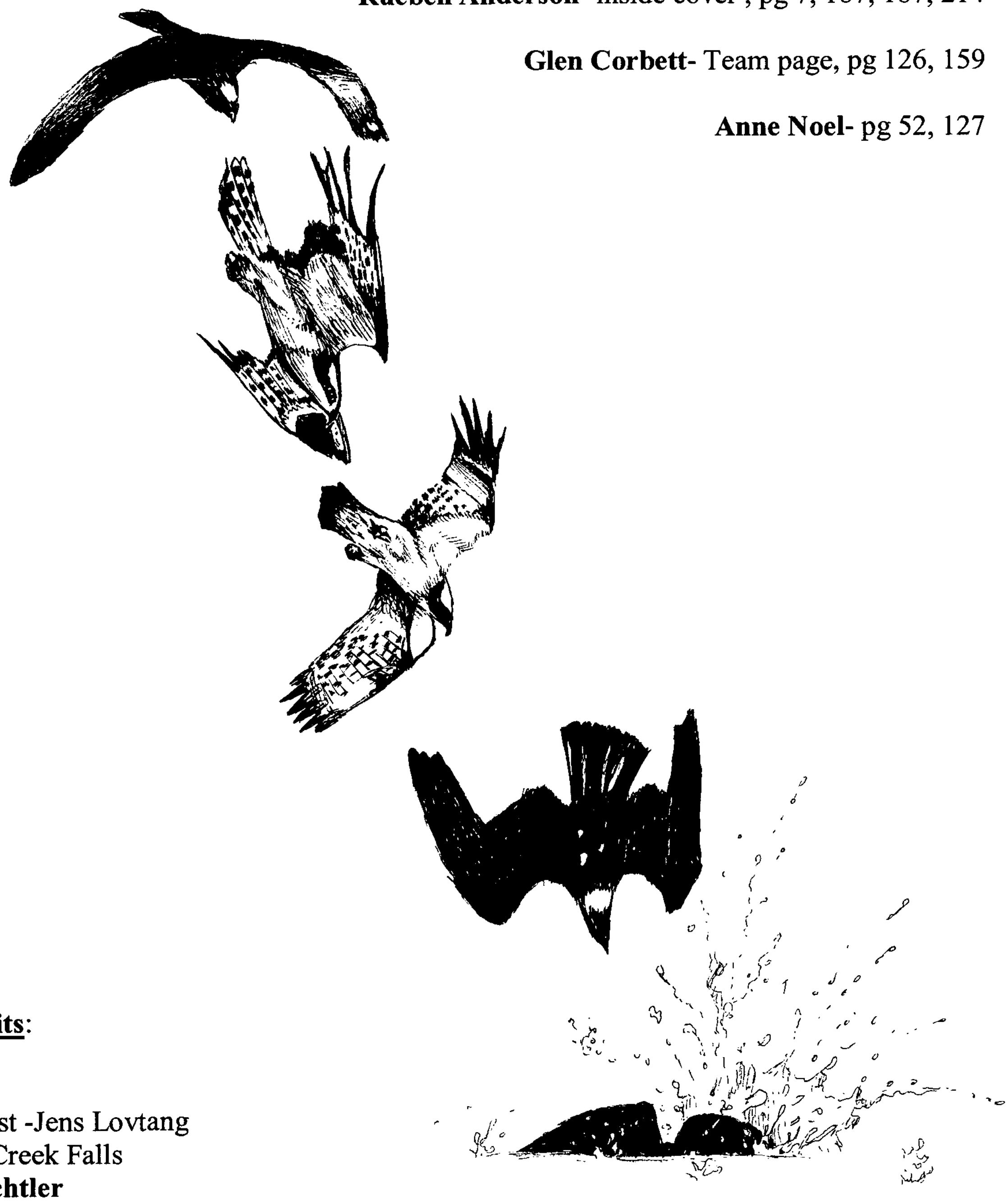


Photo Credits:

Cover-
Fish Biologist -Jens Lovtang
and Squaw Creek Falls
by **Nate Dachtler**
Computor effect of watercolor of slide

Pg 44- Sisters Forests, early 1930's,
courtesy of **Samuel S. Johnson Foundation**
and the **Deschutes County Historical Society**

Pg 230, Old growth pine snag- **Maret Pajutee**

Sisters/Why-chus

Watershed Analysis

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Rusty Merritt	GIS
Dale Putnam	Transportation
Marc Wilcox	Hydrology

Thank you to the many community volunteers who participated in the Sisters Watershed History Fest, a partnership project to study watershed history, funded by the **National Forest Foundation**, Recreation and Wildlife Matching Awards Program, The Samuel S. Johnson Foundation, and the Deschutes County Historical Society. *Special Thanks to Katherine Cerino, Georgia Gallagher, Jess Edgington, Becky Johnson, JoAnne Heinzel, Vaunell Temple, John Hayes, Bill Edwards, Barbara Lee, Agnes Rand, Glen Corbett, Cheryl Butler, The Nugget Newspaper, and Greg McClarren.*

They helped us discover some of Squaw Creeks' secrets.

TABLE OF CONTENTS

INTRODUCTION

The purpose of this watershed analysis is to provide a general understanding of the ecological conditions and processes within seven subwatersheds that comprise the Sisters/Why-chus analysis area. This area is called "Why-chus" after a Native American name for Squaw Creek, meaning "a place to cross the water".

> **Watershed analysis** is like taking your watershed to the doctor for a checkup. What are your symptoms or **issues**? Tests or **analysis** focused on these symptoms will reveal how things have changed over time. The doctor will assess the results and tell you which changes or **trends** are risks important not to ignore. The bottom line is a prescription or **recommendations** that will help correct the changes that you can control.

This information will guide future management and suggest future projects. It serves as a foundation for future project level analysis and decision-making for a wide range of potential management activities. The analysis helps to ensure that those activities are consistent with ecosystem management objectives as described in the *Deschutes National Forest Land and Resource Management Plan* (LRMP) as amended by the *Record of Decision for Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl*.

The document follows the six step analysis process outlined in the *Federal Guide for Ecosystem Analysis at the Watershed Scale* (version 2.2) and associated modules. These steps are as follows:

Step 1) Characterize the watershed
Step 2) Identify issues and key questions
Step 3) Describe current conditions
Step 4) Describe historic reference conditions
Step 5) Synthesize and interpret differences and trends
Step 6) Recommendations

In this document historic reference conditions are presented before current conditions. This analysis is not a decision making process. Project level recommendations for federal lands must be further analyzed according to the National Environmental Policy Act (NEPA) process.

Collaboration and community-based solutions are essential.

Many of the issues we face in this watershed are beyond the control of any one landowner or agency and must be solved by working together. Local solutions will be most effective. Sharing ideas, concerns, resources, agency staff time, and budgets can increase efficiency and help craft success. This analysis suggests strategies and provides focus for collaborative watershed restoration.

Location

<u>Why-chus Watershed Analysis Area</u> = Seven subwatersheds south of Sisters, Oregon. They include Squaw Creek, Pole Creek, Trout Creek, Indian Ford Creek, Melvin, Three Creek Butte and Three Creek Lake. Squaw Creek is the largest stream. The area encompasses approximately 178,000 acres.

The Why-chus Watershed analysis area is located on the eastern slope of the Cascade Mountain range. Elevations range from 10,358 feet at the top of South Sister to 3200 feet near the city of Sisters. It is part of the upper Deschutes River Basin and in a larger context the Columbia River Basin. The Deschutes River flows through Pelton and Round Butte Dams before entering the Columbia River, which flows, into the Pacific Ocean.

The area is located in the southern half of the Sisters Ranger District, Deschutes National Forest and is within Deschutes County, Oregon. The City of Sisters and housing developments such as Black Butte Ranch, Indian Ford, Tollgate, and Cascade Meadow Ranch are within the analysis area. It lies approximately 20 miles west of Bend, Oregon along Highway 20, which bisects the northern one third of the analysis area.

What makes this area important to people?

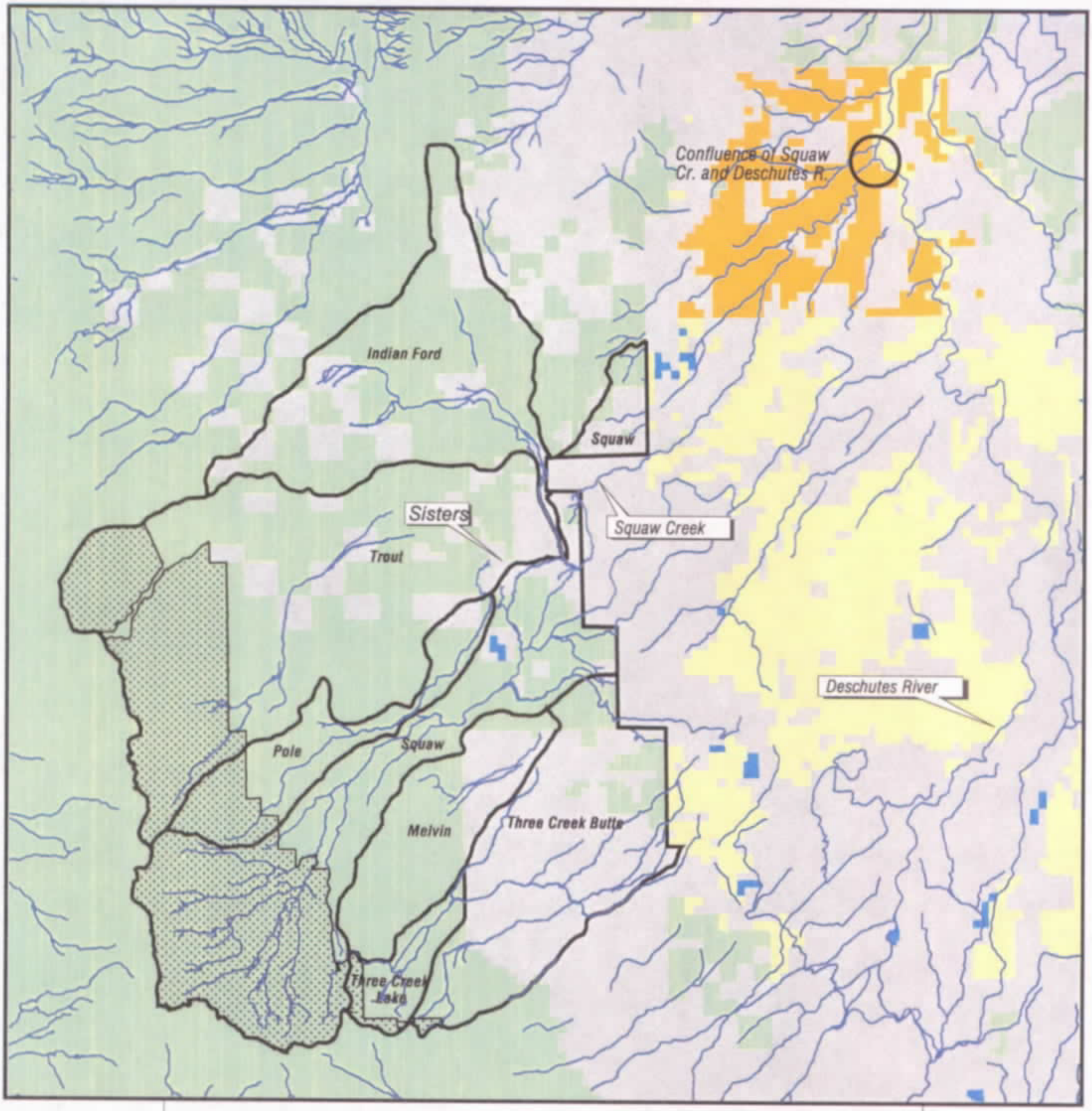
The Why-chus watershed is the setting for the city of Sisters. Sisters lies at the junction of two highway passes over the Cascade Mountains and since the late 1800's has served as a stopping place for travelers. Thousands drive through the area each day on their way to and from Central Oregon's favorite recreational areas and growing cities.

Attracted by the area beauty and quality of life, more people are choosing to live here. This makes the greater Sisters area an expanding part of rapidly growing Deschutes County. The landscape, enclosed by these seven subwatersheds, plays a large part in determining the beauty and quality of life in the area. A high level of public interest and controversy is found in the Sisters area because it is an area many people love.

Ecologically the area has unique features created by its geologic origins and location. Typical westside species, such as the spotted owl and certain native plants, survive here at the edge of their range. Hydrologically, the area contributes vast subsurface water flows to the Deschutes River Basin. There are high hopes that anadromous fish runs can be restored here.

Why-Chus Watershed Analysis Area

Location Map showing Why-Chus Analysis Area and Squaw Creek



Legend

Wilderness
Streams
Watersheds
Why-Chus Analysis Area

Ownership
USFS
Grasslands
State
BLM
Private

1:280000
June 1998

2 0 2 4 6 8 Miles

Why-chus Watershed Analysis Area ------------Distinguishing Features

Physical

- Two Key Watersheds- Squaw Creek and Three Creeks
- Three Fifth Field Watersheds- which determine important management boundaries: Squaw Creek, Three Creeks, and Indian Ford Creek
- Cascade Mountain backdrop- Three Sisters, Broken Top
- Potential geothermal energy
- Highly permeable outwash plains of sand and gravel left by glaciers
- Little surface water flow, vast quantity of subsurface water flow
- Pole Creek supplies municipal water for City of Sisters

Biological

- Trademark ponderosa pine forests
- Squaw Creek once supported large steelhead and spring chinook runs
- Large wetland and riparian habitats associated with Indian Ford Creek, Black Butte Meadow and Swamp, Glaze Meadow
- Amphibian special interest area at Three Creeks, including significant long term monitoring sites
- Sub-alpine and alpine habitats
- Bald eagle Management Area and known bald eagle nest
- Spotted owls and carnivores such as marten, lynx and wolverine
- Rare endemic wildflower, Peck's penstemon and rare fungi and lichens
- Rapidly expanding noxious weed populations associated with urban areas

Social

- Ownership- 75% Public lands, 25% Private lands
- State Highway 20- Oregon's busiest route over the Cascade Mountains
- Popular recreation/tourist destination
- City of Sisters and surrounding developments
- Rapidly growing population and new developments
- Large areas of forest/ urban interface
- Long history of Native American use and early European settlement
- Transition from historic timber/ranching economy, ongoing irrigation and ranching
- Squaw Creek is designated as a Wild and Scenic River
- Three Creeks Lake provides popular recreation area
- Valued scenic vistas, junction of 2 Scenic Byways(Hwy 20 & McKenzie Hwy)
- Innovative water and land conservation solutions involving private non-profit Trusts

Land Allocations

The following tables illustrate the land allocations within the watershed. One half of the area is covered by the Northwest Forest Plan. Table 1 describes allocations that have been designated by the Northwest Forest Plan while Table 2 shows the Deschutes National Forest land allocations.

Table 1. Land Allocations as described by the Northwest Forest Plan (NWFP) for the Why-chus watershed.

NORTHWEST FOREST PLAN (NWFP)			
MANAGEMENT ALLOCATION	ACRES	% OF TOTAL NWFP ACRES	% OF WATERSHED
Congressionally Withdrawn	40,430	45%	23%
Late-Successional Reserve	26,767	30%	15%
Matrix	20,500	23%	12%
Administratively Withdrawn	1,417	2%	1%
TOTAL	89,114	100%	50%

Table 2. Land Allocations as described by the Deschutes National Forest Land and Resource Management Plan (LRMP) for the Why-chus watershed.

LMRP MANAGEMENT ALLOCATION	ACRES	% OF WATERSHED
Other Ownership	44,509	25%
Wilderness	40,437	23%
Deer Habitat	19,900	11%
General Forest	17,900	10%
Front Country Unseen	13,692	8%
Front Country Seen	12,121	7%
Scenic Views - Retention Foreground	11,209	6%
Metolius Black Butte Scenic	4,070	2%
Scenic Views - Partial Retention	3,248	2%
Squaw Creek, Scenic Segment	2,863	2%
Metolius Old Growth	1,926	1%
Winter Recreation	1,494	1%
Intensive Recreation	936	<1%
Metolius Heritage	832	<1%
Old Growth	830	<1%
Dispersed Recreation	780	<1%
Scenic Views - Partial Retention	563	<1%
Metolius Special Interest	459	<1%
TOTALS	177,834	100%

Management Plans, Assessments, Guides

The management of this watershed is directed by the *Deschutes Land and Resource Management Plan* (1990) which was amended by 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* (1994)or Northwest Forest Plan..

Half of the area is not covered by the Northwest Forest Plan and receives additional management direction from the *"Continuation of Interim Management Direction Establishing Riparian, Ecosystem and Wildlife Standards for Timber Sales",* commonly referred to as the "Eastside Screens".

The following existing and proposed plans also apply to the Why-chus watershed:

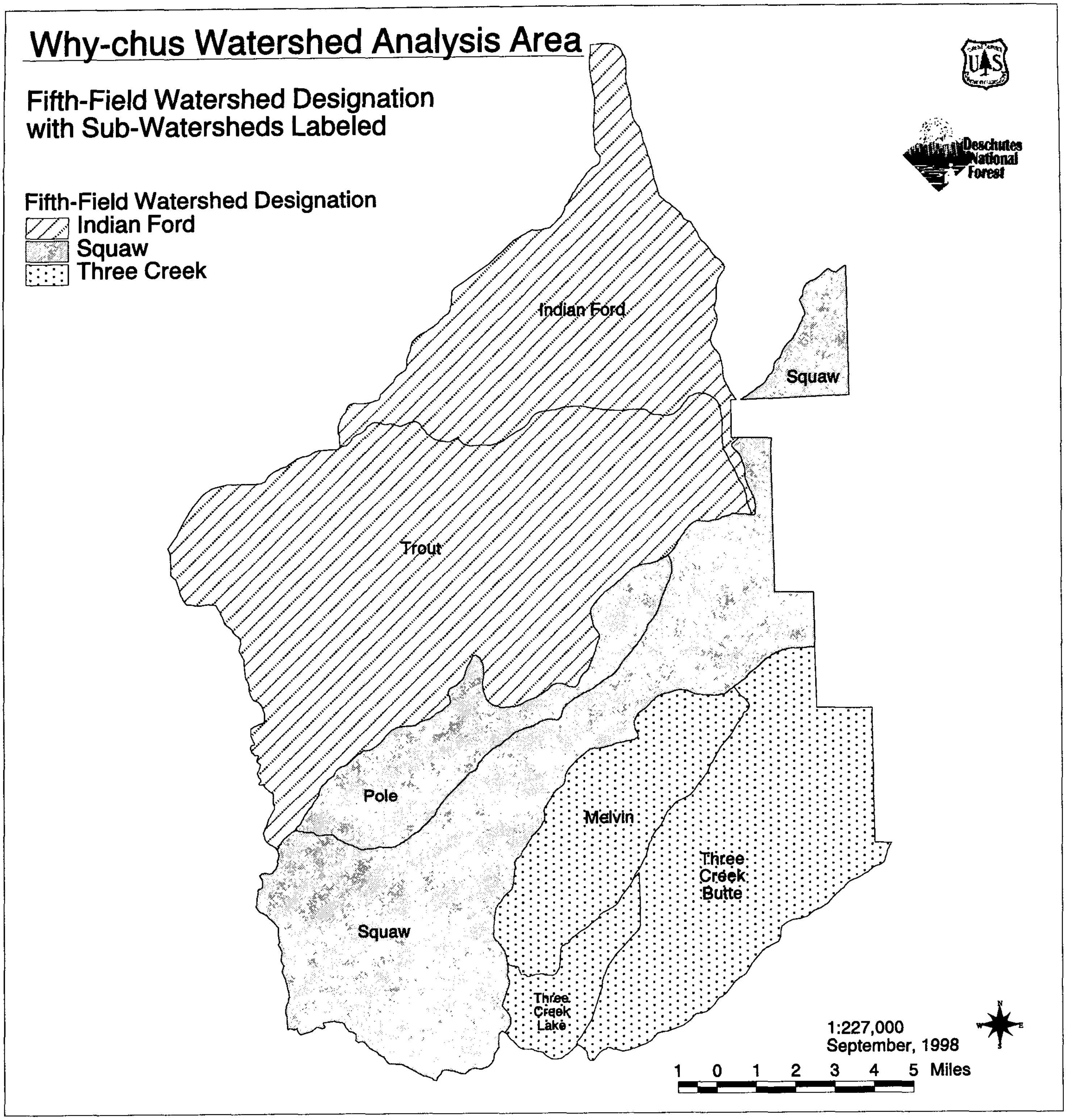
- Water Quality Management Plan for Squaw Creek/Clean Water Act Section 303D (pending)
- Federal Wildland Fire Management Policy and Program
- Cloverdale Bald Eagle Fire Management Action Plan
- Cloverdale Bald Eagle Management Plan (pending)
- Three Sisters Wilderness Fire Management Action Plan (pending)
- Why-chus Late-Successional Reserve Assessment (in progress)
- Access and Travel Management Decision Guide and Process
- Squaw Creek Wild and Scenic River Management Plan (pending)
- Species Conservation Strategy for Peck's penstemon

The ***Interior Columbia Basin Ecosystem Management Project (ICBEMP) /Eastside Environmental Impact Statement*** analyzed this area as part of the Interior Columbia River Basin. Information from that analysis was used by the Why-chus Watershed Analysis Team. The ICBEMP and final decision are on hold at this time.

Public Involvement

Public participants in the 1994 Squaw Creek Preliminary Watershed Analysis helped identify significant landscape elements and concerns which were carried into this analysis. Public presentations and requests for comments were made at Sisters City Council Public Meetings, Sisters area Chamber of Commerce, Deschutes County Watershed Council, and Squaw Creek Working Group.

A special grant was obtained from the National Forest Foundation to fund a community partnership project called the ***"Sisters Watershed History Fest*** ". This project explored watershed issues in the context of local history with a community college class, oral histories from long time residents, a series of newspaper articles, and one day event. Community volunteers contributed hundreds of hours collecting historic information and photographs that were then used in this analysis.



Nfs_water_name	Count	Sum_Gis_acres
INDIAN_FORD_CR	2	83614.1600
SQUAW_CR	3	51407.9400
THREE_CR	3	42817.6000

ISSUES AND KEY QUESTIONS

Core and Key Questions

Core questions are outlined in the Federal Guide for Watershed Analysis, Version 2.2. These are designed to guide teams through the six steps found in the Guide. The following areas were analyzed: Erosion Processes, Hydrology, Stream Channels, Water Quality, Vegetation, Species and Habitats, and Human Uses. Each area contains several core questions, and the team formulated additional questions. These questions are found and answered in each section.

Key Issues for the Sisters/Why-chus Watershed

Physical Domain

Sections of streams and wetlands are altered and are not functioning properly.

Wetlands and meadows are ditched	***SO WHAT?*** ======>	They are not storing water and releasing water during low flow periods
Streams flows are diverted	***SO WHAT?*** ======>	Low flows lead contribute to degraded water quality, especially water temperature.There is a loss of instream habitat for fish and riparian habitat causing streambank instability
Stream flows are channeled	***SO WHAT?*** ======>	There is an increase in stream velocity, loss of bank stability, and loss of floodplain habitat
People remove instream wood and riparian vegetation	***SO WHAT?*** ======>	There is a loss of habitat diversity and channel structure
Roads and compacted soils channel runoff	***SO WHAT?*** ======>	There is an increase in flow velocity, peak flows, and sediment delivery
Soil compaction has increased	***SO WHAT?*** ======>	This may affect plant growth, soil organisms, and plant diseases.

Biological Domain

Biological components and processes are altered

Forest vegetation has changed- (More white fir, less big pine,more brush, more juniper, less grassland, , more weeds)	***SO WHAT?*** ======>	Some habitats have become more unstable and at risk. There is more habitat for some species and less for others. Exclusion of fire has increased habitat complexity and increased fire risk in some areas
Forests have smaller trees	***SO WHAT?*** ======>	There is a loss of big tree habitat and stands have average smaller sizes
Forests are denser	***SO WHAT?*** ======>	Trees are stressed and vulnerable to disturbances such as insects and disease or fire.
Forests are fragmented	***SO WHAT?*** ======>	There is a loss of habitat connectivity and more habitat for edge species
Wildlife and fish species composition has changed	***SO WHAT?*** ======>	Some species, especially fish and predatory mammals have been extirpated. Some rare species are declining. Some species have more habitat while others have less. Some populations are managed for harvest for human use.

Social Domain

Population growth and changes in use affect our environment

There are more people living and recreating here	***SO WHAT?*** =======>	There is concentrated use at some destinations causing resource damage Forest/urban interface habitats are affected by dumping, vehicles, weeds, and more human caused wildfires. The quality of life and recreational experiences is changing to more crowded. Water use and wastewater production is affecting basin hydrology
Land use and ownership is changing	***SO WHAT?*** =======>	There is more urban interface and associated infrastructure and easements. Farm and forests lands decrease. There are more types of forest use. Land exchanges of public and private lands change land use and access.
Perceptions of what is natural can be in conflict with restoration of process and ecosystem function	***SO WHAT?*** =======>	Affects ability to affect change/restoration. Affects how we interact with the public Tradeoffs and costs are not clearly understood by the public
Scenic quality has been affected by past timber harvest	***SO WHAT?*** =======>	This affects landscape character and sense of place
There is continued interest in extraction of mineral sources, geothermal potential, and other natural resource use	***SO WHAT?*** =======>	There are social conflicts with resource extraction as well as economic opportunities.

Physical Domain

"With time and with water everything changes"

da Vinci

Physical Domain

Climate and Weather

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

Climate and weather influence hydrology, soil formation, and vegetation. Weather often drives erosion processes and other disturbance events. The following discussion provides context for sections to follow.

Air Temperatures. January nighttime temperatures average about 20^0 F throughout the watershed while July daytime temperatures rise into the 80's and 90's. Daytime humidity is generally low in the summer and fall. Winters are long and relatively cold with considerable cloudiness. Occasionally, arctic air from Canada flows through the area and causes temperatures to drop well below zero degrees. Summer days are usually warm with cool nights and low rainfall. Moist, subtropical air often brings thunderstorms and localized heavy rains **(Table CW -1).**

Table CW 1: *Summary of temperature data form three locations near the Why-chus Watershed.*

	Santiam Junction (1961-85)	**Camp Sherman (1984-93)**	**Sisters (1961-94)**
Average January Maximum-Mean-Min Temperatures F	34-27-21	45-32-19	41-31-21
Average July Maximum-Mean-Min Temperatures F	73-58-43	92-68-44	84-63-41

(Climate data for Santiam Junction from records supplied by Ray Hatton, Bend, Oregon: for Camp Sherman from records of the late Jim Ellingboe, resident of Camp Sherman, supplied by Hatton; and for Sisters from Hatton's 1994 book Oregon Sisters Country, Weather and Climate.)

Precipitation All surface and ground water in the watershed is from precipitation **(see Figure CW-1).** An extraordinary feature of this watershed is the range of precipitation. Over 140 inches of rain and snow fall on the Three Sisters each year, but only 14 inches per year falls at the town of Sisters.

Type/Timing About two-thirds of the annual precipitation falls between October and March. Winter storms bring heavy snowfalls to the Cascades. At lower elevations the storms bring more rain than snow. A secondary peak of precipitation occurs in May and June due to thunderstorms and upper level low pressure systems.

Rarely, great storms pass through the area such as the damaging storm of December 22, 1964. Considerable flooding and wind-toppled trees were widespread. More frequently, however, storms with warm, strong winds accompanied by heavy downpours of rain pass through the area every decade or so. These "rain-on-snow" events result in rapid melting of snowpacks and can result in significant erosion of roads, debris torrents on steep slopes, and can cause serious flooding **(Table CW-2).**

Figure CW – 1

Precipitation

Inches per Year

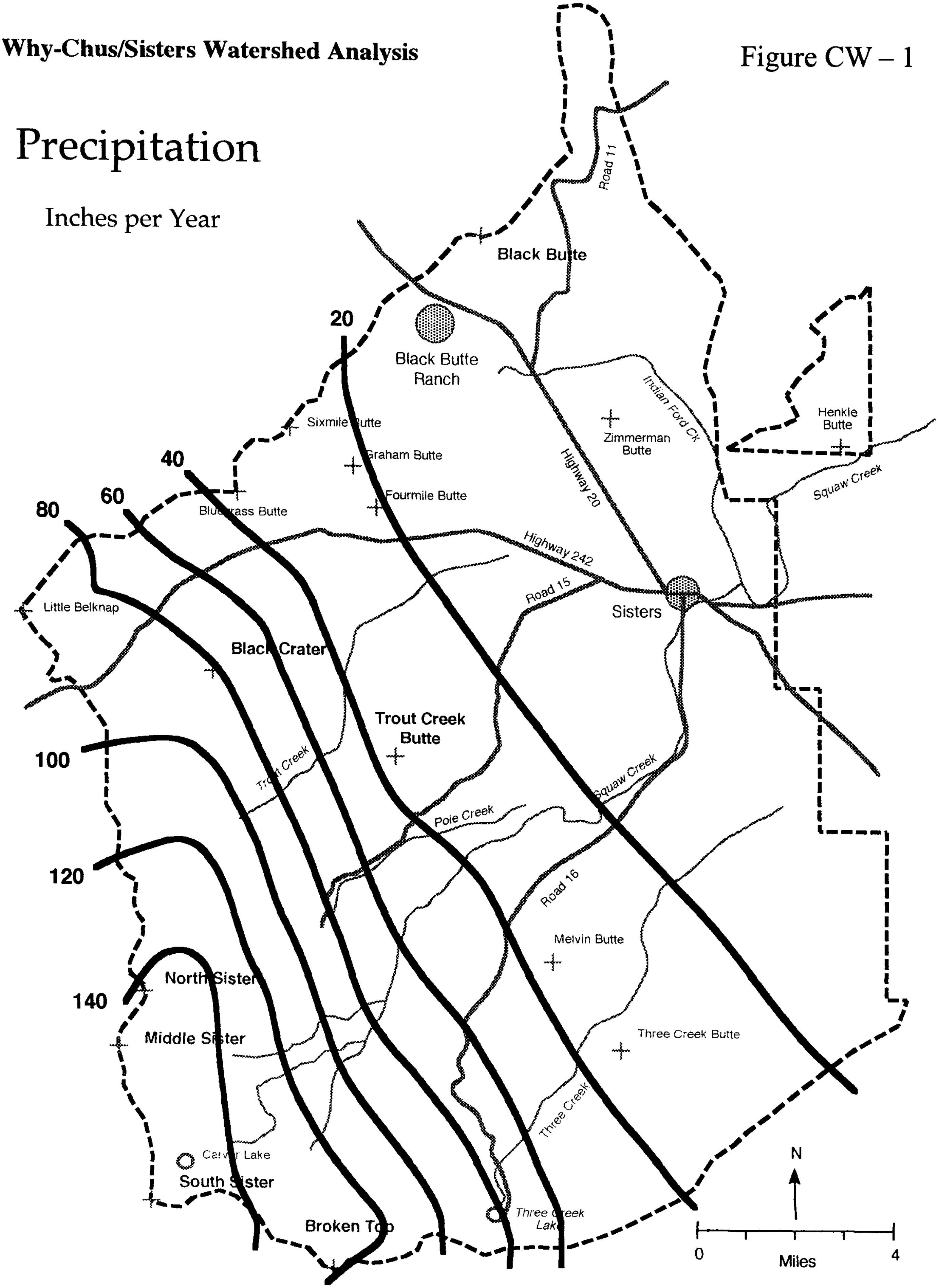


Table CW- 2: *Summary of precipitation data from three locations near the Why-chus Watershed.*

	Santiam Junction (1961-85)	Camp Sherman (1984-93)	Sisters (1961-64)
Annual Precipitation (inches)	86.7	29.8	14.1
Average January Precipitation (inches)	14.2	4.5	2.6
Average July Precipitation (inches)	1.4	0.6	0.4

(Climate data for Santiam Junction from records supplied by Ray Hatton, Bend, Oregon: for Camp Sherman from records of the late Jim Ellingboe, resident of Camp Sherman, supplied by Hatton; and for Sisters from Hatton's 1994 book Oregon Sisters Country, Weather and Climate.)

Erosion Processes

Characterization

What erosion processes are dominant within the watershed (e.g. surface erosion processes, mass wasting)? Where have they occurred or are likely to occur?

The dominant erosion processes are bank erosion, road erosion, moraine failures and debris flows. Moraine failures and debris flows are found at higher elevations in the area and are extremely infrequent. The erosion processes at work are described below under current and historic conditions and trends.

The Soil Resource Combinations of geology, climate, vegetation, other organisms, topography, and time determine the kind of soil that will develop on a given site. The characteristics of these soils determine their susceptibility to erosion processes.

Due to the relatively young geologic age of most surfaces in the watershed, soil development is limited to soil horizons with low amounts of organic material and weathered minerals. Soils in the area are classified in the andic soil order, meaning they have low bulk densities, low organic carbon, and soil chemical properties unique to volcanic ash materials. Due to their inherent porousity, these soils are normally not prone to water erosion except along steep slopes. However, management induced changes to infiltration rates can establish conditions that will make these soils more prone to surface soil erosion.

Soils in the upper elevations of the watershed have a cryic soil temperature regime (mean annual soil temperatures between 0^0 and 8^0 C) and a udic (humid) soil moisture regime. Soils are frozen or snow covered in winter, warming during the summer growing season, with some soil moisture available for plant growth throughout the year. Lower elevations have a slightly warmer, frigid soil temperature regime (mean annual soil temperatures $<8^0$ C) and a xeric (mediterranean) soil moisture regime. At the lower elevations, soil temperatures are slightly warmer during the summer months than soils in the upper elevations. Soil temperature and moisture in these areas can be characterized by cool wet winters and warm dry summers.

Reference Conditions

What are the historical erosion processes within the watershed (e.g., surface erosion processes, mass wasting)? Where have they occurred?

Volcanic eruptions build up the land and glaciers tear it down. That is the theme of landscape development in this watershed ***(see Figures EP-1 and EP-2).*** Volcanoes have been erupting for millions of years and will continue into the future. The last volcanic eruption was in the McKenzie Pass Area about 1500 years ago. Ice Ages have been coming and going for less than a million years. They come and go in cycles of approximately 100,000 years. The last one ended approximately 10,000 years ago.

During their greatest extent, glaciers came to within four miles of Black Butte Ranch and within five miles of Sisters. Besides deeply eroding all land above 5000 feet elevation, they left great blankets and ridges of silt, sand, and boulders (moraines) above 4000 feet elevation. Below 3500 feet, rivers pouring out of the glaciers left a large outwash plain of sand and gravel with a smooth, nearly flat surface. Highway 20 from Sisters to Black Butte is constructed on this outwash plain as are most homes and businesses in the watershed.

The lands not covered by moraines or outwash gravels are mostly lava flows (basalt) thinly covered by windblown volcanic ash. The volcanic cones of Black Butte, Black Crater, and Trout Creek Butte are all large accumulations of lava, broken lava, and ash. Well over 50 cinder cones and cinder ridges dot the landscape; for example, Fourmile Butte and Zimmerman Butte. Other cones that look like cinder cones are, instead, domes of lava (dacite or rhyolite) much like the one that grew in the crater of Mt. St. Helens during the 1980's (e.g., Three Creeks Butte and Melvin Butte).

Current Condition

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

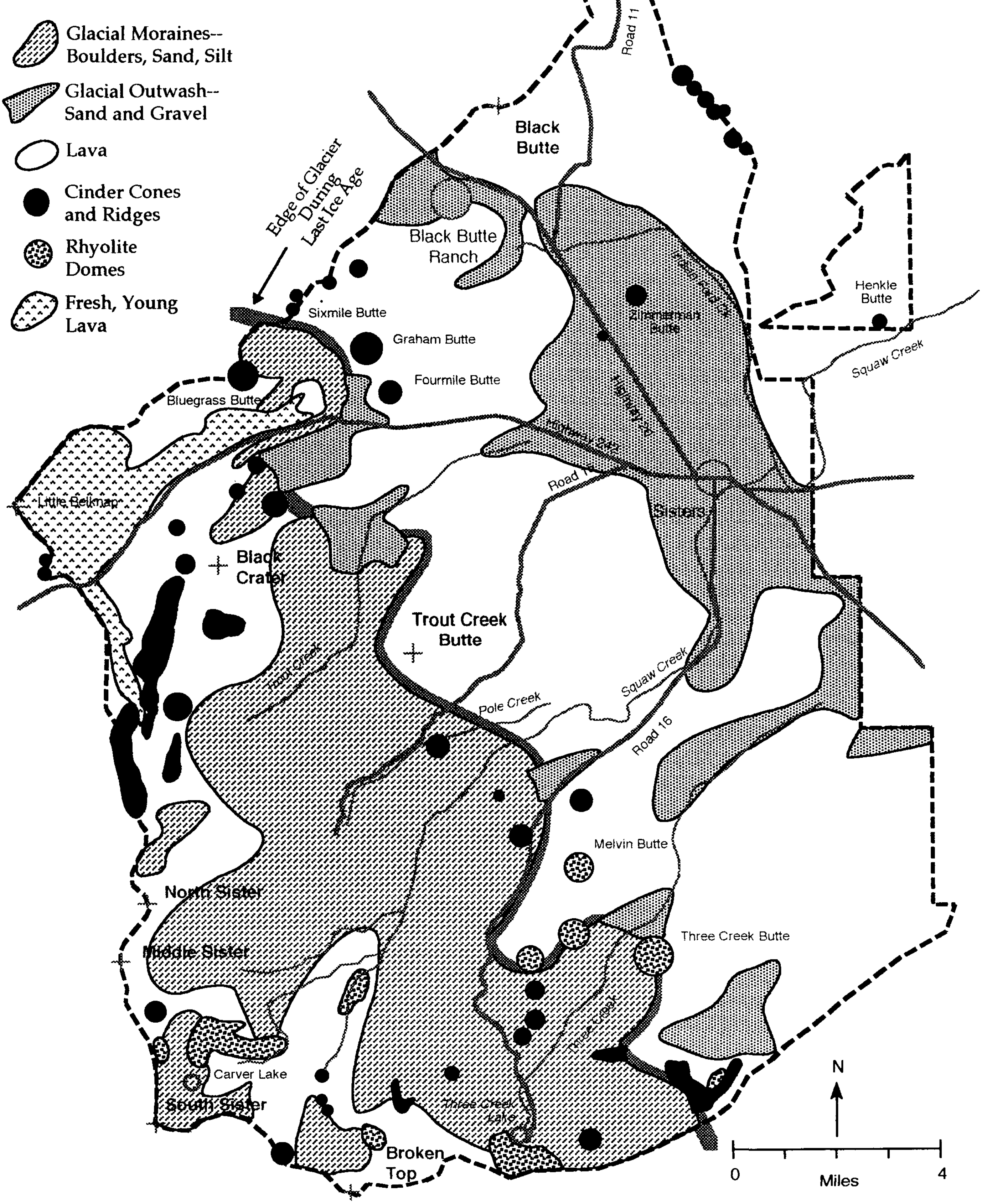
Moraine Failures Moraines, left by the receding glaciers, acted as dams behind which lakes form. About half of such lakes in the analysis area have since disappeared. For unknown reasons, moraine dams suddenly erode and the lakes drain. Carver Lake, on the northeast flank of South Sisters, is one of a dozen high-elevation lakes in the Three Sisters area that came into existence in the 1920's and 30's at the close of the Little Ice Age. In the mid-1980s, the U.S. Geological Survey (USGS) reported that Carver Lake would be the source of a major flood along Squaw Creek. Homes and people in the floodplain of Squaw Creek at Sisters were at risk. Another USGS report based on much more information will be released soon. The new report will downgrade the likelihood of a large flood from Carver Lake and downgrade it's effects.

Landslides "Landslides" include deep-seated land movements such as slumps, earth flows, block failures, and rock falls. Slumps and slides are characterized by a rotational movement that results in a fairly coherent unit of material sloping downward. These are usually associated with sedimentary type rock materials which are not found in this watershed. Geology in this watershed consists of ash soils over areas of glacial till or glacial outwash and other areas of ash soil directly over volcanic rock. Slump and slides characterized by a rotational movement have not been observed in this watershed. For the above reasons, landslides were considered but not analyzed in detail in this report.

Why-Chus/Sisters Watershed Analysis

Surficial Geology

Figure EP – 1

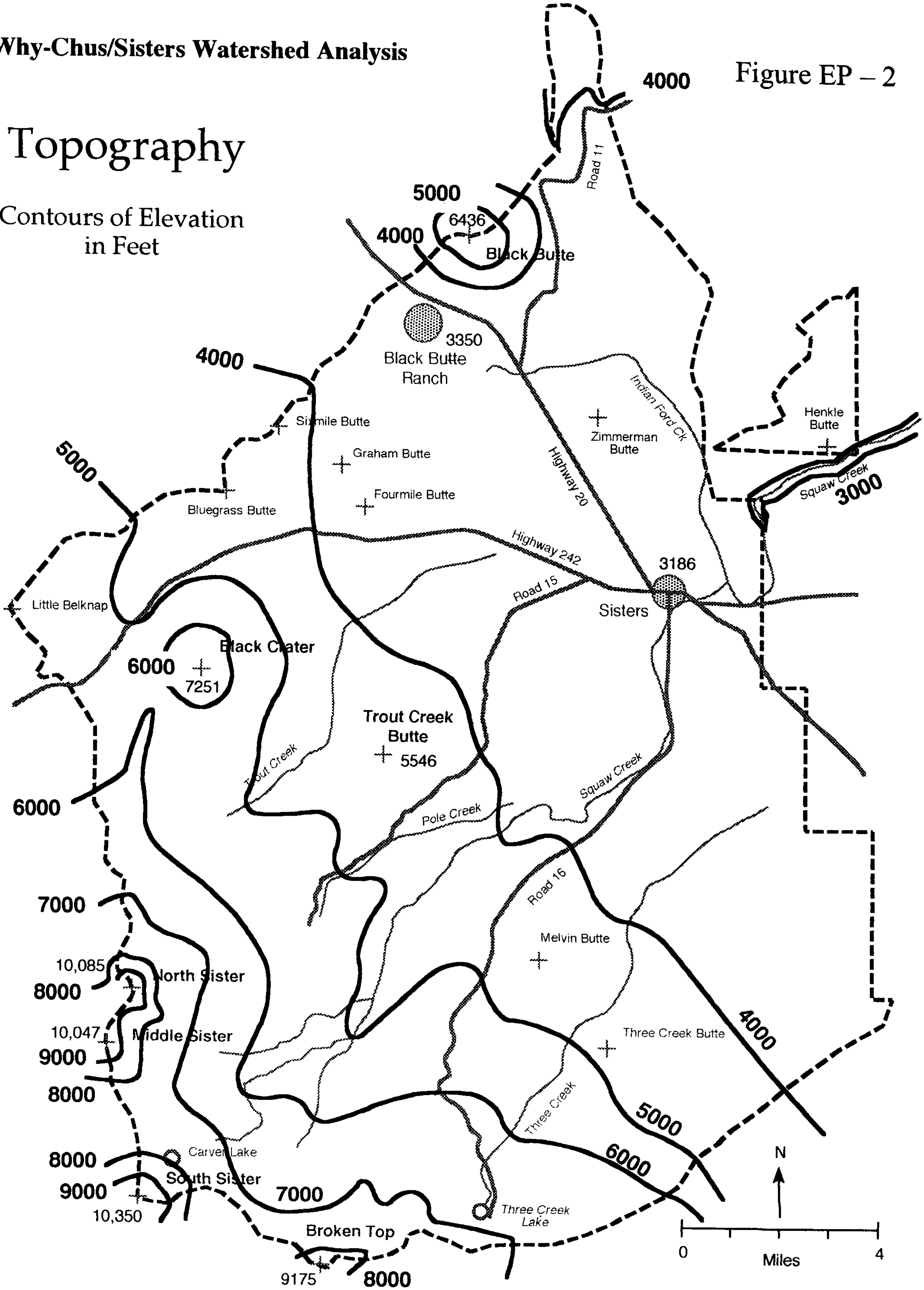


Why-Chus/Sisters Watershed Analysis

Figure EP – 2

Topography

Contours of Elevation
in Feet



Rock falls resulting from weakened and broken weathered rock that falls from higher on a slope and forms talus, does occur in limited areas of the watershed, generally in the higher elevation wilderness areas.

Debris Flows "Debris Flows" include all shallow, planar slides such as debris slides, debris avalanches, and debris torrents. Intense spring storms, resulting in "rain on snow" events, have resulted in a few debris flows on the Sisters Ranger District. The most recent occurrence was the 1996 event which caused at least eight separate debris flows in the Metolius Basin.

The debris flow of 1996 resulted from movement of a saturated unconsolidated mass of ash soil over a consolidated layer of glacial till or rock. Evidence indicated that material moved in a chaotic disorganized fluid fashion with a mixing of materials within the flow mass. Materials in the flow mainly consisted of soil, water, rocks, and trees. Size of the area removed from the slope varied from approximately 1 acre up to 5 acres. Coverage of debris on the slope below was several times larger than the area that failed above.

Six of the debris flows that occurred in the Metolius Basin during a winter storm in 1996 were located on the north aspect of Canyon Creek side slope. Factors such as soil types, slope, precipitation, and aspect were almost identical for each of these separate debris flows. Due to previous management activities, three different vegetation types occurred in this area. The first was an area of clear cuts that had young trees with brush fields of ceanothus, second an area of larger dead trees from an approximately 6 year old burn and little understory vegetation, and a third area of larger residual trees with a limited understory. A comparison of the size of debris flows in these three areas was made. It showed the area of clear cuts with young trees and brush fields had the smallest debris flows. This has been attributed to the larger amount of fine root structure provided by the ceanothus brush. The area of the old burn with almost no understory and dead trees with weak decayed root structure had the largest debris flow in the area. The area with large live trees and limited understory had a debris flow that was intermediate in size between the other two areas. Evidence seems to indicate that the frequency of this type of event is relatively rare, with conditions to produce debris flows occurring possibly only once every century or longer. Evidence of older debris flows appear to be limited to slopes greater than 50%. Because debris flows are relatively uncommon in the watershed, no further analysis was done.

Bank Erosion **Table EP-1** provides a stratification of streams to assess bank erosion processes. For more detail on stream systems, see "Subwatershed at a Glance" section.

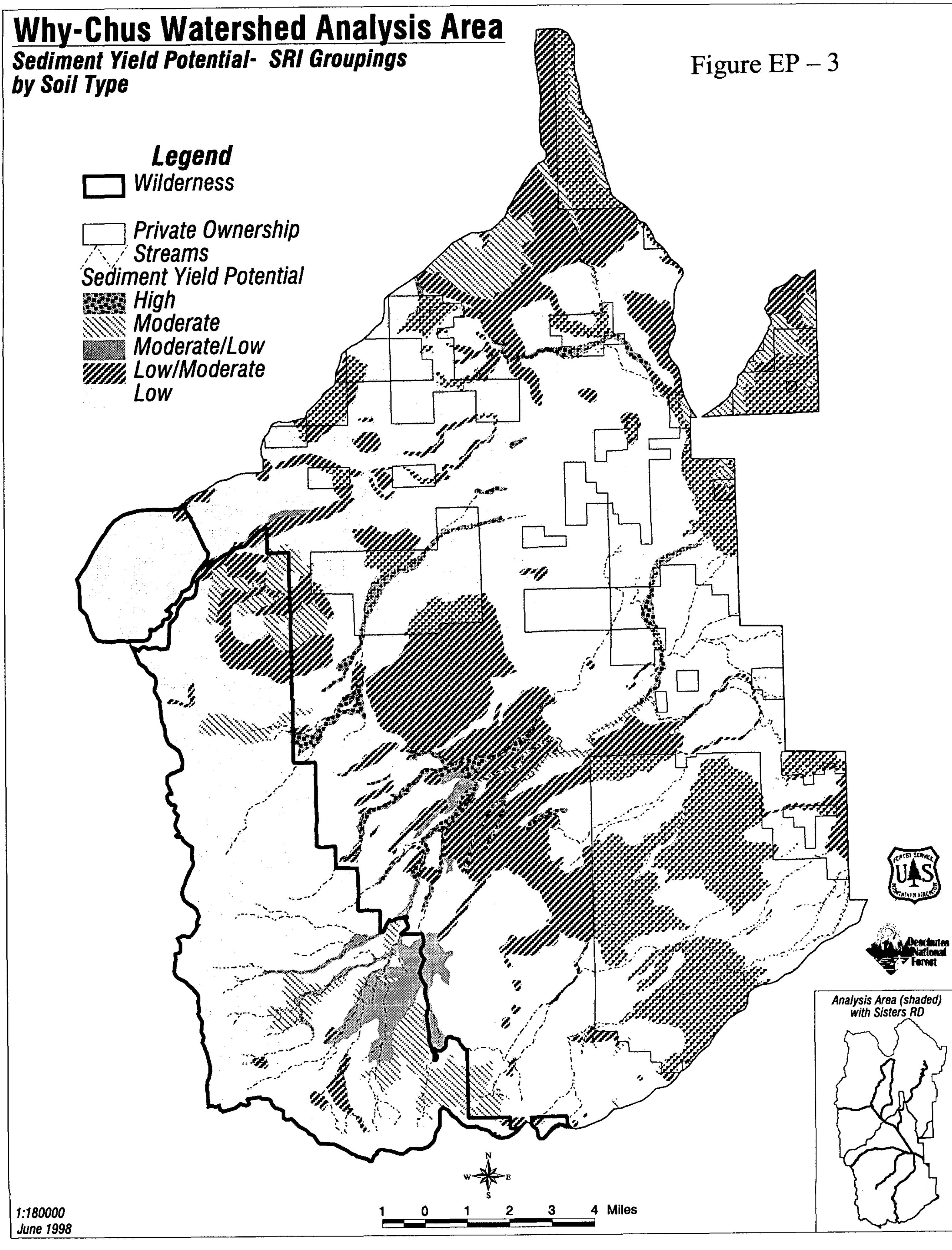
Table EP-1: *Stream bank erosion intensity.*

Stream Name	Type of System	Bank Erosion Intensity**
Squaw Creek	snow melt system	high
Pole Creek	spring fed system regulated by limited meadow release	moderate
Indian Ford Creek	spring fed system regulated by extensive meadow release	low
Trout	snow melt and spring fed system regulated by meadow release	moderate
Cold Spring	spring fed system	low
Black Pine Spring	spring fed system	absent (stream ditched)
Melvin Spring	spring fed system	absent (stream ditched)
Three Creek	Snow melt and spring fed system regulated by meadow release	low
Snow Creek	Snow melt and spring fed system	low
Three Creek Butte	Snow melt and spring fed system	low

Gully Erosion, Sheet and Rill Erosion Gully, sheet and rill type soil erosion in the watershed is typically limited to compacted roads and skid trails where the naturally high infiltration rates of the soil have been altered and water concentrates as surface flows. Although severe soil erosion caused by water is rare, isolated occurrences, such as the collapsing of Highway 20 near Suttle Lake in 1996, do occur.

Sediment Yield Sediment yield potential of soils in this watershed were evaluated using the Deschutes Soil Resource Inventory (SRI, USFS, 1976), Erosion and Hydrologic Interpretations Table (pp 222-226). This reference rates the potential for water sedimentation and pollution from sand, silt, and clay particles following timber harvest, road construction, or other management activities. Factors considered in making ratings include soil texture and structure, drainage patterns, landform, and climate. Ratings of low, moderate, and high sediment yield potential are defined below. See **Table EP-2** and **Figure EP-3** for information on sediment yield per subwatershed.

- Low - Sedimentation levels of silt and clay particles are not expected to be significant following management activities.
- Moderate - Sedimentation levels may be significantly increased following management activities with moderate loss of water quality and damage to fisheries.
- High - Sedimentation levels are expected to be high following management activities. Streams can become turbid and there can be considerable loss of water quality and damage to fisheries.


Why-Chus Watershed Analysis Area
Sediment Yield Potential- SRI Groupings
by Soil Type
Figure EP – 3
Legend
Wilderness
Private Ownership
Streams
Sediment Yield Potential
High
Moderate
Moderate/Low
Low/Moderate
Low
Analysis Area (shaded)
with Sisters RD
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June 1998
Deschutes National Forest

***Table EP-2**: Sediment Yield Potential in hundreds of acres by subwatershed.*

Subwatershed Name	Low Sediment Yield Acres	Low to Mod Sediment Yield Acres	Mod to Low Sediment Yield Acres	Moderate Sediment Yield Acres	High Sediment Yield Acres
Squaw	252	70	31	38	10
Pole	84	16	<1	<1	6
Indian Ford	143	111	<1	25	4
Trout	408	111	<1	22	11
Melvin	83	47	<1	<1	<1
Three Creek Lake	33	2	<1	8	<1
Three Creek Butte	144	105	<1	3	<1

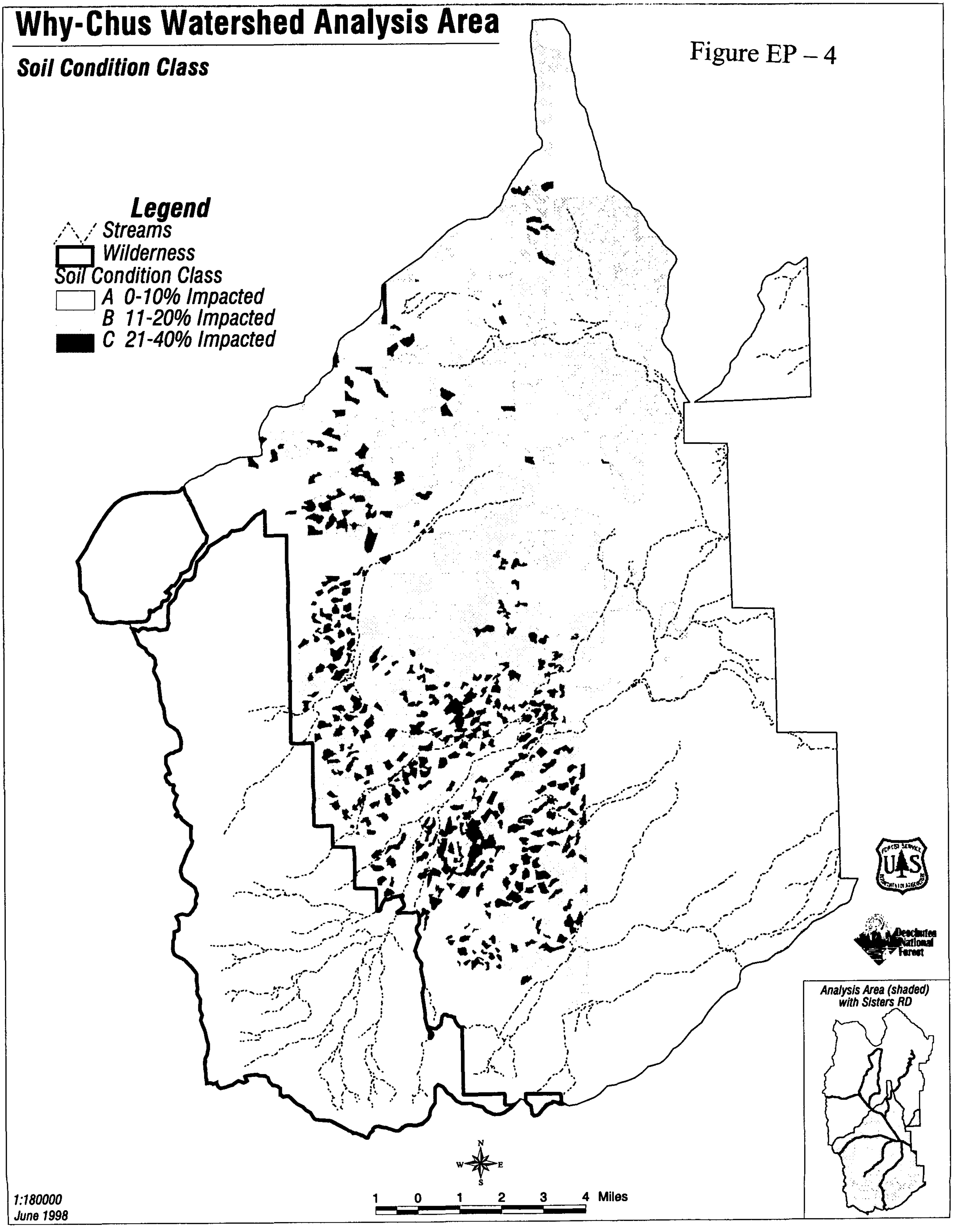
Results show Squaw subwatershed having larger amounts of acres in the moderate and high sediment yield categories. This is due mainly to the higher precipitation in this subwatershed compared to the lower elevation subwatersheds, sensitive soil types, and an increase in drainage patterns. Much of the higher sediment yield potential areas, however, are in the wilderness area. Indian Ford and Trout subwatersheds have considerable acres in the moderate and high sediment yield categories. This is due mainly to the steeper slopes of Black Butte, Black Crater, and Trout Creek Butte.

Natural and Human-Caused Changes

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

Soil Existing Condition Existing condition of the soil resource within the analysis boundary has been influenced by past management activities such as harvest and road building. Recent harvest activities have included salvage, harvest by clear cut, and uneven-age management prescriptions. Recent management operations have used primarily mechanized harvest and yarding systems. In these harvest units, varying degrees of soil compaction, displacement, and other soil impacts have been observed. See **Figure EP-4**.

Detrimental soil impacts are impacts to the ground that cause the soil quality to be adversely impacted. Region 6 Soil Quality Standards are found in the Forest Service Manual, FSM 2521.1 and provide definitions for detrimental soil compaction, puddling, displacement, burn intensity, and erosion. **Table EP-3** is an estimate of the amount of detrimental soil impacts in the watershed and was generated using several GIS layers to make assumptions based on different activities. **See Appendix- EP-1.**


Why-Chus Watershed Analysis Area
Soil Condition Class
Figure EP – 4
Legend
Streams
Wilderness
Soil Condition Class
A 0-10% Impacted
B 11-20% Impacted
C 21-40% Impacted
Deschutes National Forest
Analysis Area (shaded) with Sisters RD
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June 1998

Table EP-3: Existing soil condition in the watershed.

Soil Condition Class	% Total Watershed	% Watershed Outside of Wilderness
A (0-10% detrimental)	74	59
B (10-20% detrimental)	20	31
C (20-40% detrimental)	6	10
D (>40% detrimental)	0	0

Two soil surveys have been completed within the watershed boundary. The first is the Deschutes Soil Resource Inventory (SRI). This is an order 4 reconnaissance type soil survey with coverage of the entire analysis area. This level of mapping relies mainly on landscape position and geology to break out map units. Soils, landforms, and bedrock characteristics are defined at an intensity sufficient to help develop resource management guidelines. This information has been used with very good success in project planning on the forest. **See EP-5.**

The second survey in the area includes a small portion of the larger Upper Deschutes Soil Survey, completed in 1994 by the Natural Resources Conservation Service (NRCS). This survey was done at a level 3 intensity and is more detailed than the order 4 SRI. Documentation includes soil types classified to the series level, taxonomic unit descriptions, map unit descriptions, and engineering interpretations (form 5's). Unfortunately, this survey only covers a small portion of the watershed, mainly on the private lands.

For further analysis on changes between historical and current conditions of erosion processes or the influences and relationships between erosion processes and other ecosystem processes such as fire, see the Trend Section and the Stream Channel and Habitat, Current Condition section.

Discussion By Activities

The following includes a discussion of soil impacts from different logging systems, various harvest treatments, and post harvest treatments. Forest soil monitoring has shown that soil impacts from both mechanical harvest treatments and fuel treatments are mainly due to increases in detrimental soil compaction and displacement. Impacts depend on the volume removed, harvest method and season, fuel treatments, previous detrimental soil impacts, as well as, other variables. Other minor soil impacts observed on the forest have included detrimental burned areas mainly under large slash piles and soil erosion primarily on roads and compacted skid trails. The following is an overview of harvest equipment types, silviculture treatments, and fuel treatments commonly used on the forest and the resulting impacts to the soil resource. This information is intended to be used during timber sale planning.

Logging Systems

Ground based logging systems

Efforts by sale administrators to match different types of ground based harvest machinery to the type of material being harvested has greatly aided in reducing soil impacts. Experience has shown that matching the type of harvest equipment to the type of material being treated can both make the operation more efficient and reduce soil impacts.

Helicopter and cable logging systems
These systems are almost exclusively used to treat soils that are sensitive to management, in particular, steeper slopes (usually slopes greater than 30%) and areas in riparian reserves. Non-ground based harvest systems produce soil impacts that are much lower than ground based harvest systems. Cost is the limiting factor for implementing these systems. Amount of the sale requiring a non-ground based systems is usually limited by sale economics to approximately 30%. Having non-ground base logging systems in the timber sale has increased the opportunity to treat sensitive soil areas that are in need of treatment and also small areas of larger sale units that have limited areas of sensitive soils.

It is recommended that these less impactive logging systems be considered when planning timber treatments. Spending funds on logging systems to prevent soil and water impacts is preferred to spending funds to try to fix damage. Once an area is impacted it is impossible to completely rehabilitate it back to an unimpacted condition.

Soil Impacts Resulting From Different Harvest Methods

HCC Clearcut/HCR Seed Tree Cut
These harvest treatments eliminate or greatly limit the need for multiple harvest entries over the age of the stand. They also allow for the greatest opportunity to eliminate the transportation system by subsoiling. Options for less impactive fuel treatments are also usually increased by this harvest method.

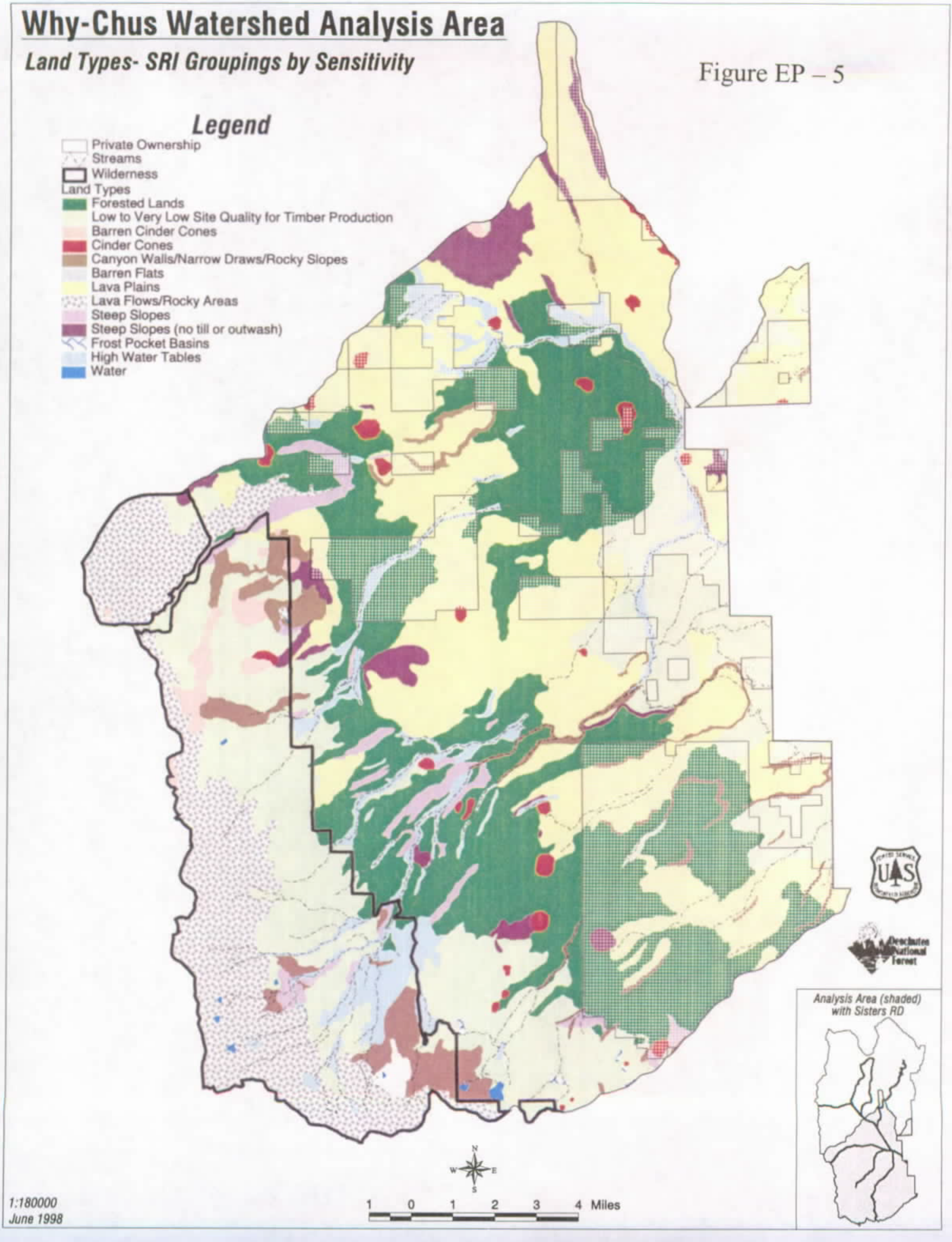
HSL Selection Cut
This harvest treatment can result in high soil impacts over the stand rotation. It results in multiple harvest entries over the age of the stand and because the skidtrail and landing system is used with each successive entry, it is usually necessary to leave the transportation system in place. This reduces the opportunity to do subsoiling. To protect woody debris in the surrounding area, fuel treatments are usually limited to machine pile.

HSV Salvage
Depending on the amount of dead material in a unit, this treatment may or may not result in high soil impacts. If little dead material is removed, a number of entries will be made over the stand rotation and soil impacts could be high.

HSV Salvage/HTH Commercial Thin
Thinning at the same time as salvage can sometimes increase the period of time between entries into a stand over that of salvage alone. This may result in less entries over the rotation of the stand, thus reducing soil impacts. Less soil impacts also result when fuel treatment objectives are met with the harvest treatment. Opportunities for subsoiling are usually limited in this type of treatment.

Soil Impacts Resulting From Different Fuel Treatments

Harvest activities need to be designed to try to meet as much of the fuel treatment objectives as possible and minimize post logging activities that result in further impacts to the soil resource. In addition, a minimum level of logging slash that will still meet the fuel objectives needs to be retained on site for maintenance of long term soil productivity.



Why-Chus Watershed Analysis Area
Land Types- SRI Groupings by Sensitivity
Figure EP – 5
Legend
Private Ownership
Streams
Wilderness
Land Types
Forested Lands
Low to Very Low Site Quality for Timber Production
Barren Cinder Cones
Cinder Cones
Canyon Walls/Narrow Draws/Rocky Slopes
Barren Flats
Lava Plains
Lava Flows/Rocky Areas
Steep Slopes
Steep Slopes (no till or outwash)
Frost Pocket Basins
High Water Tables
Water
Analysis Area (shaded) with Sisters RD
Deschutes National Forest
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June 1998

FBR Broadcast Burn
Recent soil monitoring has indicated that broadcast burning results in very little increase in detrimental soil impacts. This type of fuel treatment reduces post harvest operation of equipment on the site, reducing soil impacts. Burn plan objectives for soils have been developed for burning of activity fuels and help to insure that soil damage does not occur.

This method of fuel treatment is usually more expensive than mechanical treatments, such as machine piling. It is recommended that activity areas with low soil impacts be given priority for broadcast burning. In areas that already have high detrimental soil impacts, mechanical fuel treatments may not add greatly to soil impacts and it may be more cost effective to treat fuels with mechanical methods and then subsoil the unit.

In some situations, the opportunity to do broadcast burning is limited because of the following:
- plant associations with residual tree species such as lodgepole, white fir, and hemlock are not adapted to fire.
- harvest areas in which advanced regeneration needs to be protected.
- HSL selection cuts where it is necessary to protect woody debris in surrounding areas.

FHB Hand Pile
Hand piling avoids soil impacts such as compaction and displacement by avoiding equipment operation. Hand piles are small and soil damage from high intensity burns under piles is minimal. Hand piling may be useful on steep slopes and in riparian areas to treat fuels and avoid soil impacts from equipment. Costs are high when compared to most other types of fuel treatments, with sale economics usually limiting the acres of hand pile.

FMB Machine Pile
Machine piling has the potential to increase impacts to the soil resource by increasing compaction and displacement. Some soil impacts can be avoided by the operator being aware of concerns and selection of the proper size and type of equipment. Machine piling and subsoiling in the same operation has also been used with good success. Soil impacts may be reduced by identifying harvest areas where machine piling is the only option for fuel treatment and trying to meet fuel objectives by removing as much material as possible with the harvest treatment.

TRENDS:

- Bank erosion has increased.
- Riparian vegetation has decreased.
- Increase in detrimental soil impacts, mainly compaction, altered infiltration rates.
- Decrease in water quality due to increased sediment delivery to streams.
- Increase in soil compaction.
- Increased run-off due to decreased infiltration rates.

See **Trend Table** in **Synthesis Section** for more information.

Physical Domain

Hydrology

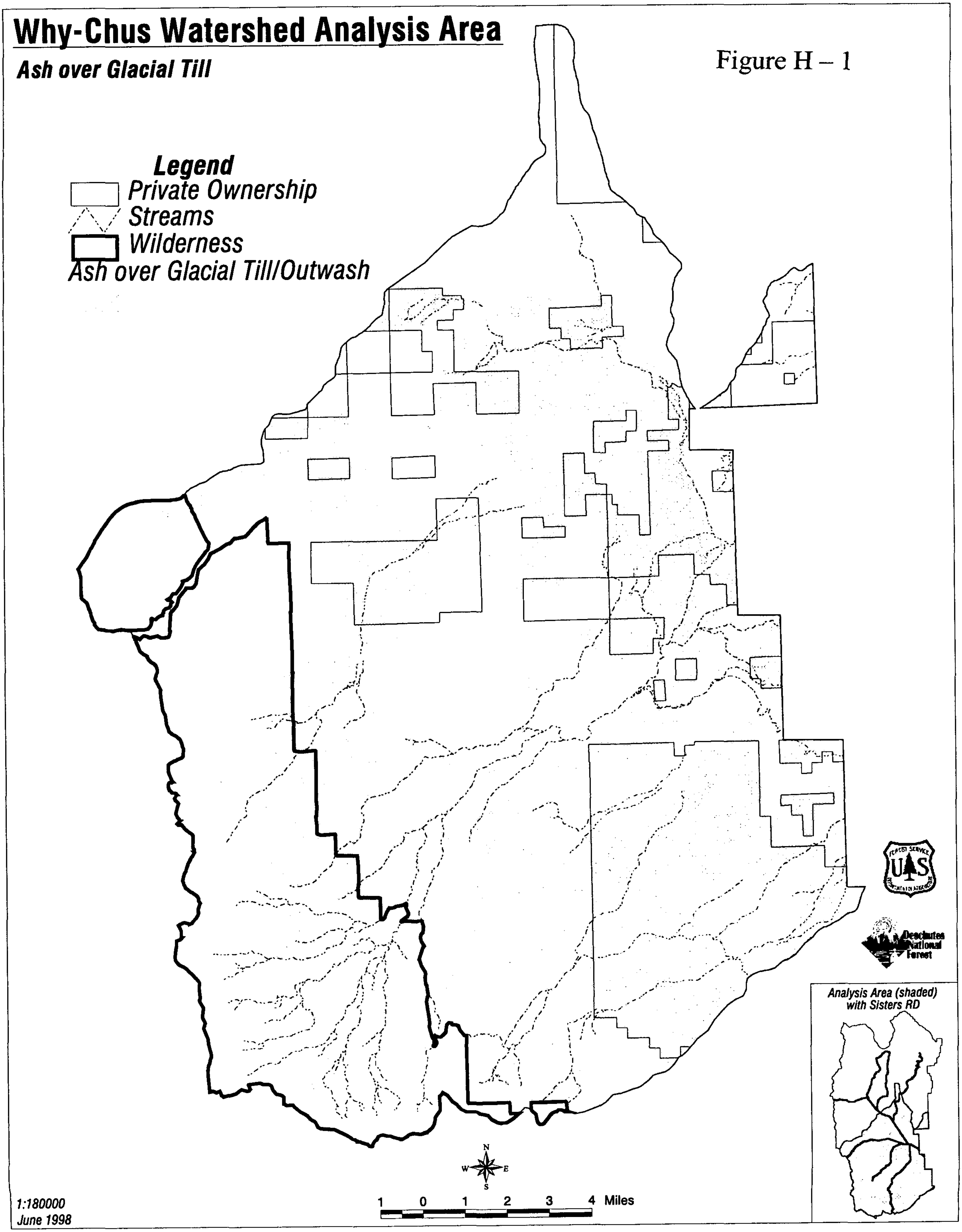
Characterization

What are the dominant hydrologic characteristics (e.g. total discharge, peak flows, minimum flows) and other notable hydrologic features and processes in the watershed (e.g. cold water seeps, groundwater recharge areas)?

Surface Flows vs Subsurface Flows In the seven subwatersheds, surface water flows in a limited number of streams including spring fed and snow/glacier melt systems. See **Table EP-1**. Small glacial lakes are common in the wilderness areas of the watershed. With the exception of the Squaw subwatershed, much of the surface stream flow is influenced by small areas of wet meadows. A low drainage density for the amount of precipitation occurring in the watershed indicates significant subsurface flow of water. Groundwater from this watershed is a major contributor to the Deschutes River.

The majority of the precipitation in the watershed occurs in the higher elevations as snow. Sources of water in streams includes precipitation in the form of rain, melting snow, and glacier ice. Surface soils in the watershed have rapid water infiltration rates. Below the surface soils, glacial till and glacial outwash materials sometimes influence water flow. Glacial till and outwash can act as a barrier to water movement. As water moves down through the coarser surface soil profile, it may become perched by glacial till or outwash materials that are relativly impervious to water movement. This causes water to move laterally along the glacial materials and through the soil profile. Evidence of this can be found in the bright colored soil mottles in some soil horizons, indicating seasonal wetness.

Water moves differently in areas where highly permeable fractured rock, cinder, and volcanic ash occurs below the surface soils without the glacial till or outwash materials. Rather than perching water, these porous materials cause water to move deeper into the ground water. All subwatersheds in the analysis area have a significant percentage of highly permeable surface materials that are not covered by glacial till or outwash and cause water to move subsurface. **See Figure H-1 and Table H-1.** Location of these surfaces on the landscape and their ability to move water subsurface is the reason for the low density of permanently flowing streams in the area.



Why-Chus Watershed Analysis Area
Ash over Glacial Till
Figure H – 1
Legend
Private Ownership
Streams
Wilderness
Ash over Glacial Till/Outwash
Analysis Area (shaded) with Sisters RD
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June 1998
Deschutes National Forest

Why-Chus/Sisters Watershed Analysis

Figure H – 2

Groundwater

Precititation produces
600 cubic feet per second
of groundwater, which
flows in direction of arrows

Contours of Precipitation
Inches per Year

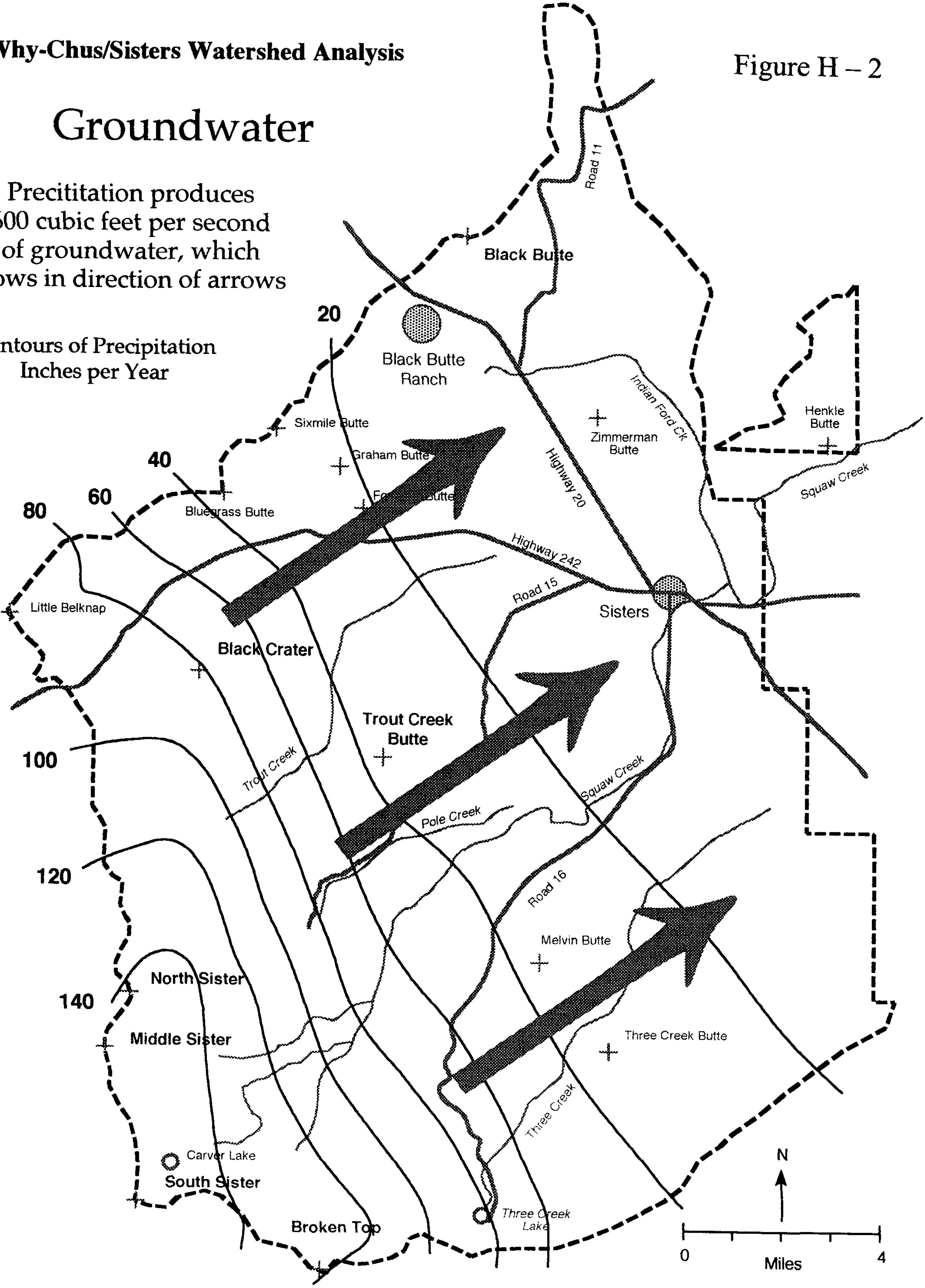


***Table H-1**: Percentage of the subwatershed area with fractured rock, cinder, or other permeable materials below ash soils. Data generated using DES SRI report.*

Subwatershed Name	Percentage of the subwatershed area with fractured rock, cinder, or other permeable materials below ash soils
Squaw	46
Pole	35
Indian Ford	69
Trout	53
Melvin	32
Three Creek Lake	30
Three Creek Butte	29

If all the rain and snow that fell in the watershed were flowing in a river, it would discharge an average of about 1010 cubic feet per second (cfs) (94,000 ac-ft/yr) year after year. Squaw Creek, the only surface water that flows east beyond Indian Ford Creek, discharges about 110 cfs (10,000 ac-ft/yr) or 11% of the total precipitation. About 300 cfs (28,000 ac-ft/yr), evaporates or is transpired by plants. However, most of the precipitation infiltrates the ground and flows northeast as groundwater (**Figure H-2**). About 600 cfs (56,000 ac-ft/yr), or 60%, flows through the highly permeable and porous underground of fractured lava flows, cinders, and volcanic ash. Ultimately, this groundwater discharges into the Deschutes River at springs. The U.S. Geological Survey, which is completing a major groundwater study of the Upper Deschutes Basin, estimates that approximately 50 cfs (4600 ac-ft/yr) of groundwater is the total amount currently being pumped from the ground throughout the entire Upper Deschutes Basin. If all of this groundwater were being pumped from this watershed, it would reduce the groundwater flow to the Deschutes River by only 8%.

Reference Conditions

What are the historical hydrologic characteristics (e.g. total discharge, peak flows, minimum flows) and features (e.g. cold water seeps, groundwater recharge areas) in the watershed?

Peak Flow

Peak flows in the watershed are controlled by quantities and delivery rates of rain and snow. Surface water flow in the watershed is controlled by snow melt, "rain on snow" events, springs, meadow release, lake release, blocking of overflow channels, ditching of streams, and stream flow diversions for irrigation. Influences on flows in this watershed include soils and geology that contribute to low stream densities and a large proportion of the water moving as ground water.

Squaw Creek Squaw Creek has the largest volume of surface flow in the watershed. Originating in the wilderness, stream channels flow from steeper gradient mountain terrain into a flat plateau at approximately river mile 26.8 where two USGS gauging stations are located within a quarter mile of each other. Gauging station #74-0750.00 records discharge data for Squaw Creek and gauging station

#14-0760.00 records Squaw Creek canal water measurements.

Peak flows in Squaw Creek are much flashier than other streams in the watershed. Due to the soil types in the headwaters of Squaw Creek, snow melt and rainfall enter the channel at a higher rate there. Squaw Creek flows depend on how quickly snow melts at elevations above 5000 feet. Rapid snowmelt means temporarily high discharge. Large flood events in Squaw Creek have occurred during the months of November and December (Army 1978) . Peak flows generally occur from May to July when snow melts at higher elevations. The stream experiences "rain on snow" events which raise the water level and turn it brown overnight. The average flow for Squaw Creek over a 77 year period is 105 cfs, and has ranged from 14 cfs to the highest flow recorded - 2000 cfs on December 25, 1980. A floodplain study done by the Army Corps in 1978 estimated a 500-year flood event to be around 3400 cfs at the USGS gauging station. Squaw Creek is subject to large floods and is a serious threat to homes and structures within its' floodplain.

With the exception of Squaw Creek, flows of other streams in the watershed are either spring fed or influenced by lake release. Most stream flows are also influenced by riparian meadows at mid elevations in the watershed. Due to the high infiltration rates of the soils and the influence of the underlying geology, some streams and smaller springs in the area flow subsurface in their lower reaches and only connect with higher order streams during flood events.

Indian Ford Creek Indian Ford Creek, in the northern portion of the watershed, is a tributary to Squaw Creek. This perennial stream originates from springs at Black Butte Ranch. Relatively large riparian meadows occur in the spring area. Indian Ford Creek has a low stream gradient and a somewhat constant flow rate. From Black Butte Ranch, the creek flows east through ponderosa pine plant associations. Riparian vegetation occurs in the floodplain and consists of aspen type woodlands in the upper reaches and willow/sedge in the lower reaches. Indian Ford Creek flows into Squaw Creek below the boundary of the National Forest near McKinney Butte.

Trout Creek Trout Creek originates from springs in the mid to upper elevations of the watershed. It flows through a small riparian meadow area, Trout Creek Swamp, and then pine forest. Trout Creek is a tributary to Indian Ford Creek but only connects during rare flood events. Trout Creek typically sinks flowing subsurface in it's lower reach.

Information regarding other streams in the watershed is not available at this time. It will be discussed at a later date when information does become available.

Current Condition

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

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

For more information on current conditions regarding hydrology and stream characteristics, see the **"Subwatershed at a Glance" Section.**

Streamflow Characteristics

Squaw Creek The condition of Squaw Creek has had little influence from management above the USGS gauging station. Below this point, the creek has been influenced by water diversions for irrigation purposes, blocking of overflow channels for flood control, hardening of banks, and removal of riparian vegetation. Based on aerial photo interpretation, portions of reaches below the National Forest Lands appear to have been straightened and channelized and are only occupying a portion of the original flood plain.

There are eight water right claims located between the town of Sisters and the USGS gauging station. The first diversion was established in 1871. These water right claims range from 0.7 cfs to 181 cfs. More water is claimed than is typically in the stream during the summer. The six claims made before 1895 have priority and usually use all of the water within the stream. This has resulted in the section from Sisters to the springs at Camp Polk being annually dewatered.

Figure H-3 illustrates the affect of diversions on Squaw Creek. This shows that diversions are occurring at critical times eliminating the establishment of riparian vegetation **(USGS, Internet)**.

Two stream surveys were completed for Squaw Creek in 1997. The first is the Squaw Creek Stream Survey Habitat Summary, Deschutes NF and Oregon Department of Fish and Wildlife (ODFW). In this survey, ODFW surveyed the lower portion of Squaw Creek extending from the confluence of the Deschutes River to the Squaw Creek Irrigation District (SCID). The second survey is the Squaw Creek Modified Level II Stream Inventory, Deschutes NF - Sisters Ranger District. In this survey, the Forest Service surveyed from the irrigation diversion upstream to Squaw Creek Falls. To compare the two types of survey methods used, a section of overlap between the two surveys was included.

Squaw Creek Modified Level II Stream Inventory, Deschutes NF - Sisters Ranger District, identifies six reaches between the town of Sisters upstream to Squaw Creek Falls. Reaches are delineated based on geomorphic and geographic differences. Although the main purpose of this survey was to determine the condition of the aquatic habitat and distribution of fish species present, the survey also contains a complete review of watershed issues, management recommendations, as well as other hydrologic information.

Trout Creek With the exception of Squaw Creek, stream flows in other streams in the watershed are either spring fed or are influenced by lake release. Most of the stream flows are also influenced by riparian meadows at mid elevations in the watershed. Many of the meadow areas have had ditching or are influenced by road construction and may not be functioning at releasing water as well as they did in their undisturbed condition. Due to the high infiltration rates of the soils and the influence of underlying geology, some streams and smaller springs in the area flow subsurface in their lower reaches and only connect with lower order streams during flood events. Trout Creek in particular only connects to Indian Ford during rare flood events. In its' lower reach, this creek flows through pine forests and the channel is not well defined. A number of houses have now been built in the floodplain of Trout Creek and in other areas with poorly defined ephemeral stream channels near the town of Sisters.

Indian Ford Creek Indian Ford Creek has a low stream gradient and a somewhat constant flow rate, however, the system has been affected by stream diversions. Indian Ford Creek is typically completely dewatered in summer before it reaches Squaw Creek. Flows in meadows have been altered by ditching. Riparian vegetation occurs in the floodplain and consists of aspen type woodlands in the upper reaches

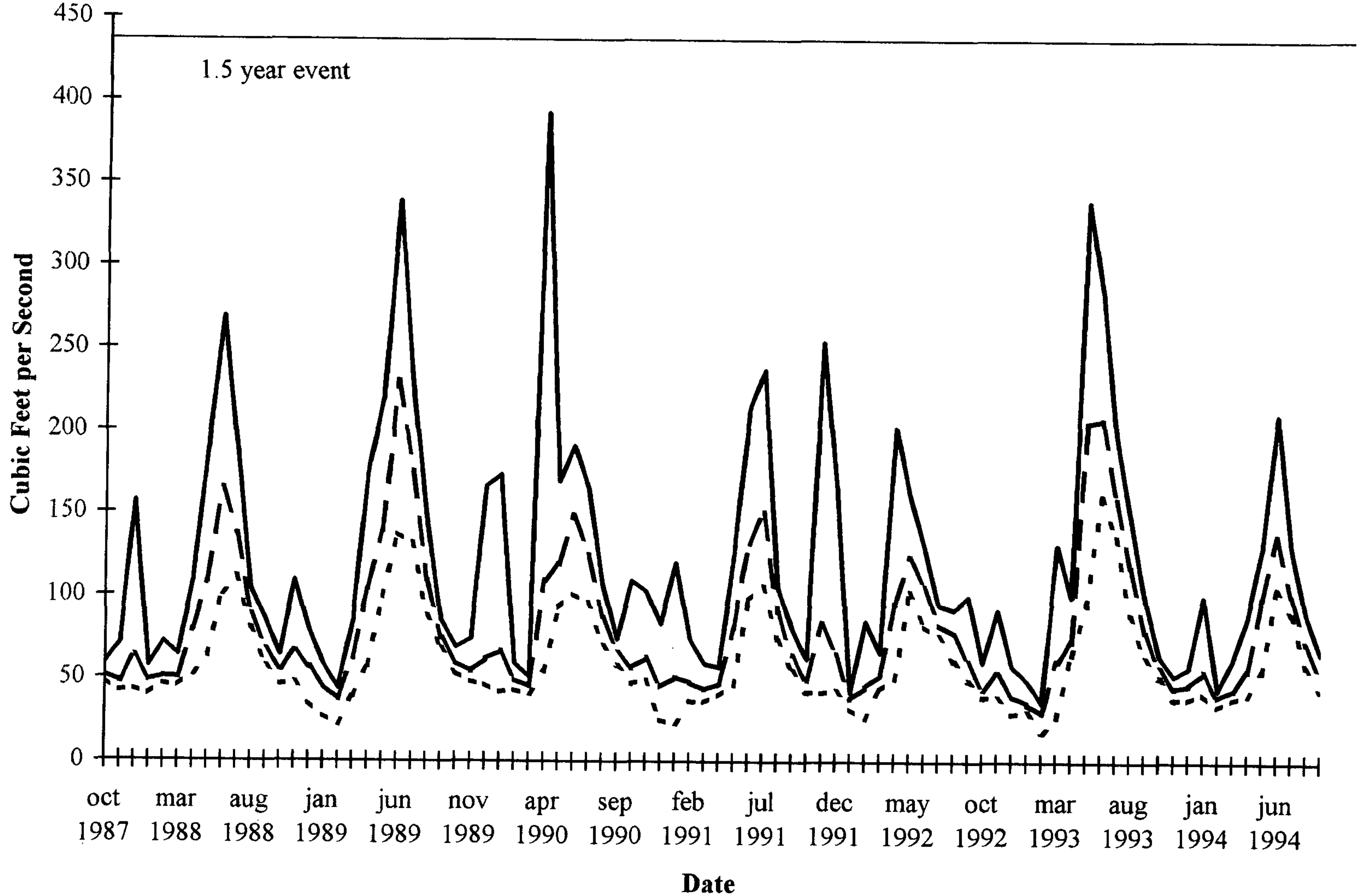


Figure H-3. Hydrograph of Squaw Creek from 1987 to 1994.

and willow/sedge in lower reaches. Much of the riparian vegetation has been impacted by drying up floodplains, past and present grazing, and by removal of willow by mechanical means.

Pole Creek Pole Creek used to be a tributary to Squaw Creek but now is diverted before reaching Squaw Creek to serve as part of the water supply for the town of Sisters. Like Trout Creek, Pole Creek originates from springs in the mid to upper elevations of the watershed. It flows through a small riparian meadow area, Pole Creek Swamp, and then through ponderosa pine forests. Its' lower reach has been ditched and is periodically cleared of wood. Ice dams are also cleared from the ditch as part of the maintenance of the water supply.

Overland Flow

Overland flow of water has been discussed in the Hydrology section, Characterization. Due to the lack of overland flow, as evidenced by the low drainage density in the watershed, rain on snow events and the influences of human-caused openings are not significant processes in this watershed. Analysis of effects of cumulative harvest acres (CHA) and rain on snow hazard ratings were not analyzed.

Roads in the watershed are considered to have the greatest influence on overland flows. Road ditches function as "extensions" of intermittent streams, increasing the overall drainage density and transporting water more rapidly than would occur naturally. In some areas, roads may be affecting the amount of water delivered to surface streams and having an influence on timing and magnitude of peak flows.

TRENDS:

- Increased bank erosion due to lack of riparian vegetation.
- Increased down cutting of streams from lack of sinuosity.
- Reduced stream flows during summer months.
- Low flows contribute to degraded water quality due to elevated temperatures.
- Degraded fish habitat and riparian effectiveness.
- Altered storage and release influencing peak flows.
- Altered stream function due to reduced amounts of down woody debris.
- Increased run-off from roads.

See **Trend Table** in **Synthesis Section** for more information.

Physical Domain

Stream Channel and Habitat

The Sisters/Why-chus watershed has a variety of aquatic habitats from lowland streams and wetlands to high elevation waterfalls and glacial lakes. Stream habitats in the Squaw Creek drainage are linked to the Deschutes River and once supported spring chinook salmon and summer steelhead. The wetlands of Indian Ford Creek and Trout Creek play an important role in providing aquatic habitat in these watersheds. Wetland streams are productive diverse habitats for fish and amphibians. They also play a role in the water budget of a watershed, at times storing high flows and later slowly releasing the stored water. The biodiversity is greatly increased in riparian habitats and in the interface between uplands and wetlands.

Characterization

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

The analysis area can be divided into two main drainages. Most streams flow into the Squaw Creek subwatershed, although the connection to Trout Creek is ephemeral. The southern portion of the analysis area flows toward the Deschutes River, although the flows sink and never completely connect. Those southern subwatersheds include Three Creek Lake, Three Creek Butte, and Melvin.

Most permanent streams in the analysis area are found in the Squaw Creek subwatershed with a high percentage of the stream miles located in the Three Sisters Wilderness within the Squaw Creek and Three Creek Lake subwatersheds **(Figure SH-1).** These subwatersheds have the highest surface run-off. Other subwatersheds have a high proportion of permeable soils or occur at lower elevations with lower annual precipitation **(Table SH-1, see Hydrology section).**

Lake habitats are primarily small, high elevation glacial lakes and ponds **(Figure SH-1, Table SH-2).** Some lower elevation ponds on private land have been constructed for fish, wildlife or livestock along Indian Ford Creek. Irrigation storage ponds have been created along the diversion ditches of Squaw Creek. The most important ponds and lakes are located in the Three Creek Lake subwatershed and are the primary reason for its designation as a Key Watershed in the Northwest Forest Plan. This is associated with rare, endemic amphibian species in this area.

Table SH-1. Stream miles and density of subwatersheds in the analysis area.

Subwatershed	Acres in Analysis Area	Total Stream Miles	Permanent Stream Miles	Total Stream Miles per Mile^2	Permanent Stream Miles per Mile^2
Indian Ford	28,250	16.7	10.3	0.4	0.2
Melvin	13,132	8.1	5.3	0.4	0.3
Pole	10,662	9.0	6.9	0.5	0.4
Squaw	40,745	94.1	68.9	1.5	1.1
Three Cr Butte	25,219	27.7	0	0.7	0
Three Cr Lake	4465	7.4	4.4	1.1	0.6
Trout	55,364	20.9	13.5	0.2	0.2

Table SH-2. Acres of wetlands and lakes in the watersheds.

Subwatershed	Analysis Area Acres	Acres of Wetlands	Acres of Lakes
Indian Ford	28,250	1790	44
Melvin	13,132	0	2
Pole	10,662	107	1
Squaw	40,745	1119	84
Three Creek Butte	25,219	0	1
Three Creek Lake	4465	34	91
Trout	55,364	264	26
Totals	177,837	3314	248

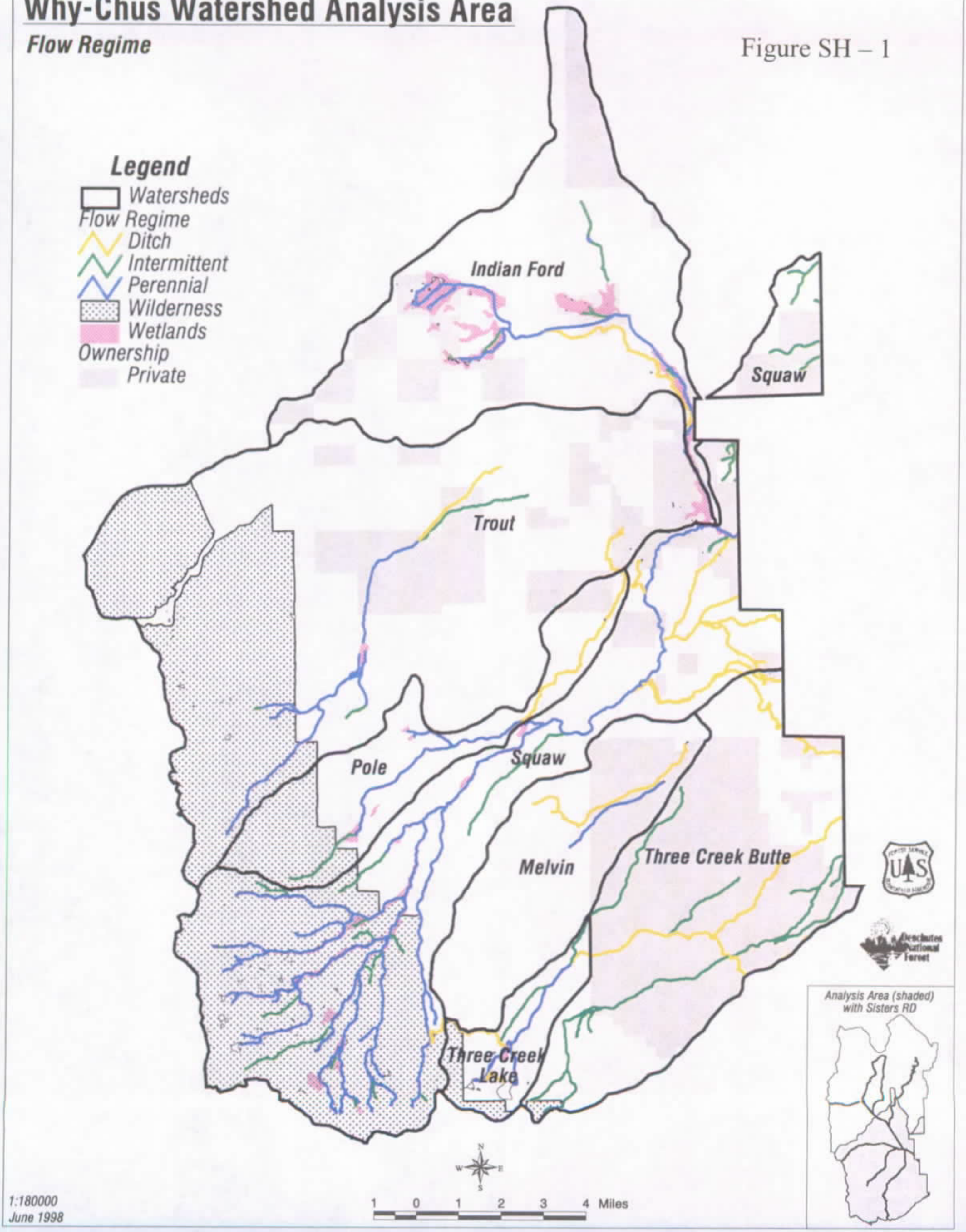
As streams flow through the landscape, the stream characteristics change to reflect these landform changes. Stream habitat inventories have been conducted by the Sisters Ranger District. These measurements have been summarized into channel types according to Rosgen (1993). Generally, channel types are labeled A through G. By typing the channels, an assessment of watershed condition can be made with a look at how the landscape patterns play a role in channel development and function.

- A Channels – Steep gradient headwater streams
- B Channels – Moderate gradient, moderately confined channels with step-pool morphology
- C Channels – Lower gradient streams with deep pools, clean riffles, and cover under stream banks and riparian vegetation. Makes good fish habitat.
- D Channels – Braided channels
- E Channels – Low gradient meadow channels
- F Channels – Down cut channels
- G Channels – Deeply entrenched channels

Why-Chus Watershed Analysis Area

Flow Regime

Figure SH – 1



Many of the channels of the Sisters Why-chus watersheds are A types in the wilderness. These channels flow down and form B channels into glacial valleys and form C channels in the open, wide valleys near the town of Sisters **(Table SH-3).** The A type channels are located in the narrow, steep canyons of Squaw Creek and its tributaries. These channels often have fish migration barriers such as waterfalls and cascades, and are generally poor fish habitat. Meadows in the high alpine valleys or in the lowlands near Sisters have E type channels. Examples of E channels are Indian Ford Creek in Black Butte Swamp or Three Creek in the meadows. Some reaches are mixed, with sections of meadow and sections of steep cascades between.

Table SH-3. Stream reach classifications using the Rosgen classification system based on data from stream surveys. Reaches are numbered starting from the mouth upstream or starting at the National Forest boundary.

Stream	Reach	Rosgen Channel Type	Wetted Width (ft)	Valley Width (ft)	Gradient	Substrate
Squaw Creek	1	C	29.7	400	1	CO
	2	C	41.7	600	1	CO
	3	B	32.3	250	3	CO
	4	C	35.1	1200	2	CO
	5	B	33.2	500	3	BR
	6	B	30.4	500	4	GR
W.F. Park Creek	1	A	16.2	<100	8	BR
Snow Creek	1	A	10.2	100-300	8	SA
	2	A	10.8	<100	10	GR
	3	A/E	9.9	300-600	8	GR
Pole Creek	1	B	10.4	<100	2	GR
	2	B	7.2	<100	2	SA
	3	B	-	<100	9	-
	4	A	-	<100	2	-
Trout Creek	1	A	20.9	<100	5	CO
	2	E	13.1	>600	1	SA
	3	A	14.9	300-600	5	GR
Indian Ford Creek	1	E	9.6	300-600	1	SA
	2	E	9.6	300-600	1	SA
Three Creek	1	A	-	<100	9	GR
	2	A	19.3	100-300	5	GR
	3	A/E	19.1	300-600	3	SA
	4	A/E	18.4	300-600	6	GR

Reference Conditions

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

Historically, Squaw Creek probably had similar bedload in the upper reaches. The sources of bedload in Squaw Creek are largely from moraines and debris slides. Recent glacial moraine and debris slides near the Three Sisters and the steep valleys with loose soils give rise to high sediment transport rates. With a large part of the watershed in high elevation and high precipitation zones, Squaw Creek has a flow regime that is competent to move the high bedload. Where the stream is unconfined near Sisters, this higher bedload and lower gradient probably resulted in a braided channel that was shifting frequently as the bedload aggregated. The shifting of channels was restricted to the floodplain area, but at high flows, floods spread out into flood channels that at times flowed up to a mile from the main channel. The spreading of flood water reduced the flow in any one channel and may have reduced the bank erosion. Floodplain shrubs and cottonwoods were more abundant in the floodplain and covered the gravel bars and stream banks that today are exposed due to dewatering and erosion. Sediment loads may have been less than the current condition in the lower reaches due to less bank erosion near Sisters.

Historic migration routes of steelhead trout, spring chinook salmon, and redband trout included Squaw Creek from the mouth to the lower falls near the wilderness boundary, and Indian Ford Creek from the mouth upstream to Black Butte Ranch. Lower Snow Creek was open to migration as well. At times, beaver dams along the willow wetlands of Indian Ford Creek may have temporarily restricted resident fish migrations.

Prior to any water developments, water temperature in the lower reaches of Squaw Creek were probably near the Oregon Department of Environmental Quality (ODEQ) standard for temperature. Houslet (1998) found that if average summer flows were not diverted, the average maximum water temperature for August would be near 66.5^0 F above Alder Springs. Historically, an estimated 13 miles of Squaw Creek between the Squaw Creek Irrigation District (SCID) and road 6360 could have met the ODEQ standard for water temperature. Today, only 2 miles of the stream meet this standard (Houslet 1998).

Off-channel habitats would have been more abundant in Squaw Creek and Indian Ford Creek because of higher natural flows and more frequent use of side channels and floodplains. Pools would have been deeper on these streams due to more flow during summer months. Riparian vegetation, such as willow and cottonwood, would have played a larger role in providing cover in off-channel and pool habitats, especially in Squaw Creek. Pools formed by large wood may have been more frequent historically in lower Squaw Creek.

The width to depth ratio of Squaw Creek was likely more close to the median for the Southern Cascades or Upper Deschutes prior to development (**Figure SH-8**).

Current Conditions

What are the current conditions and trends of stream channel types and sediment transport and deposition processes prevalent in the watershed?
What are the natural and human causes of change between historical and current channel conditions?
What are the influences and relationships between channel conditions and other ecoysystem processes in the watershed (e.g., inchannel habitt for fish and other aquatic species, water quality)?

Sediment transport is high in Squaw Creek. Sources of sediment come from the unstable moraines at the base of the Three Sisters and Broken Top. The active moraines are comprised of cinder and loose rock, which rapidly erode during snow melt, high precipitation events or debris flows. Other sources of high bedload in Squaw Creek are the areas of steep dry slopes of the canyons. The soils of the watershed are coarse and sandy, making them prone to dry ravel during the summer. Where the steep incised canyons cut through these soils, active soil creep into the streams increase the bedload of Squaw Creek. Floods accelerate this process by washing large quantities of volcanic ash soils and unsorted glacial till into the stream. This process has been accelerated in the wildfire area near Weir Grade. The dry slopes within the old burn are actively raveling into Squaw Creek and contribute to the overall bedload of the system. Based on field observations, road cuts and road ditches mimic this process and may increase the fine sediment load to Squaw Creek, especially along Road 1514. The contribution of road borne sediment must be low compared to the inherent bedload based on field observation.

Low gradient flats along the course of Squaw Creek tend to be depositional areas for bedload. Generally, flats are areas where the valley widens but then is constricted. The constriction acts as a dam, and over centuries sand, gravel, and cobble washed downstream are deposited. Over time, the valley floor rises, widens, and the gradient lessens. These alluvial valleys are productive salmonid habitats because they have low water velocities, sorted spawning gravel and often provide a diversity of cover from the interaction with the floodplain. Lower gradient C type channels meander through their floodplain, creating side channels, overhanging banks, and log jams from logs and woody debris in the floodplain. Confined reaches with steep valley walls or bedrock channels tend to float the wood and transport the debris to the lower gradient, unconfined reaches.

Low gradient flats have been identified for Squaw Creek **(Figure SH 2).** Although these flats are important fish habitat, they are also the most susceptible to degradation from development. The flats are most readily developed for homes and agriculture. The flats are also areas where floodplains are the widest, conflicting with land uses that have encroached onto the floodplain. The channel in these flats tend to meander, relying on riparian vegetation to hold the streambank together. Much of the riparian vegetation on the floodplains has been lost from removal, channelization, or dewatering from irrigation. Since meandering streams dissipate their energy laterally, channelization and loss of riparian vegetation has had a destabilizing affect on these important habitats.

The elevational profile **(Figure SH-2)** of Squaw Creek shows areas of low gradient, primarily in the channelized reach through Sisters and in the reach below Road 1514 (reach 4). It is clear from the plot that the most productive and lowest gradient reach is the 8 mile reach through the town of Sisters. Additional areas that provide thermal refugia may also be productive reaches, for example, areas near the springs in reach 4, areas near the Camp Polk Springs, and the lower 3 miles near Alder Springs.

Aerial photo interpretation of the meander pattern of Squaw Creek shows the affects of channelization. Straightened reaches are located in the flat reaches from the Squaw Creek Irrigation District (SCID) diversion to below Camp Polk road. The reach was likely an important habitat for steelhead and chinook salmon spawning and rearing. Bank stablity is poor in this reach of Squaw Creek due to the trenching, increased gradient and lack of summer flow to support riparian vegetation. A similar reach above the channelized section showed half of the unstable banks (6-7%) as the channelized reach (12-13%) (Dachtler 1997).

The 100yr and 500yr floodplain of Squaw Creek has been mapped (Army 1978). There is a distinct channel that at high flow branches off of Squaw Creek just upstream of the SCID diversion and reenters

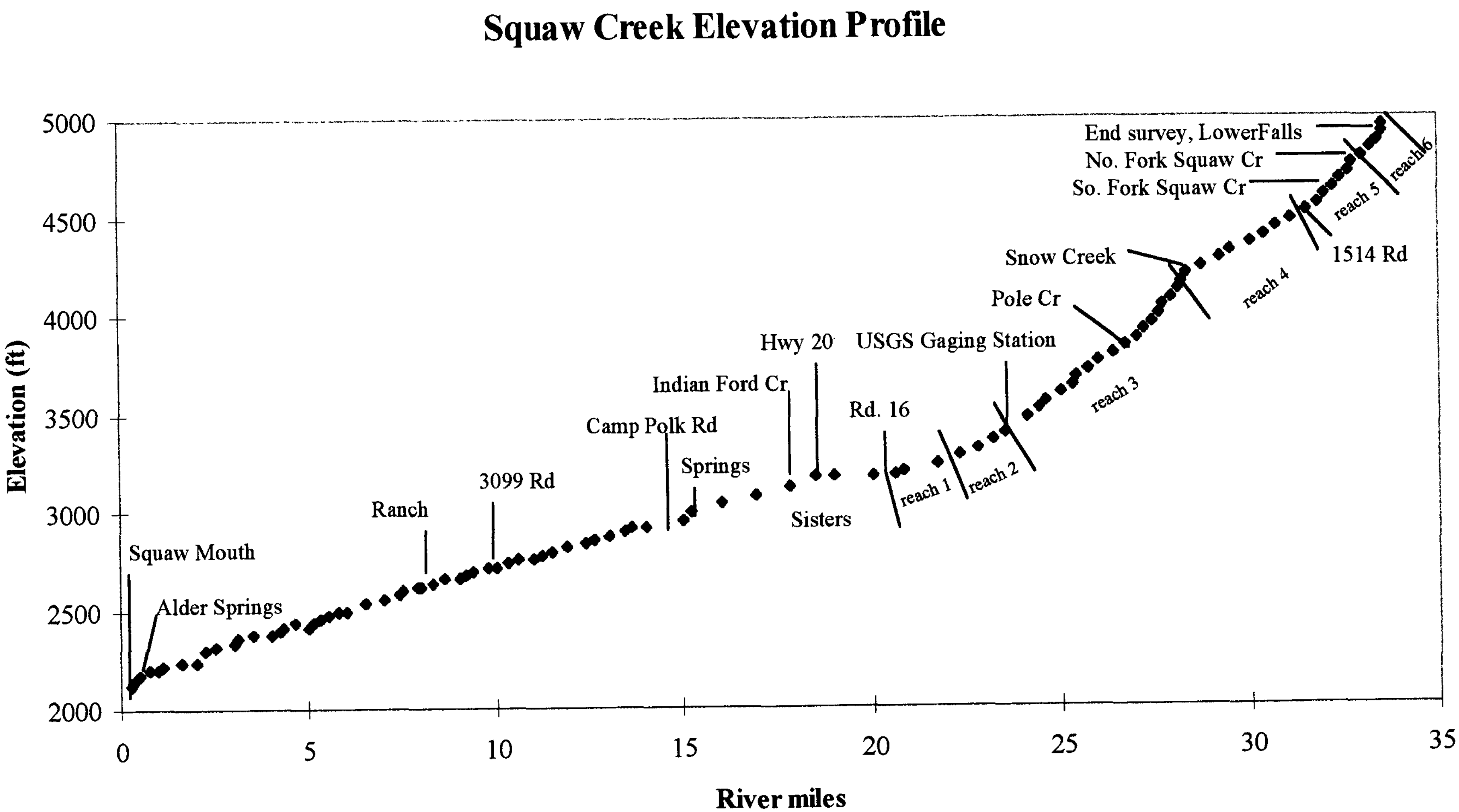


Figure SH – 2. Elevational profile of Squaw Creek, showing low gradient reaches near the town of Sisters.

Squaw Creek just downstream of Indian Ford Creek. Some flood work may have been done to this channel to restrict the flood flow from this channel. Cutting off additional flood channels intensifies the flood in the main channel increasing erosion. The stream will erode and reshape until the channel reaches a profile that will fit the new flow regime.

At the time of this analysis, steelhead trout, chinook salmon and other fish are unable to migrate upstream from the lower Deschutes river due to Round Butte / Pelton Dams (see Aquatic Species section). Fish passage proved unsuccessful after three years of operation of the adult passage tramway. Unable to collect juvenile migrants, fish passage at the project was abandoned in 1968 and a hatchery was constructed as mitigation. Spawning redband trout, brown trout, and kokanee migrate into the lower 3 miles of Squaw Creek. Juvenile bull trout rear in the same lower 3 miles of Squaw Creek but no evidence of spawning has been documented. Limited passage at certain flows is allowed at several diversion dams on Squaw Creek and Indian Ford Creek. The lower Squaw Creek falls near the wilderness boundary limits upstream migration of fish **(Figure SH -3).** Pole Creek has a 7 to 8 foot falls at the mouth and may have limited migration at certain flows. Trout Creek has an ephemeral connection to Indian Ford Creek and only flows during winter every 10 to 20 years.

Present water temperatures in Squaw Creek do not meet the Oregon DEQ standard of < 64^0 F seven day average maximum **(Figure SH-4)** and has been listed on the ODEQ 303d list for water quality limited streams. Squaw Creek reaches temperatures near 80^0 F near the 6360 rd on the Crooked River National Grasslands. At the mouth of Indian Ford Creek, surveyors recorded water temperatures of 70^0 F in August of 1997 (Burke 1998).

Channel mapping from aerial photos from 1943 and 1991 show dramatic changes in Squaw Creek. In the reach from the SCID diversion to below Camp Polk Road, there has been a loss of stream complexity **(Figures SH- 9 and 10)**. Stream length has been shortened by 1.4 miles, sinuosity has decreased 15% and gradient has increased (**Table SH-4**).

Table SH-6. Stream miles, gradient and sinousity measured from aerial photos of Squaw Creek from 1943 and 1991. The stream was channelized in 1968 in response to the 1964 flood.

Reach of Squaw Creek	Stream Miles		Gradient %		Sinuousity	
	1943	1991	1943	1991	1943	1991
Reach 4 – not Channelized	N/A	2.1	N/A	1.8	N/A	1.1
SCID to 4606 Rd	1.9	1.8	1.3	1.4	1.21	1.14
4606 Rd to Hwy 20	1.6	1.5	0.9	1.0	1.23	1.14
Hwy 20 to Camp Polk Rd	4.9	4.1	0.7	0.9	1.30	1.10
Camp Polk Rd to Wood Bridge	1.25	0.9	1.2	1.4	1.50	1.10
Total Combined Reach	9.65	8.3	N/A	N/A	1.30	1.10

N/A – Data was not currently available.

Changes in channel shape from trenching, dewatering, loss of cottonwood and willow, and removal of

Why-Chus Watershed Analysis Area

Potential Fish Barriers between Sisters and SCID Diversion

Figure SH – 3

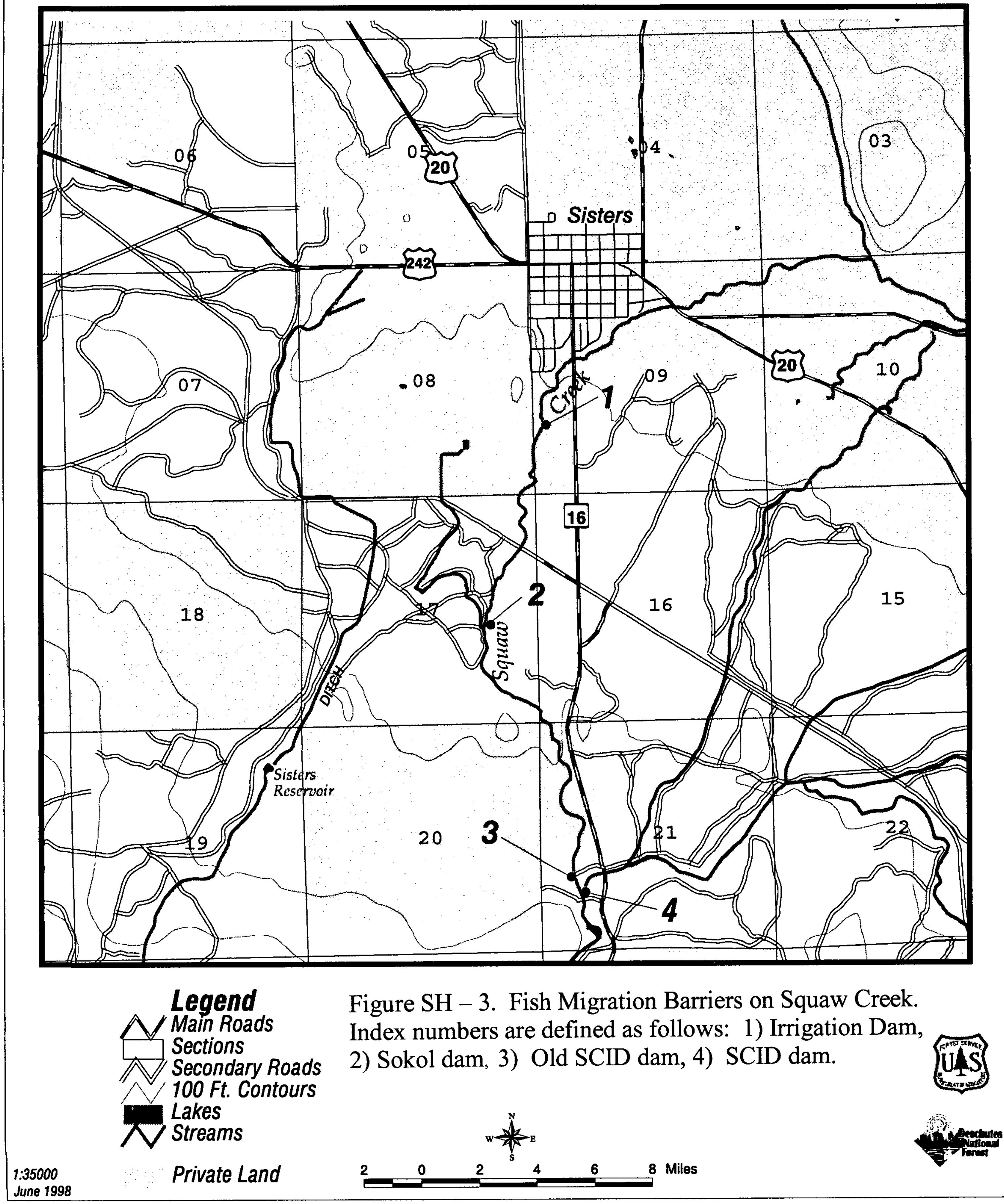


Figure SH – 3. Fish Migration Barriers on Squaw Creek. Index numbers are defined as follows: 1) Irrigation Dam, 2) Sokol dam, 3) Old SCID dam, 4) SCID dam.

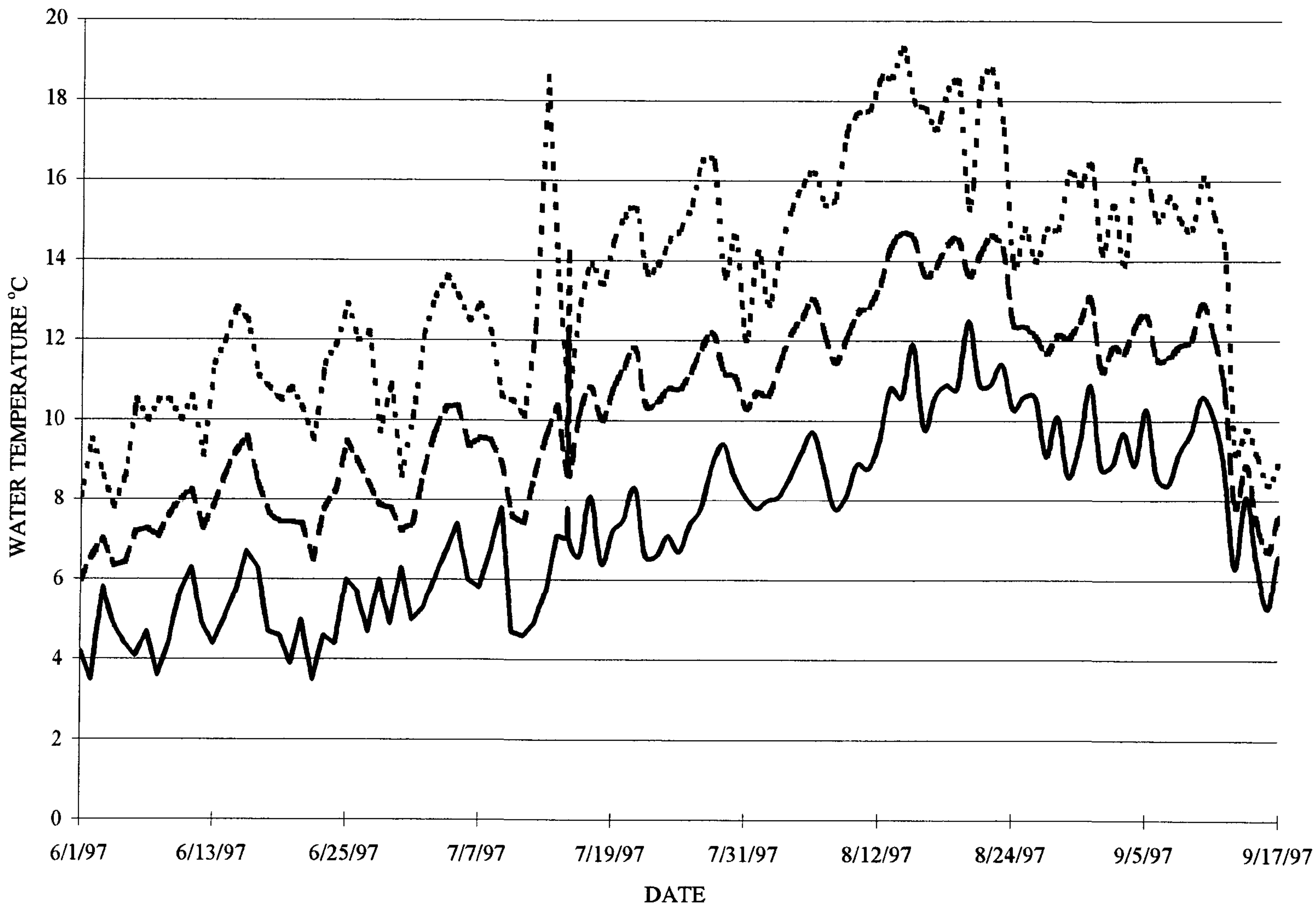


Figure SH-4. Maximum (small dash) minimum (solid line) and average (large dash) water temperatures (degrees Celcius) for Squaw Creek at the 16 rd crossing, 1997.

wood has destablized the stream and widened the channel shape. Lower depth and wider widths expose the stream to more solar heating and further push Squaw Creek outside of the historic range of stream temperatures which are already elevated by water diversions.

Thermal refugia for salmonids occurs in the upper portion of Squaw Creek and Indian Ford Creek. Upper Squaw Creek tributaries are snow melt driven and are generally cold water sources. Snow Creek and Pole Creek, tributaries to Squaw Creek, are spring fed and provide water temperatures near 50^0 F in the summer. The headwater tributaries of Indian Ford Creek are spring fed and provide winter cold water refugia. The Springs on Squaw Creek near Camp Polk Road provide a moderating effect of summer temperatures. Alder Springs near the mouth of Squaw Creek are near a constant 51^0 F and provide a summer and winter refugia for lower Squaw Creek and the Deschutes River above Lake Billy Chinook.

Off channel habitats offer rearing habitat for juvenile salmonids and create diverse habitat for invertebrates and amphibians. Off channel pools were inventoried in the 1997 stream survey (Dachtler 1994). Reach 1 (at 29 cfs) and reach 4 had the most area in off channel habitats **(Figure SH- 5)**. Low flow (7cfs) in reach one offered one third the off channel habitats than at higher flows (29cfs). These habitats included off channel pools, isolated pools, backwater pools, and alcoves. These habitats are also important for bull trout rearing cover, although they are scarce in this watershed. Side channels occur in low frequency except in Squaw Creek, Three Creek, and Trout Creek **(Table SH-5).**

Pool frequency in Squaw Creek and other streams are generally below the PACFISH/INFISH standards of 20 logs per mile greater that 12" diameter **(Table SH-5).** Most streams were below the median pool frequency in the Southern Cascades and the Upper Deschutes River Basin **(Figure SH-6)** (McKinney 1996). Exceptionally high pool frequencies were found in the first reach of Squaw Creek, just south of Sisters, and the first reach of Trout Creek, just below Trout Creek Swamp. Pool quality is good however, with Squaw Creek residual pool depth ranging up to 3 ft and Three Creek ranging over 4 ft deep **(Table SH-5).** See Water Quality section.

Generally, streambed substrates are cobble and gravel dominated. The headwater portions of Squaw Creek and Park Creek are bedrock dominated channels. Indian Ford Creek is dominated by sand which is a limiting factor for aquatic marcoinvertebrates in that stream **(Tabel SH-5).**

Large wood is generally over PACFISH standards of >20 pieces over 12 inches in diameter **(Tabel SH-5).** Densities were low in meadow reaches (Three Creek) and in the lower reaches of Squaw Creek. The lower reaches of Squaw Creek have been cleaned of wood after the 1964 flood. Smaller streams retain large wood more than larger streams. Generally, streams in older lodgepole pine and spruce stands have high densities that result from high tree mortality. Examples of lodgepole/spruce dominated streams with high densities are Snow Creek, Pole Creek and Trout Creek **(Table SH-5)**. Compared to median wood densities in other streams in the Southern Cascades or the Upper Deschutes River Basin, the streams in this analysis generally contain higher densities of large wood **(Figure SH-7)**.

Loss of instream wood occurred in Squaw Creek during channelization after the 1964 flood. The removal of logs for maintenance of irrigation diversion structures may have reduced the recruitment in those lower reaches. The loss of cottonwood forests in the floodplain of Squaw Creek was a major cause of loss of instream wood near the town of Sisters. Long term wood recruitment has been reduced along some streams due to clearcutting of the riparian reserves (e.g., Pole Creek and Trout Creek). The riparian zone of Indian Ford Creek has the highest level of development and agriculture. Indian

Ford, Three Creek and Trout Creek have a significant portion of the riparian zone in open grass/shrub or wetland vegetation. All subwatersheds had a low proportion of riparian forest in large tree character. Potential recruitment of large wood into the streams or lakes has low potential in the subwatersheds in this analysis (**Table SH-6**).

Bankful width-to-depth ratios are generally within the range expected or better. Squaw Creek however, is much wider and more shallow than expected, averaging twice the PACFISH standard and half the median width/depth ratio for the South Cascades (**Table SH-5, Figure SH-8**). The wide and shallow profile of Squaw Creek is probably due to the lack of stable streambanks, dewatering, wood removal, and channelization.

Table SH-5. Stream habitat characteristics measured during stream surveys.

Stream	**Substrate**	**Bankfull Width to Depth Ratio**	**Pools/Mile**	**Residual Pool Max Depth (ft)**	**Large Wood/Mile >12" dbh**	**Percent Side Channels**
Indian Ford Cr	SA	-	3	1	43	<1
Pole Creek	GR/SA	2 - 3	20 - 26	1.5 – 1.7	151 – 175	<1
Snow Creek	GR/SA	5 – 7	4 – 16	1.3 – 1.6	23 – 178	0.1 – 2
Squaw Creek	CO/BR/GR	13 – 26	4 – 16	1.9 – 3.0	11 – 48	0.1 – 7
Three Creek	GR/SA	4 – 7	4 – 9	3.3 – 4.1	1 – 29	3 – 7
Trout Creek	CO/SA/GR	6 – 13	24 – 33	1.1 – 1.8	115 – 128	2 – 5
West F. Park Cr	BR	-	<1	2	78	<1

Table SH-6. Riparian vegetation size classes within 100ft of water bodies within the analysis area, as identified using PMR data from GIS.

Subwatershed	**Acres Within Analysis Area**			**Size Classes within 1000 ft of Channel**					
	Acres within Water-shed	Riparian Reserve Acres	Riparian Vegetation Acres mapped	Large Tree %	Medium Tree %	Pole Tree %	Grass/ Shrub %	Water or Rock %	Agriculture and Developed
Indian Ford	28,250	2885	491	1	23	23	35	1	18
Melvin	13,132	508	0	1	58	28	9	0	5
Pole	10,662	879	154	8	33	55	4	1	0
Squaw	40,745	7236	1722	8	29	41	14	6	2
Three Cr Butte	25,219	1475	0	2	49	38	9	0	3
Three Cr Lake	4465	800	90	4	15	41	17	23	0
Trout	55,364								
Total	177837								

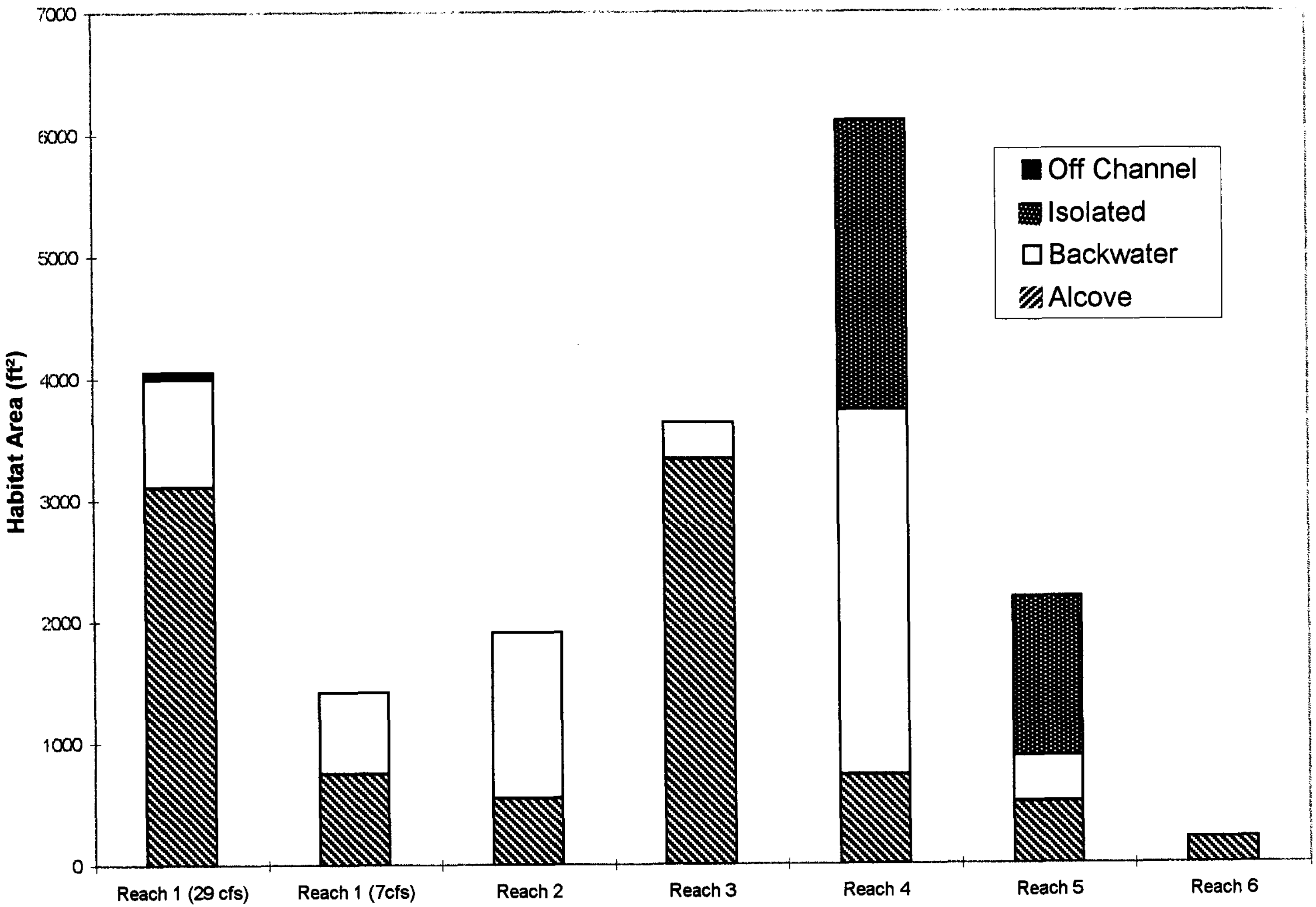


Figure SH-5. Area of off - channel pool types for reaches 1-6 on Squaw Creek.

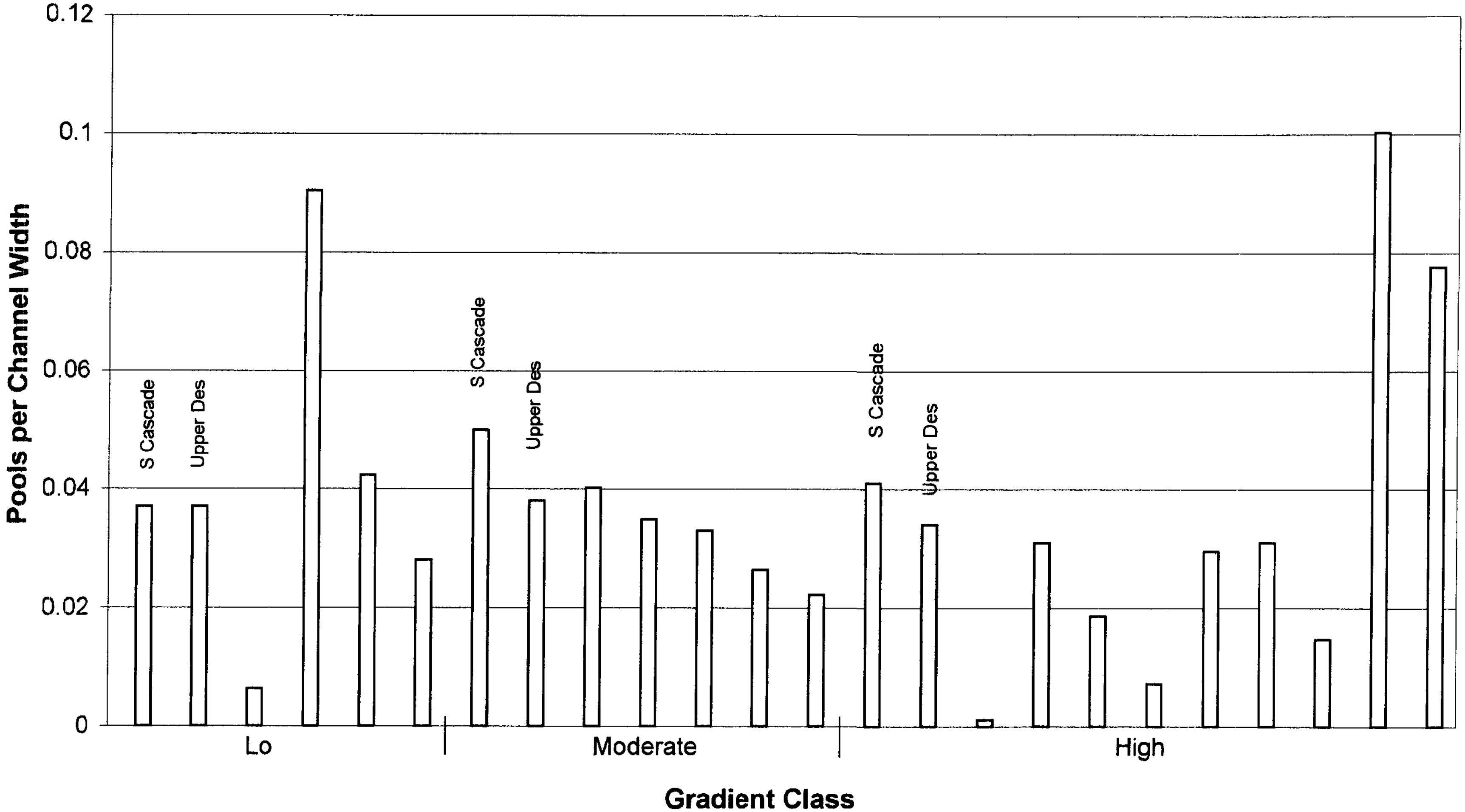


Figure SH-6. Pools per channel width for reaches in the analysis area and median values for the south Cascades region and Upper Deschutes Basin.

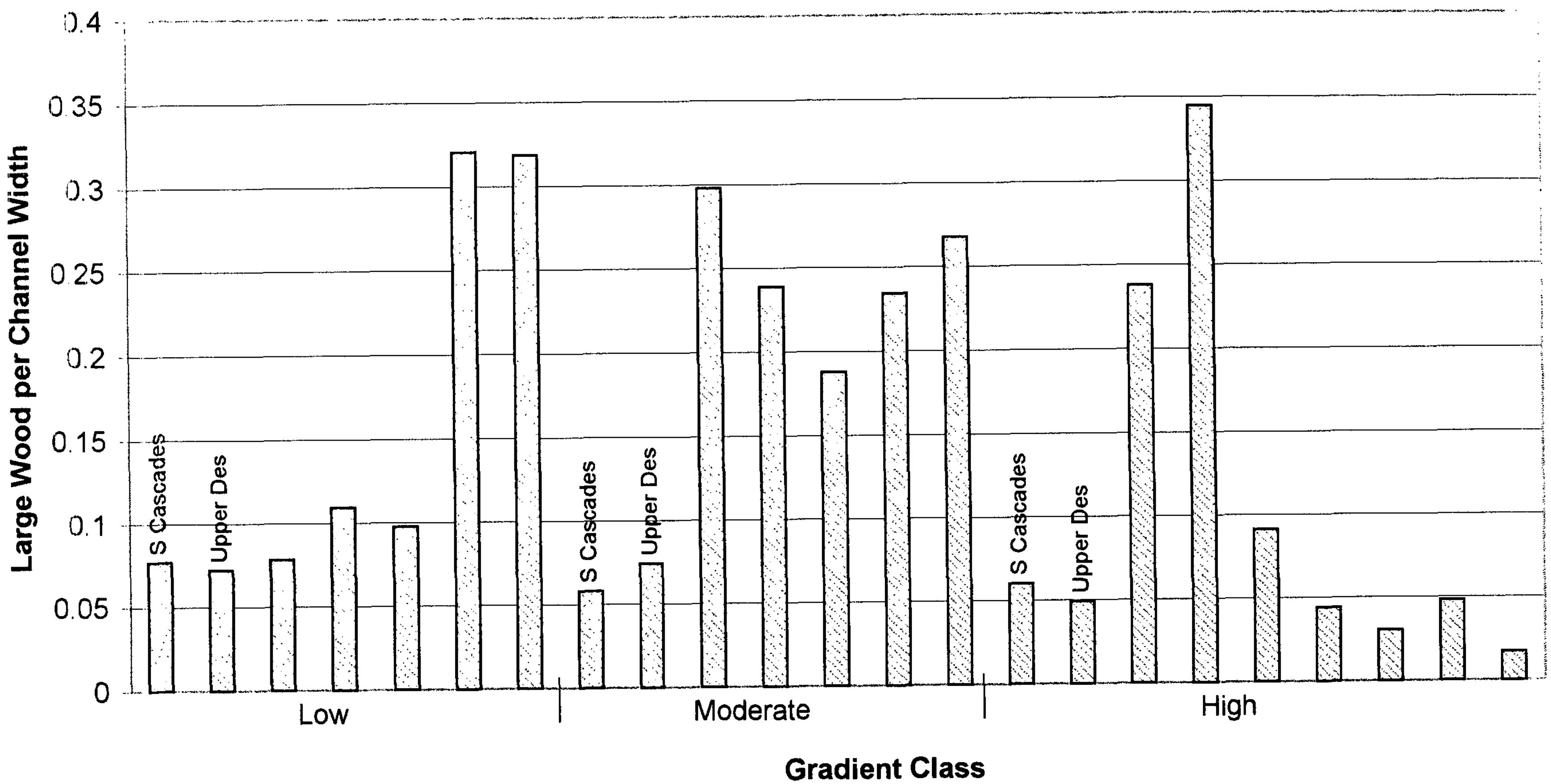


Figure SH-7. Large wood per channel width for reaches in the analysis area and median values for the south Cascades region and the Upper Deschutes Basin.

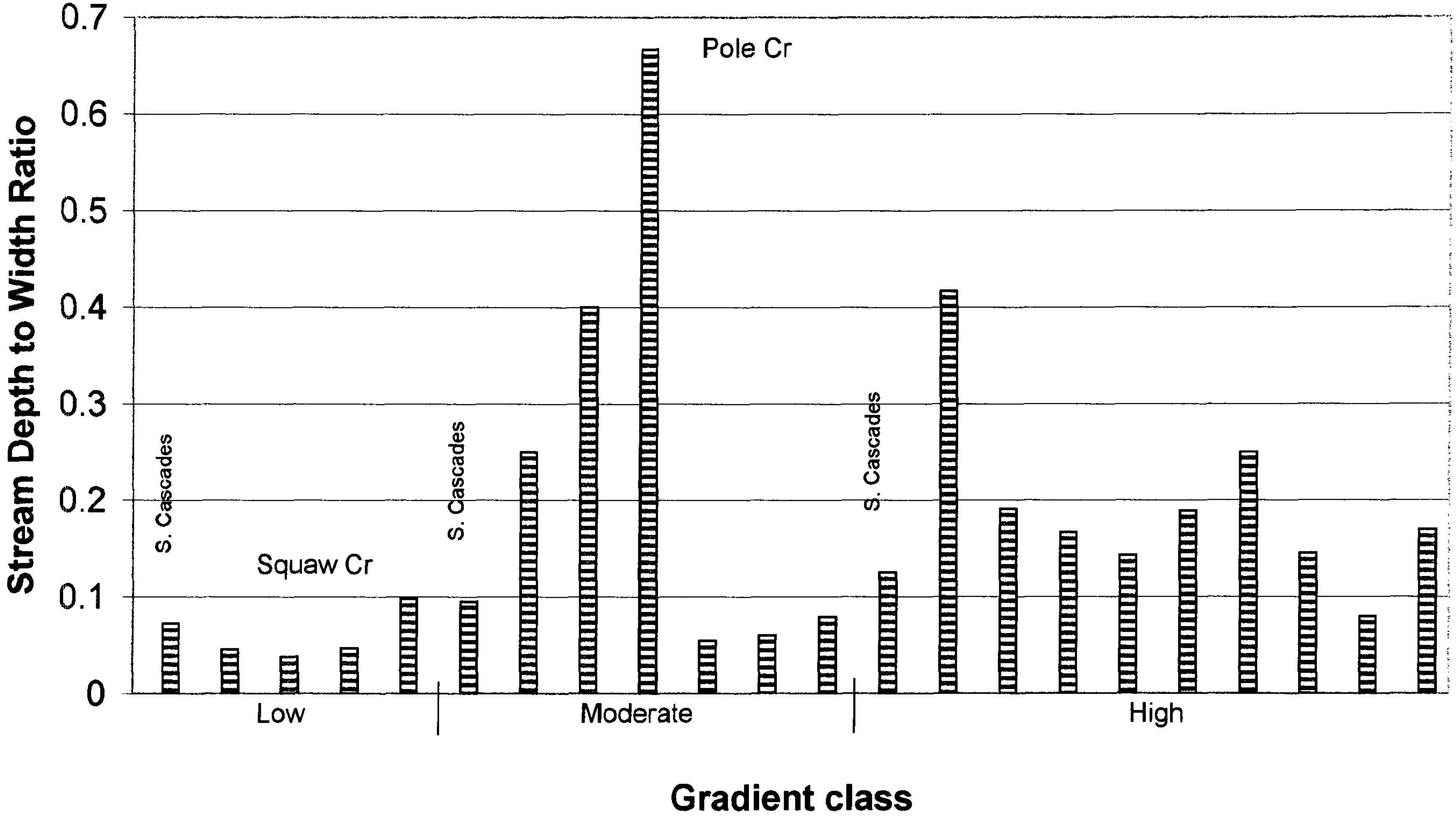


Figure SH-8. Stream depth to width ratios for reaches in the analysis area and median values for the south Cascades region.

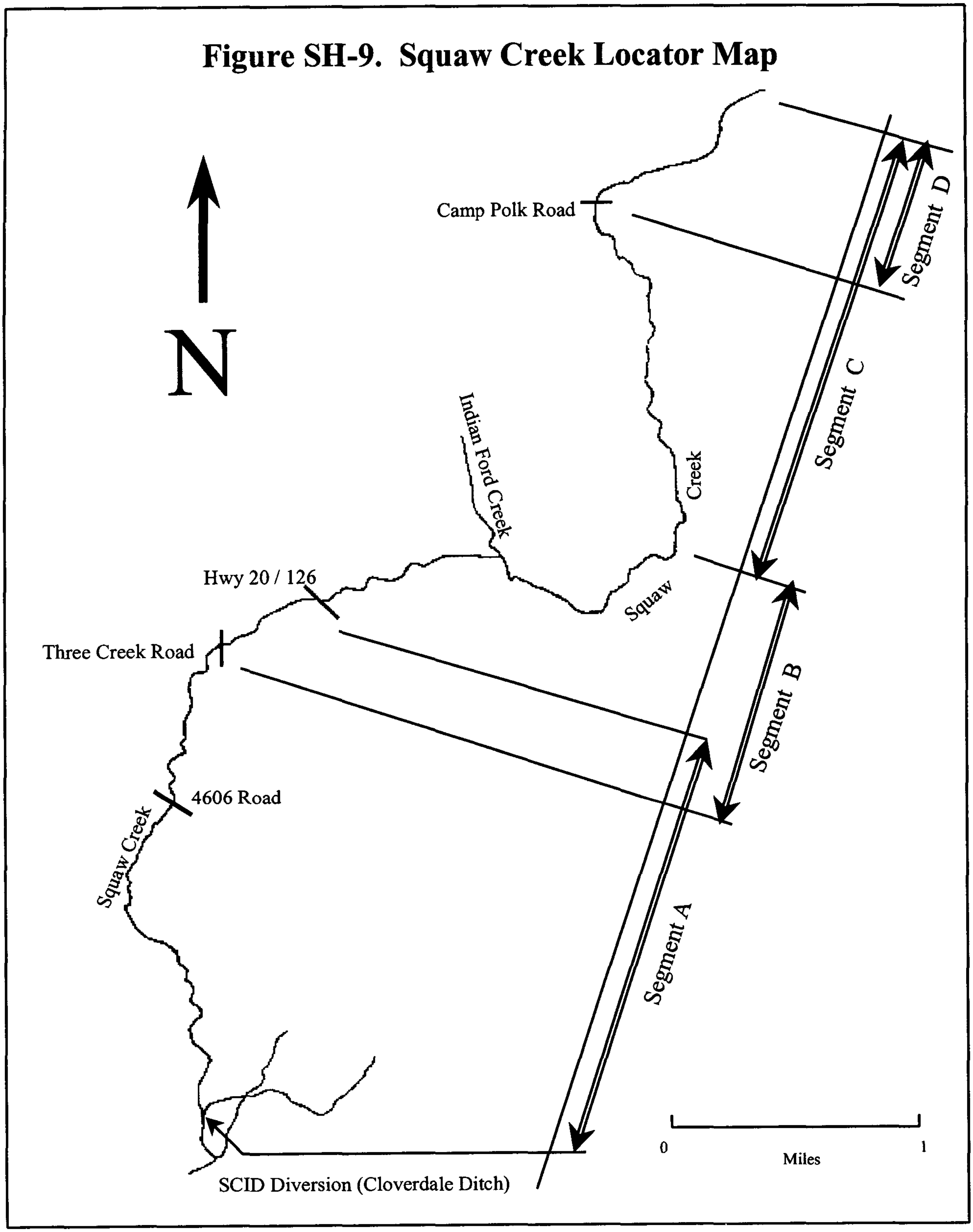


Figure SH-9. Location map of segments presented in figure SH-10. In each segment, the channel was mapped from air photos in 1943 and 1991.

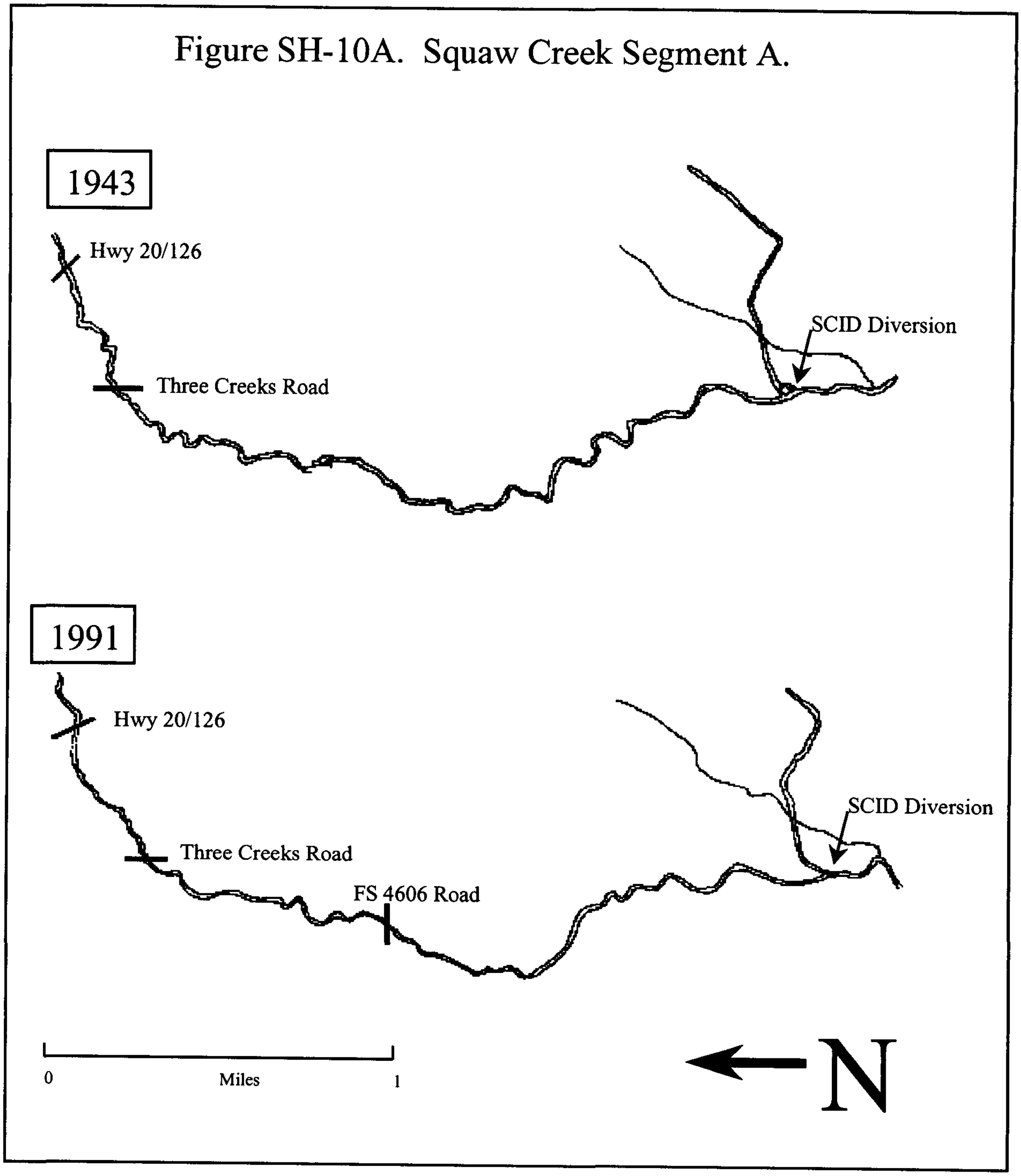


Figure SH-10 (A-D). Comparison of channel location and meander patter of Squaw Creek in 1943 and 1991. Segments A through D are shown in Figure SH-9 for larger perspective.

Figure SH-10B. Squaw Creek - Segment B

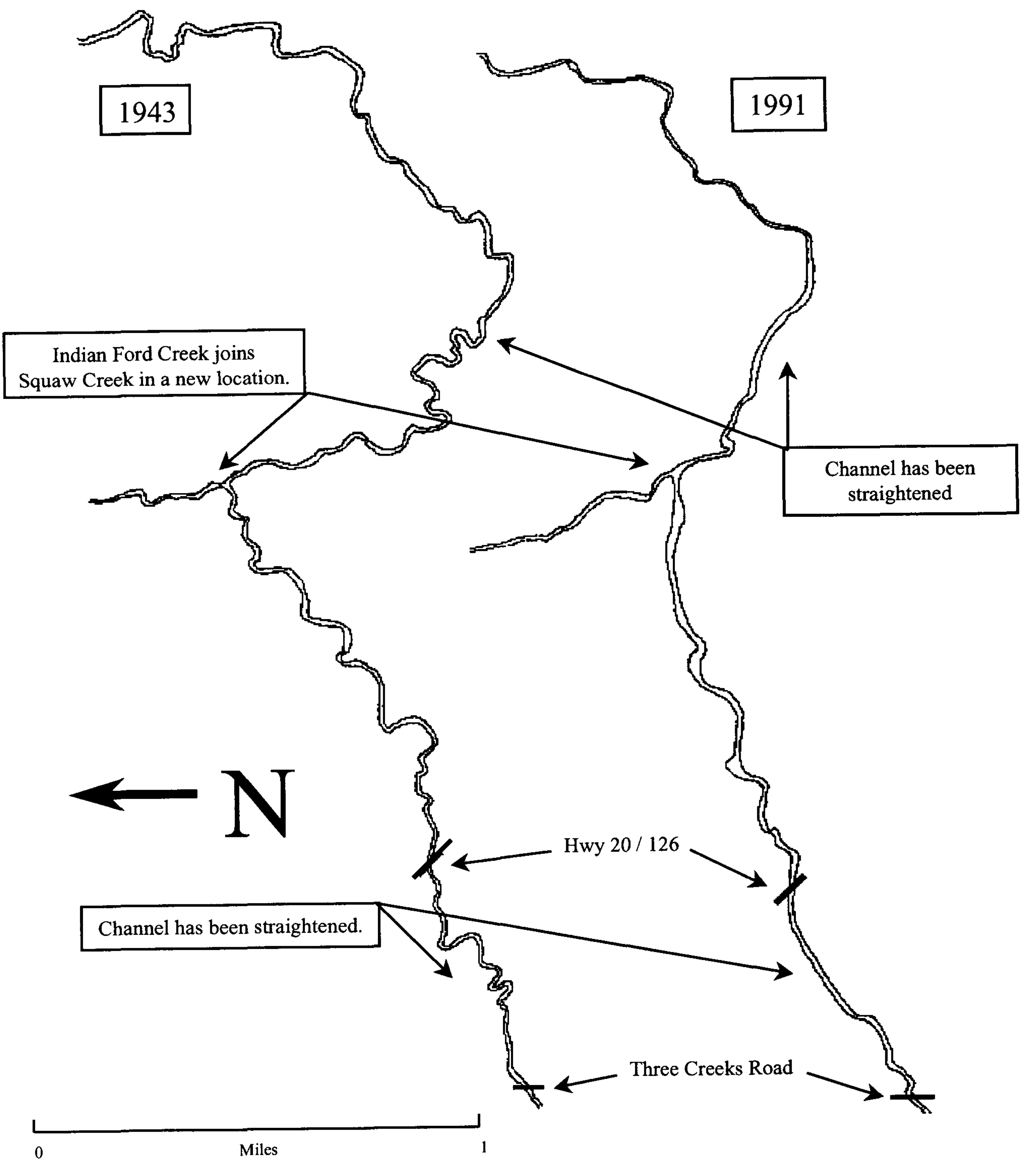


Figure SH-10C. Squaw Creek - Segment C

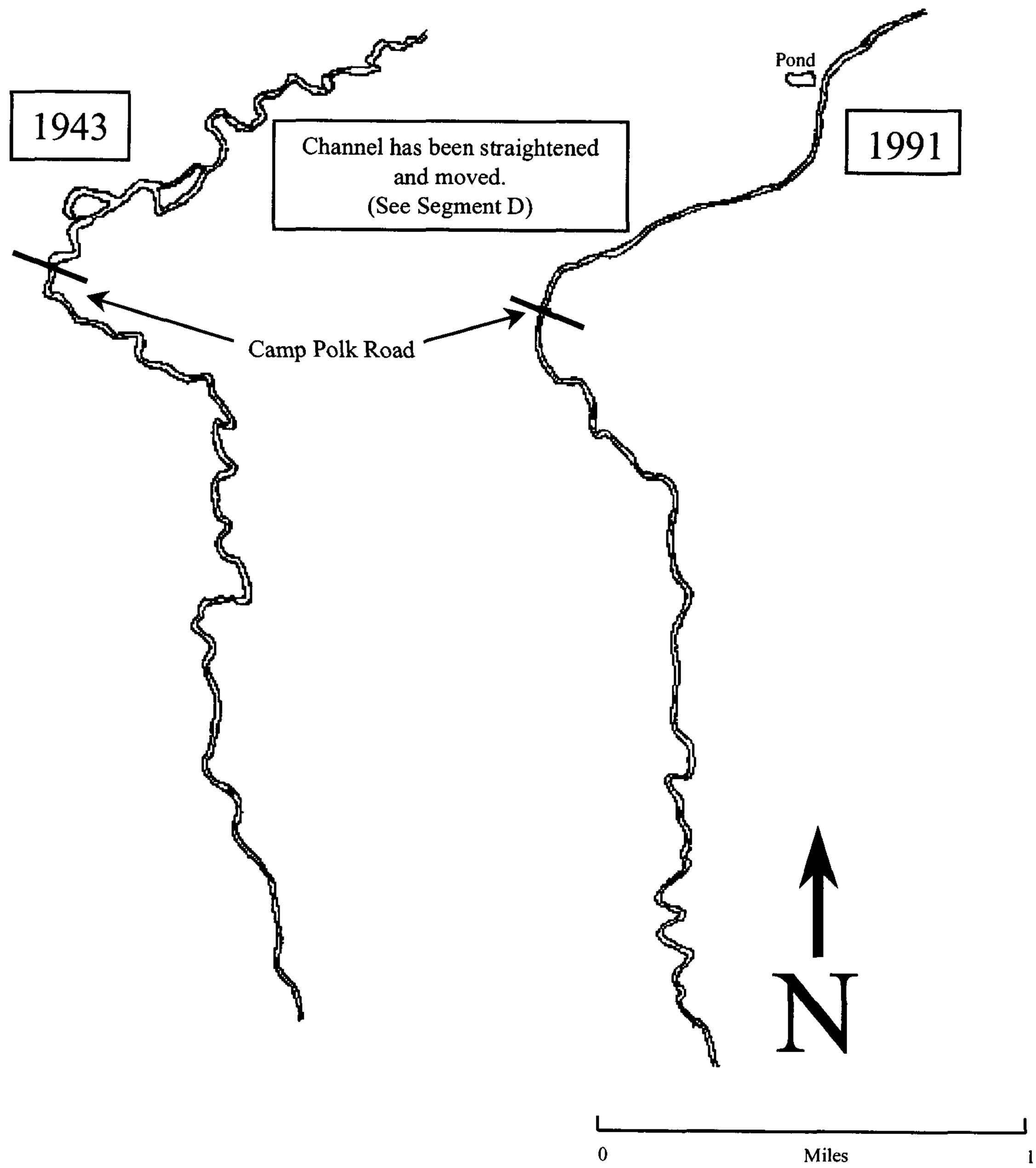
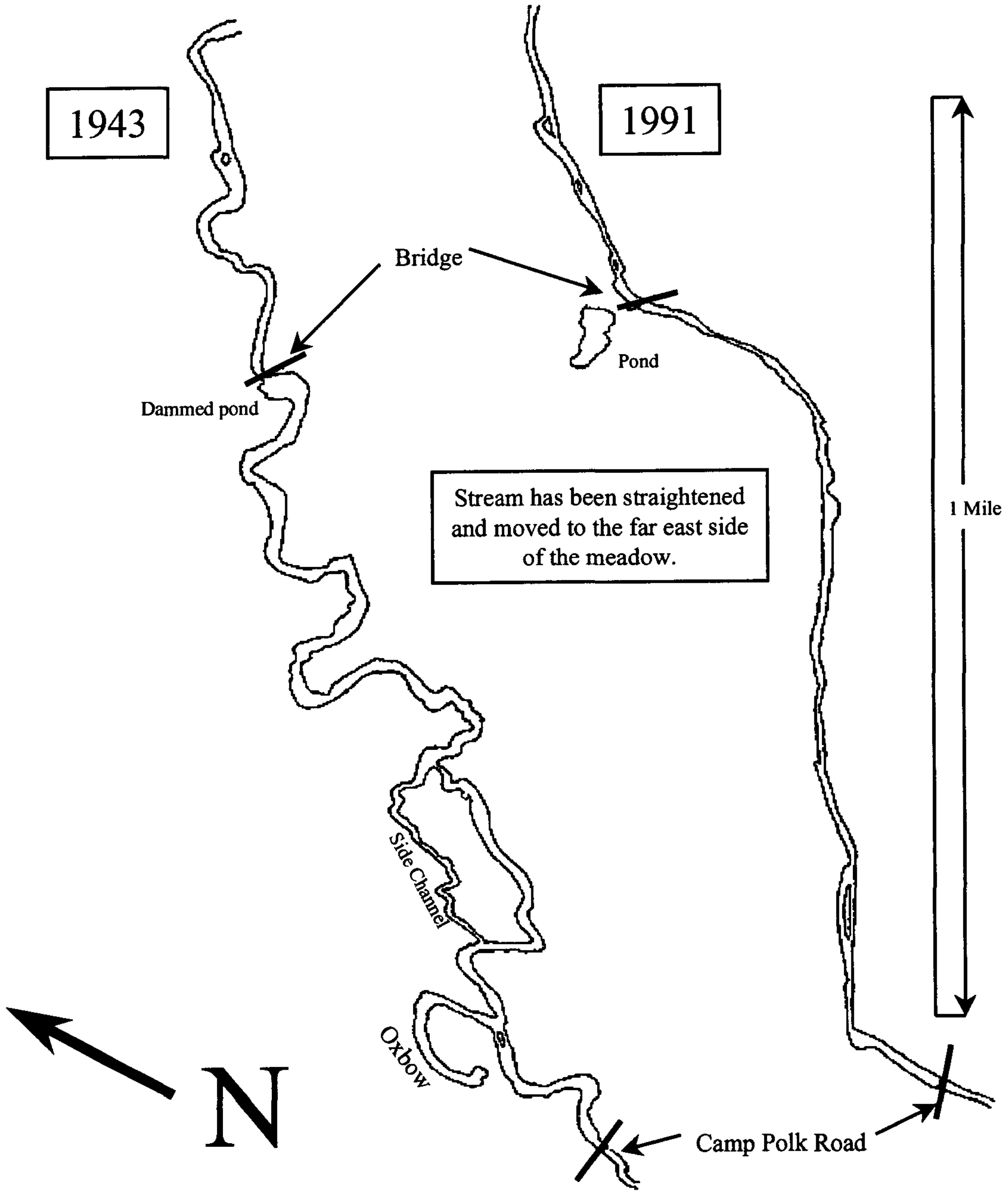


Figure SH-10D. Squaw Creek - Segment D



The most change in stream habitat conditions have occurred in Squaw Creek and Indian Ford Creek. Summer flows have been reduced, willow and cottonwoods have been removed, summer water temperatures have been increased, and migration routes for fish have been interrupted. The most severe change has occurred in Squaw Creek. The loss of stable stream banks combined with the unnatural flow regimes have made Squaw Creek highly unstable, threatening both fish habitat and development that has encroached onto the floodplain.

Indian Ford Creek may have once been a complex habitat for redband trout, with a diverse stand of willows that provided shade and complex cover and off-channel habitats. The broad floodplain of Indian Ford Creek allowed safe refuge from flooding and may have been an important rearing habitat for redband trout. Beaver ponds and E type channels provided a diversity of habitats for all age classes of trout. Moderate water temperatures and organic matter inputs provided Squaw Creek with an added capacity for trout production.

Squaw Creek was an important habitat for trout production in the Deschutes River Basin. Both steelhead and fluvial redband trout had open migratory routes connected to a diverse array of habitats. Cooler water temperatures maintained by riparian forest shade and spring-fed tributaries protected resident trout from high summer temperatures. Winter habitat was provided by diverse off-channel low velocity habitats and tributaries with warmer spring fed water. Pools were more abundant for rearing and migratory holding habitat due to the interaction of the cottonwood/conifer forest and the floodplain in the flats. Timing and upstream range of steelhead and salmon were not limited except by the size of headwater streams and bedrock falls near the wilderness.

Today, trout production is dependent primarily on those stream reaches having ample summer flows and lower water temperatures. Stream reaches not providing these habitats in the summer are barriers to trout migration. Other barriers such as Round Butte/Pelton Dams and most irrigation dams limit migration all year. Habitat quality in the middle reaches of Squaw Creek and Indian Ford Creek have declined from not only the loss of summer flow but from the simplification of the stream channel from loss of riparian vegetation, wood removal, and channelization.

Erosion of stream banks threatens both fish habitat and property values. Naturally occurring floodplains allow floods to spread and reduces the erosive power of the stream. The reduction of the floodplain area through riprap, trenching, building encroachment, and downcutting has increased the problem by concentrating the water into a single, swifter channel. Channelization has straightened the channel and increased the gradient and speed of the water, further increasing the erosive power of the stream. These changes have reduced fish habitat by reducing pools, off-channel habitats, fish cover, and increased water temperatures to harmful limits for trout.

TREND SUMMARY

- Streambank erosion has increased.
- Fish habitat has been degraded threatening native stocks.
- Riparian vegetation has decreased.
- Summer flows are decreased.
- Water temperatures have increased.
- Migration routes for fish have been interrupted or lost.
- Threats of flooding may be more severe.
- Developments within floodplains are threatened due to unstable streambanks.

See **Trend Table** in **Synthesis Section** for more information.

Physical Domain

Water Quality

The target of this analysis is to review those water quality attributes that are tied to beneficial uses of the watershed. In this way, we can focus on those attributes that are important for maintaining the quality of those resources important to us (**Table WQ-1**). With a watershed as large as the Sisters/Why-chus, beneficial uses were assessed on water bodies that had useful water quality information. Uses vary from irrigation to aesthetics. Many of the associated water parameters overlap these various uses.

Characterization

What are the beneficial uses dependent on aquatic resources occur in the watershed? Which water quality parameters are critical to these uses?

Table WQ-1. Beneficial uses of surface water and the associated parameters that are important to that resource. Oregon DEQ state standards, compliance with those standards and possible listing on the Clean Water Act 303(d) list of water quality limited water bodies is given.

Water Body	Beneficial Uses	Associated Water Parameters	State Standard	State Compliance	303(d) List
Indian Ford	Irrigation Fishing/aquatic life Contact Recreation Grazing	Flow Temperature E. coli Tot. phosphorous Dissolved Oxygen	water rights 7d max <= 64 F temp <126/100ml <10% exceed standard 11mg/l or 95% saturation	No Need data Need data Need data Need data	Need data
Pole Creek	Municipal Water Supply Irrigation	Turbidity Flow	<10% increase turbidity water rights	Yes Yes	No
Squaw Creek	Irrigation Fishing/aquatic life Contact Recreation Wild and Scenic River Bull Trout Habitat	Flow Temperature Instream Flow Turbidity Temp- Bull Trout Dissolved Oxygen	water rights 7d max <= 64 F temp min. flow not set <10% increase turbidity 7d max <= 50 F temp 11mg/l or 95% saturation	No No No Yes No Need data	Yes
Three Cr. Lake	Fishing/aquatic life Contact Recreation Irrigation Storage	Lake level Dissolved Oxygen	water rights/dam safety 11mg/l or 95% saturation	No Yes	No
Three Creek	Irrigation Fishing/aquatic life	Flow Temperature	water rights 7d max <= 64 F temp	Yes	No
Trout Creek	Fishing/aquatic life	Temperature	7d max <= 64 F	Yes	No

Reference Conditions

What were the historical water quality characteristics of the watershed?

Historic flow conditions in Squaw Creek in August would have been about 92 cfs in the town of Sisters. This estimate is based on USGS flow records without the natural flow of Pole Creek. Without diversion, Indian Ford Creek may have contributed between 7 and 11 cfs of flow to Squaw Creek. The flow of Squaw Creek would have been much greater and riparian vegetation would have been maintained along the streambanks throughout the summer. There is little evidence that any other flow modifications have been made other than through diversions (see hydrology section).

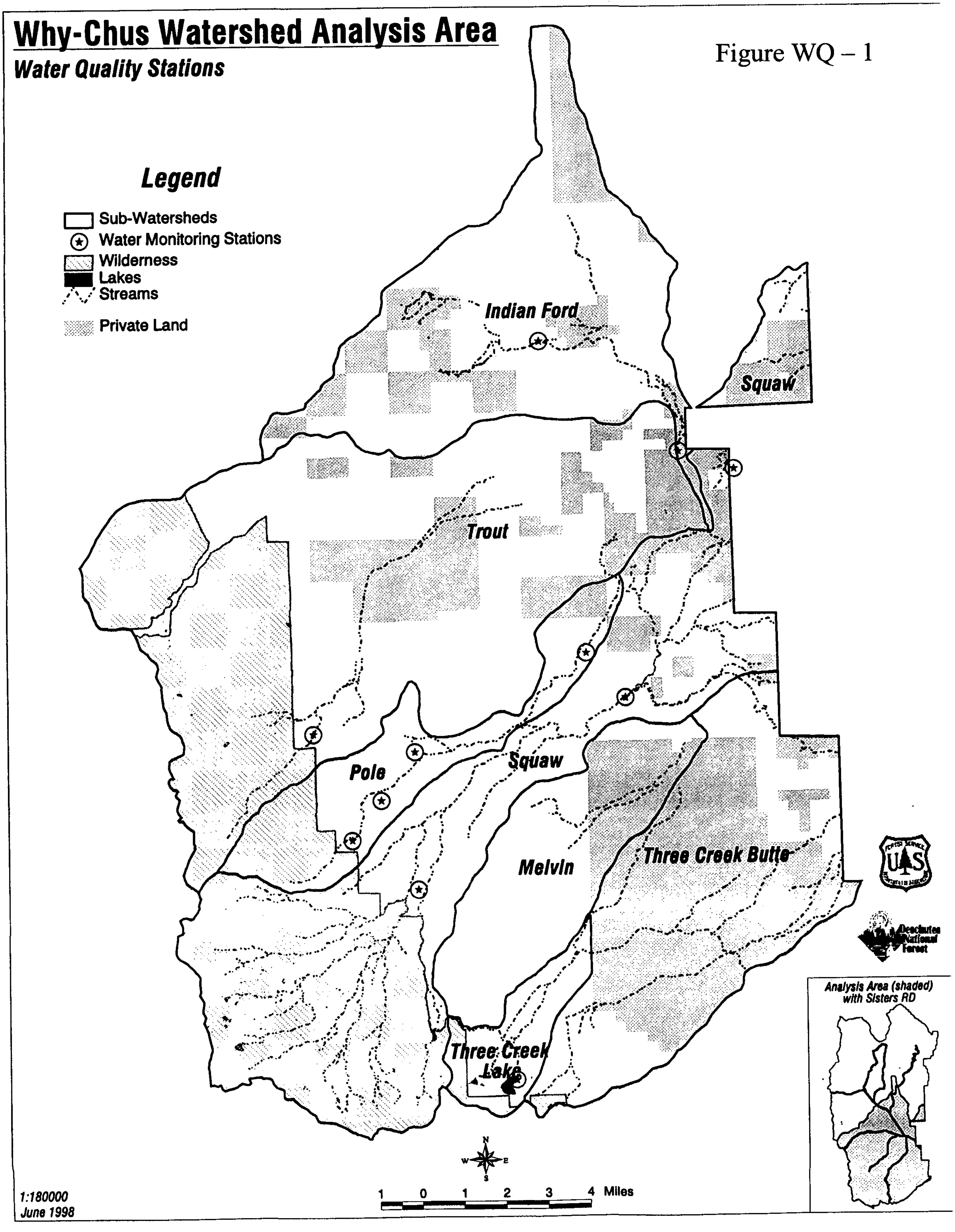
Instream flow reduction has a great affect on water temperature. Houslet (1998) found that water temperature in Squaw Creek, historically, may have been a maximum of 66 °F at the 6360 Rd. Today, the stream temperature can rise to 80 °F (**Figure WQ-1**). The miles of stream between the Squaw Creek Irrigation District Diversion Dam and the 6360 Rd that would meet DEQ temperature standards was estimated to be 2 miles under present conditions and 10 miles under historic flow (see **Appendix WQ-1**, Houslet 1998).

Historic water temperatures are more difficult to estimate for Indian Ford Creek. Wetlands through which the stream flows may have been a stand of willow, mixed with beaver ponds, side channels, and backwaters. Willow would have provided shade needed to prevent excessive heating in the low gradient reaches. Beaver ponds and side channels would have regulated the release of water during the summer and may have moderated low flows. The release of water in the late summer may have tempered low flows, but the affect on stream temperature is unknown. The contribution of flow to Squaw Creek may have had a beneficial effect from added nutrients from the Indian Ford Creek wetlands.

Dissolved oxygen would have been near saturation in any stream in the analysis area historically. Nutrients should have been similar in non-wetland streams. Phosphorous was probably in similar concentrations due to the geology of the watersheds. In backwaters of beaver effected channels, some temperature and dissolved oxygen problems could have occurred in isolated areas. The main channels probably were not significantly affected. The intensive use of stream meadows by animals would have been less during the summer months and no additional nutrients would have been discharged into the streams. Bacteria may have reached higher levels in areas of high beaver and elk use. Generally, these areas would have been used for short time periods and would have recovered. Beaver tend to use an area and move on when resources become limited.

Turbidity was probably similar to present day ranges and mostly controlled by glacial and debris flow activity. Stream pH was also similar to present day variability. In large wetland areas, pH may have been lower due to the decomposition of vegetation. This may have occurred on Indian Ford Creek and Trout Creek.

Historically, native fish were well distributed in Squaw Creek. Summer steelhead and spring chinook used Squaw Creek for spawning and rearing habitat. Redband trout used most of Squaw Creek from mouth to falls. Trout Creek may have had some connection to Squaw Creek during wet cycles. Bull trout may have used more of Squaw Creek for rearing and some limited spawning. Water temperatures would have been more suitable for foraging and migration throughout the length of stream. Competition from brook trout and brown trout was not a factor historically.



Why-Chus Watershed Analysis Area
Water Quality Stations
Figure WQ – 1
Legend
Sub-Watersheds
Water Monitoring Stations
Wilderness
Lakes
Streams
Private Land
Indian Ford
Squaw
Trout
Pole
Squaw
Melvin
Three Creek Butte
Three Creek Lake
Deschutes National Forest
Analysis Area (shaded) with Sisters RD
N
W
E
S
1 0 1 2 3 4 Miles
1:180000
June 1998

Amphibians, such as Cascades frogs and tailed frogs, may have been more common along Squaw Creek during times of no water diversions. Cascades frogs can tolerate colder water and tailed frogs require cold temperatures along streams, even as adults. Without the stocking of brook trout in the high lakes, some amphibians may have been better distributed or more abundant where they are found today.

There is little question that the Sisters reach of Squaw Creek and lower Indian Ford Creek had a more diverse and more abundant invertebrate community prior to dewatering. Springs along Squaw Creek currently help provide thermal refugia in some areas of the dewatered reaches, but invertebrate diversity has declined in other areas.

Width to depth ratios on Squaw Creek were much lower under natural flow. The added water helped maintain streambanks with abundant riparian vegetation, a process that further helped to narrow the channel. The narrow channel helped reduce stream temperatures. Stable streambanks resulted in less sediment inputs in the reach through Sisters. Percent fine sediment in Indian Ford Creek may have been lower in some reaches but higher in areas dammed by beaver.

Prior to logging in the riparian areas and stream cleanout projects, large wood was more common in the streams. There is a good relationship between the size structure of riparian forests and the sizes found instream (Bilby and Wasserman, 1989). Squaw Creek may not have retained much of the large wood during floods in the confined reaches. In unconfined flats, log jams on islands and along the outside of bends would have provided important deep-pool habitats and cover for most species of fish.

Current Conditions

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

A primary concern for water quality in the analysis area is reduced instream flow in Squaw Creek due to irrigation diversions. Active water rights take water from Squaw Creek from river mile 23 to river mile 14.2 (**Table WQ-2**). At times, Squaw Creek can be completely dewatered from the Sisters City Park to just above Camp Polk Road (approximately 3 miles). Flow is restored above Camp Polk Road by springs that contribute up to 5 cfs. Reduced summer flow above and below Sisters contributes to the high water temperatures that exceed state standards. Other parameters such as pH, dissolved oxygen, and bacteria can also be affected by elevated temperature. Fish assemblages will change with the altered flow and temperature regime.

The primary irrigation season starts around April 15 and continues to October 15. Low flow can also occur in April when some water is taken and snowmelt is low due to cold weather. Generally, April water temperatures do not exceed standards due to the cold weather, short length of daylight, and angle of the sun. However, during the drought in April of 1991, a fish kill was documented in the normally watered section above the town of Sisters. At times, May water temperatures can exceed state standards for the 7 day maximum temperature.

Normal August flow upstream of Sisters averages 92 cfs (USGS data). In 1998, nearly one cfs was allowed to flow through Sisters due to water rights purchased for instream flow. Many of the concerns for water quality are related to the lack of a minimum instream flow in Squaw Creek.

Other than flow reduction from irrigation, there is no evidence to suggest the flow regime of Squaw Creek or other streams have changed due to timber harvest or roads (see Hydrology Section). The watersheds in this analysis have a relatively large proportion of land area comprised of soils and underlying rock having high infiltration rates and high permeability. Therefore, the link between timber harvest and changes in surface flows may be less than expected. However, major changes in the vegetation may have affected other resources (See Vegetation and Terrestrial Species sections).

The greatest affect on stream channels from timber management may be from the road network. Road crossings often direct runoff from roads into streams and can increase fine sediment in the streambed. Fine sediment reduces the survival of trout fry, aquatic invertebrates, and tailed frogs. The affect of roads on streams is most pronounced on spring-fed streams because of their naturally stable flow and low sediment transport rates. From limited road surveys conducted during this analysis, the affect of roads appears to be localized to certain roads within the riparian reserves or at road crossings (**Table WQ-3**).

Table WQ-2. Cubic feet per second (cfs) taken from Squaw Creek and the river mile (RM) location (as measured from the Deschutes River). Priority date is given for the water right or for the youngest right associated with that diversion point. Sisters is located near RM 20 where the stream often runs dry..

RM	Date	Water Right Flow (cfs)
23.0	1901	25.4
22.8	1904	31.6
22.5	<1895	7.6
22.3	1895-1904	181.0
22.2	<1895	0.7
21.2	<1895	3.3
20.7	1917	1.5
20.2	<1895	3.4
19.7	<1895	1.1
19.2	1913	0.9
18.1	1914	0.4
18.1	1975	0.1
17.3	1884	0.4
16.6	1948	0.5
15.6	1884	0.3
15.6	1904	0.3
15.6	1961	0.4
14.2	1972	0.1

Table WQ-3. Road crossings and road densities within the subwatersheds of the Sisters/Why-chus analysis area.

Watershed	Acres	Acres of riparian reserve	Road crossings per stream mile	Miles of road per miles ^{2}	Riparian road miles per mile ^{2}
Indian Ford	28,250	2885	0.7	3.8	3.9
Melvin	13,132	508	1.9	4.1	9.2
Pole	10,662	879	1.2	3.5	4.1
Squaw	40,745	7236	0.5	2.1	2.6
Trout	55,364	1838	1.1	3.4	4.7
Three-Creek Butte	25,219	1475	2.6	0.7	6.2
Three Creek Lake	4465	800	0.9	1.7	2.2

Stream temperature was measured using continuous recording sensors in Squaw Creek, Trout Creek, Indian Ford Creek, Pole Creek, and Snow Creek. State standards require summer temperatures not exceed 64°F (17.8° C) for the 7 day average maximum. The stream station not meeting this standard was Squaw Creek at 6360 Rd (**Table WQ-4**). Squaw Creek has elevated summer temperatures due to low flow related to water diversions. The flow of warm water from Indian Ford Creek into Squaw Creek contributes to the degradation of water quality in Squaw Creek. Temperature data has been collected in the summer of 1998 at additional stations on Squaw Creek.

Table WQ-4. Water temperatures recorded approximately hourly using a HoboTemp logger.

Stream	Location	Year	Period of Record	Maximum °C	7 day max °C
Squaw Cr	1514 rd	1997	6/1 - 9/30	11.3	10.8
Squaw Cr	USGS gauge	1996	4/28 - 9/30	14.8	13.5
Squaw Cr	Mainline rd	1998	1/1 - 5/25	23.2	16.4
Squaw Cr	6360 rd	1998	1/1 - 6/28	20.0	18.4
Squaw Cr	d/s Alder Springs	1996	7/13 - 10/28	16.7	15.8
Indian Ford Cr	d/s Black Butte Ranch	1997	4/28 - 9/30	16.1	15.4
Indian Ford Cr	d/s Glaze Allotment	1997	4/28 - 9/30	14.0	13.2
Pole Cr	1514 rd	1997	5/1 - 9/30	8.3	7.6
Snow Cr	1514 rd	1997	5/1 - 9/30	12.3	11.4

Cold water sources in the analysis area are Pole Creek, Snow Creek, and Squaw Creek above the USGS gauge station and below Alder Springs (**Table WQ-4**). These streams had water temperatures that generally averaged less than 52^0 F (11.1^{0}C). Although these streams represent good bull trout habitat based on temperature, only lower Squaw Creek has been documented to support rearing bull trout currently.

Dissolved oxygen is directly related to water temperature and biological activity. Higher water temperatures result in lower dissolved oxygen. An abundance of algae and microbial activity will also result in lower dissolved oxygen. Normally, dissolved oxygen is not a problem for trout in free flowing streams at mid to upper elevations. Small streams are more likely to have high temperatures due to the direct exchange of heat from the air to the water. Also, small streams have more exposure to the sun, as related to the volume of water. Polluted streams will have low dissolved oxygen because of added nutrients, increasing the algae and microbe activity which use dissolved oxygen . Trout need high dissolved oxygen compared to most other inland fishes. Summer temperatures reach critical peaks in late July and August when there is a combination of low flow, long days, and a high sun angle in the sky. Another critical period is when trout eggs incubate in the gravel. Fine sediment and warm temperatures can reduce intergravel dissolved oxygen and cause mortality of developing trout embryos.

Table WQ-5. Water column parameters associated with beneficial uses in the analysis area. Data summarized form the Storet data base.

Location	Station Number	Dissolved Oxygen mg/l	Dissolved Oxygen % Sat.	Nitrate/ Nitrite mg/l	Nitrate mg/l	Total Phosphorous mg/l	Turbidity JTU/FTU	pH
Squaw USGS	404978	10.0-11.8	106-108	0.02	-	0.04	2 FTU	7.2-7.7
Squaw d/s SCID	404980	11.2	106	0.02	-	0.05	1 FTU	7.2-7.4
Squaw 6360rd	405329	11.5	99	0.11	-	-	-	8.0
Squaw Sisters East	405695	8.8	94	0.16	-	-	-	8.4
Squaw Camp Polk	404087	10.1-12.1	97-108	-	0.02-0.05	0.1-0.4	1.0-30.0 JTU	6.9-8.2
Trout 1018rd	14075000	-	-	0.01-0.11	0.01	0.06-0.15	-	6.8-7.6
Indian Ford 2058rd	404981	8.1-8.2	89-90	0.02	-	0.14-0.16	1 FTU	6.9-7.5
Indian Ford Camp	402306	9-11.6	100-102	-	0.06-0.07	-	1 JTU	7.2-7.4
Squaw SCID canal	404979	11.4	108	0.02	-	0.05	2 FTU	7.1-7.5
Three Cr Lake	415160	8.3	109	0.02	-	0.01	-	-
Pole Spr	1003201/ 0193A001	5.6-17	-	-	-	-	0.25-0.8 FTU	7.0-8.8
Pole 1514	1003202/ 0193A002	7.6-15	-	-	-	-	0.32-0.7 FTU	6.9-9.0
Pole Res	1003203/ 0193A003	7.9-15	-	-	-	-	0.45-1.0 FTU	6.9-8.8

Squaw Creek and Indian Ford Creek reach critical low dissolved oxygen in the summer months. Indian Ford Creek dissolved oxygen has been recorded less than 8.2 mg/l and 90% saturation. Squaw Creek has been recorded to have extremely high water temperatures that would allow a maximum of 8.2 mg/l if at 100% saturation. In both situations, these stream segments would probably fall short of meeting state standards for dissolved oxygen if measured according to state DEQ protocol.

Nutrients can be measured several ways depending on the question being raised. Generally, phosphorous is the most common limiting nutrient for plant growth in aquatic systems (Wetzel 1975)). Often, the optimal nitrogen to phosphorous ratio for primary production is 16:1. Phosphorous is more abundant in watersheds with volcanic origins. In the volcanic Cascade Mountains, streams have a higher level of phosphorous than nitrogen (McDonald and Wissmar 1991). This factor leads us to expect nitrogen to be limiting to plant growth in the waters of the Why-chus watershed.

From the phosphorous data available in the Storet database, red flags were noted for Indian Ford Creek at the 2058 Rd, Trout Creek, and Squaw Creek at Camp Polk Rd **(Table WQ-5)**. Nitrate levels were comparatively low for those streams. Although data is limited, there does not appear to be unusual nutrient levels in other waters within the analysis area.

More frequent nutrient sampling would need to be collected for more intensive analysis. Indian Ford Creek would require winter sampling to monitor runoff from Black Butte Ranch irrigation of the meadow with treated effluent. In 1997, an accidental spill from a failed pump discharged untreated sewage into a spring, which joins Indian Ford Creek. Although no fish died, the affects on the stream biota are relatively unknown.

Fecal bacteria can cause illness if ingested and is a concern for waters where people swim or wade. Bacteria data is limited for this watershed, but generally, all streams meet state standards for contact recreation. Some limited *Escherichia coli* bacteria sampling has been performed on Indian Ford Creek and Squaw Creek. The risk is higher in low flow and warm waters with heavy use by animals. In Indian Ford Creek, fecal coliform bacteria was highest near Camp Polk Road. In Squaw Creek, the highest recorded *E. coli* sample was 46 /100ml, taken from Squaw Creek at the Camp Polk road (USFS unpub. data). The maximum allowed *E. coli* counts is 126/100ml by state standards for contact recreation. More data is needed to define the range of bacteria and if Indian Ford Creek meets state standards.

Turbidity is not a concern in the waters of this analysis area. All recorded measures show low turbidity **(Table WQ- 5)**. Squaw Creek has short events of high turbidity from glacial runoff in the late summer. At times, sudden changes in the turbidity can result from some washout or collapse of moraines or cinder deposits at the base of the Three Sisters or Broken Top.

The pH of streams considered here were generally in the range of 6.8 to 8.0. Some measurements of Pole Creek were high and ranged up to 9.0 at the 1514 Rd.

Native fish diversity and distribution can reflect water quality and habitat conditions. Redband trout are native to the area and are found throughout Squaw Creek, Trout Creek, Indian Ford Creek and Snow Creek. Sculpin, longnose dace, and bridgelip suckers are found the lower portions of Indian Ford and Squaw Creek. Mountain whitefish and bull trout are only found in Squaw Creek below Alder Springs **(Table WQ-6)**. **See Aquatic Species section.**

Introduced fish include brook trout, brown trout, and kokanee salmon. Brook trout are found in the high lakes where they have been stocked since the 1920's. Brook trout are found throughout much of Squaw Creek, Park Creek, and Three Creek while brown trout are found in the lower portions of Squaw Creek. Kokanee salmon, from Lake Billy Chinook, migrate into the Deschutes River and spawn in Squaw Creek, near Alder Springs.

Table WQ-6. Fish community currently found in the Why-chus watershed.

Fish Species	**Squaw Creek**			**Indian Ford Creek**	**Pole Creek**	**Snow Creek**	**Park Creek**	**Trout Creek**	**Three Creek Lake**
	U/S of SCID	SCID to Alder Springs	D/S of Alder Springs	D/S of Camp-ground					
Anadromous Fish									
Redband Trout	X	X	X			X		X	
Mountain Whitefish			X						
Bridgelip Sucker		X							
Sculpin	X	X	X						
Longnose Dace		X							
Kokanee			X						
Bull Trout			X						
Hatchery Rainbow		X							X
Brook Trout	X	X					X		X
Brown Trout		X	X						

U/S = Upstream
D/S = Downstream
SCID = Squaw Creek Irrigation District

There are two sightings of tailed frogs in the watershed (Natural History Database). One is in the head springs of Indian Ford Creek and another is in the interface between the ditch and Three Creek Lake. These sightings may need some confirmation but may indicate cold water habitats.

Macroinvertebrate sampling has been conducted to monitor aquatic integrity on Indian Ford Creek and Squaw Creek (**Table WQ-7**)(Vinson 1995). Indian Ford Creek showed indications of a limited invertebrate community with low diversity, probably due to a sandy substrate and open canopy. Stonefly richness, or the number of taxa of stoneflies found, may be increasing in Indian Ford Creek south of Hwy 20. Many stoneflies need colder water and an increasing number of stoneflies may suggest improvements in water quality. The limited sampling of Squaw Creek at the USGS gauge showed low abundance, but good diversity.

Table WQ-7. Aquatic marcoinvertebrate community summary for Squaw Creek and Indian Ford Creek (Wisman 1992) (Vinson 1995, 1996, 1997).

Stream	Year	Location	EPT Richness	Stonefly Richness	Total Richness
Indian Ford Cr	1991	D/S Glaze Allotment	6	3	25
	1992	D/S Glaze Allotment	28	3	49
	1994	D/S Glaze Allotment	10	3	30
	1996	D/S Glaze Allotment	15	5	30
	1996	Black Butte Ranch	9	4	22
Squaw Cr	1990	USGS Gauge	13	5	30

Table WQ-8. Measures of sediment and streambank conditions in the watersheds studied.

Stream	Reach	Pebble Count % Fines < 6.4mm	Percent Stable Streambanks
Squaw	1	28	87
	2	22	93
	3	14	98
	4	13	94
	5	10	93
	6	22	97

Stream	Embeddednes s >35%
Indian Ford	Yes
W.F. Park	No
Pole	No
Trout	No

Sediment is a concern because trout and invertebrates are more productive in systems with low fine sediment. The spaces between gravel and cobbles are living space for juvenile fish and the invertebrates on which they feed. Pebble counts conducted on Squaw Creek showed a slight trend toward higher fines with decreasing stable streambanks (**Table WQ-8**). Reach one and two were channelized by the Army Corps of Engineers and showed the highest levels of fine sediment in recent surveys (Dachtler 1997). Indian Ford Creek was the only other stream that was rated at greater than 35% embedded gravel. Fine sediment in Indian Ford Creek was also found to be a limiting factor for macroinvertebrate community.

Steam channel condition can influence water quality through processes that involve flow, sediment, and channel shape. As reviewed in the Physical Stream Habitat section, stable streambanks are important to sediment budgets of the stream. Squaw Creek has up to 13% unstable streambanks in the channelized reaches. Other stream reaches had nearly half of the unstable banks (Dachtler 1997). The ratio of the stream bankfull width to its depth can affect stream temperature, sediment transport, and fish habitat. Generally, the streams examined have good width to depth ratios (**Table WQ-9; see Physical Stream Habitat section**). Squaw Creek is below the regional medians for width to depth because of the loss of meanders, riparian vegetation, and flow. Poor streambank stability and low summer flow may be leading to increased fine sediment from bank erosion in the flats near Sisters.

Although most streams had more wood than the regional average, most streams fell short of regional medians for pool frequency (see Physical Stream Habitat section). In the case of Squaw Creek, pools have been reduced in the channelized section from historic condition. However, the same section offers more pools than the high gradient reaches upstream. With the swift nature of most streams in the area, pools are important holding and rearing habitat for fish.

Table WQ-9. Stream habitat characteristics measured during stream surveys.

Stream	Bankfull width to depth ratio	Pools/ Mile (ft)	Residual pool max depth	Large wood/ Mile >12in dia
Squaw Creek	13 - 26	4 – 16	1.9 - 3.0	11 – 48
Three Creek	4 - 7	4 - 9	3.3 – 4.1	1 – 29
West F. Park Cr.	-	<1	2	78
Snow Creek	5 – 7	4 – 16	1.3 –1.6	23 – 178
Pole Creek	2 – 3	20 - 26	1.5 – 1.7	151 –175
Trout Creek	6 – 13	24 - 33	1.1 – 1.8	115 – 128
Indian Ford Cr.	-	3	1	43

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

The fundamental water quality issue is low stream flows in Squaw Creek and Indian Ford Creek. Related issues are the loss of riparian vegetation in both streams and channel stability in Squaw Creek. In Squaw Creek, the loss of flow and channelization may have led to the loss of riparian vegetation and less stable streambanks. The low flows are directly related to higher water temperatures. The loss of riparian willows and cottonwoods on both streams may lead to additional thermal loading. Higher temperatures lead to lower dissolved oxygen and high rates of bacteria growth. Removal of willows along Indian Ford Creek and intensive grazing can increase water temperature and bacteria. Discharge of effluent from Black Butte Ranch in the winter needs more assessment of effects.

These changes have led to a decline in the quality of habitat for some invertebrates and fish. Historically, bull trout may have ranged farther upstream into the upper portions of Squaw Creek. Summer steelhead and spring chinook salmon are now excluded from the watershed due to dams on Deschutes River. Non-native species, such as brown trout and brook trout, now have a niche in the system. Native fish, such as sucker, sculpin, and long nose dace, can use warmer stream temperatures and may now range farther upstream in Squaw Creek and Indian Ford Creek than historically.

With increasing demand for more land development, there is an increasing demand for water resources. An opportunity now exists to work with land use changes to benefit the stream. As agricultural uses change to residential uses, surface water rights may be traded for groundwater well rights. Any increases of instream flow in Squaw Creek will increase water quality and habitat for aquatic life.

TREND SUMMARY

- Stream flows are reduced.
- Water temperatures have increased threatening fish and invertebrate habitat.
- Channel stability is decreasing.

See **Trend Table** in **Synthesis Section** for more information.

Biological Domain

"All you could see were the stems of those great big pines, they called them "yellow bellies". And there wasn't a lot of undergrowth. So those forests were open and wonderful and you could see through them."

Becky Johnson (Mrs. Sam)

"Theres been drastic changes all the way down. There's fewer deer, fewer coyotes, fewer cougar, fewer bobcats, practically no bear, and the wolves are gone. I've seen 2 wolves in my time, in the 1930's."

"We had a few Bull Trout or Dolly Varden as we called them. We used to catch the small ones. I remember 2 big ones that cleaned all the fish out behind what was then the Cloverdale dam."

"I don't deny there could be some big trout in Squaw Creek coming up from the irrigation pond. I think that's a possibility. So if somebody says I don't know what I'm talking about, why they may be right from the standpoint that I didn't ever catch up with them."

Jess Edgington

" I never saw any salmon on Squaw Creek but someone got an octopus once. That stirred everybody up." Homer Shaw

Biological Domain- Forest Vegetation

INTRODUCTION

The Why-chus Watershed Analysis area is located in the High Cascades Province and on the edge of the High Lava Plains Province on the eastern slope of the Cascade Mountains (Franklin and Dyrness, 1973). Forested lands in this area include associations climax to western juniper, ponderosa pine, Douglas-fir, lodgepole pine, white fir, Engelmann spruce, subalpine fir, pacific silver fir and mountain hemlock. Vegetation in the Deschutes National Forest varies in response to several environmental gradients, including a precipitation gradient, from the Cascades eastward to the desert-forest ecotone, an edaphic gradient in Mazama pumice deposits, north and east from Crater lake, and micro-climate gradients associated with local changes in topography (Volland, 1985). At least 53 forested and non-forested plant associations have been mapped in this watershed analysis area.

Knowledge of the vegetative structure, composition, and density in the analysis area is a critical factor in evaluating the historic and existing physical, biological, and social processes occurring in this area. The quality of most of the processes is directly related to the structure, composition, and density of the vegetation where those processes take place. Vegetative structure, composition, and density are a function of climate, topography, disturbance events, succession, seed availability, newly introduced species, time, social values, and economics. Climate and topography remain fairly constant over time compared with the other processes mentioned. Disturbance events include insect attacks, disease infestations, wind, storms, fire, and management and recreational activities of people. Human activities are influenced by social values and economic needs and desires.

There are three major vegetation trends that apply to all plant associations in the watershed:

- Greatly increased stand densities are putting all sizes of trees at risk.
- Species composition has been shifting from early to late seral species.
- Stand structure has been shifting from larger tree sizes to smaller tree sizes, and from single or two canopy-layers to multi-canopy-layers.

Patterns of Vegetation--Plant Association Groups (PAGs)

What is the array and landscape pattern of plant communities and seral stages in the watershed (riparian and non-riparian)? What processes caused these patterns (e.g., fire, wind, mass wasting)?

This section contains an introduction to the vegetation found in the watershed. It contains discussions and analyses of potential natural vegetation, the natural disturbance processes that influence vegetation, human caused changes through active management, and historic and current conditions relating to size and structure, canopy cover, species composition, stand density, mortality, and habitat patterns and conditions across the landscape.

A discussion of the natural range of variability and sustainable conditions in the watershed sets the stage for more specific discussions on current and historic vegetation conditions and trends in each plant association group.

Potential Natural Vegetation

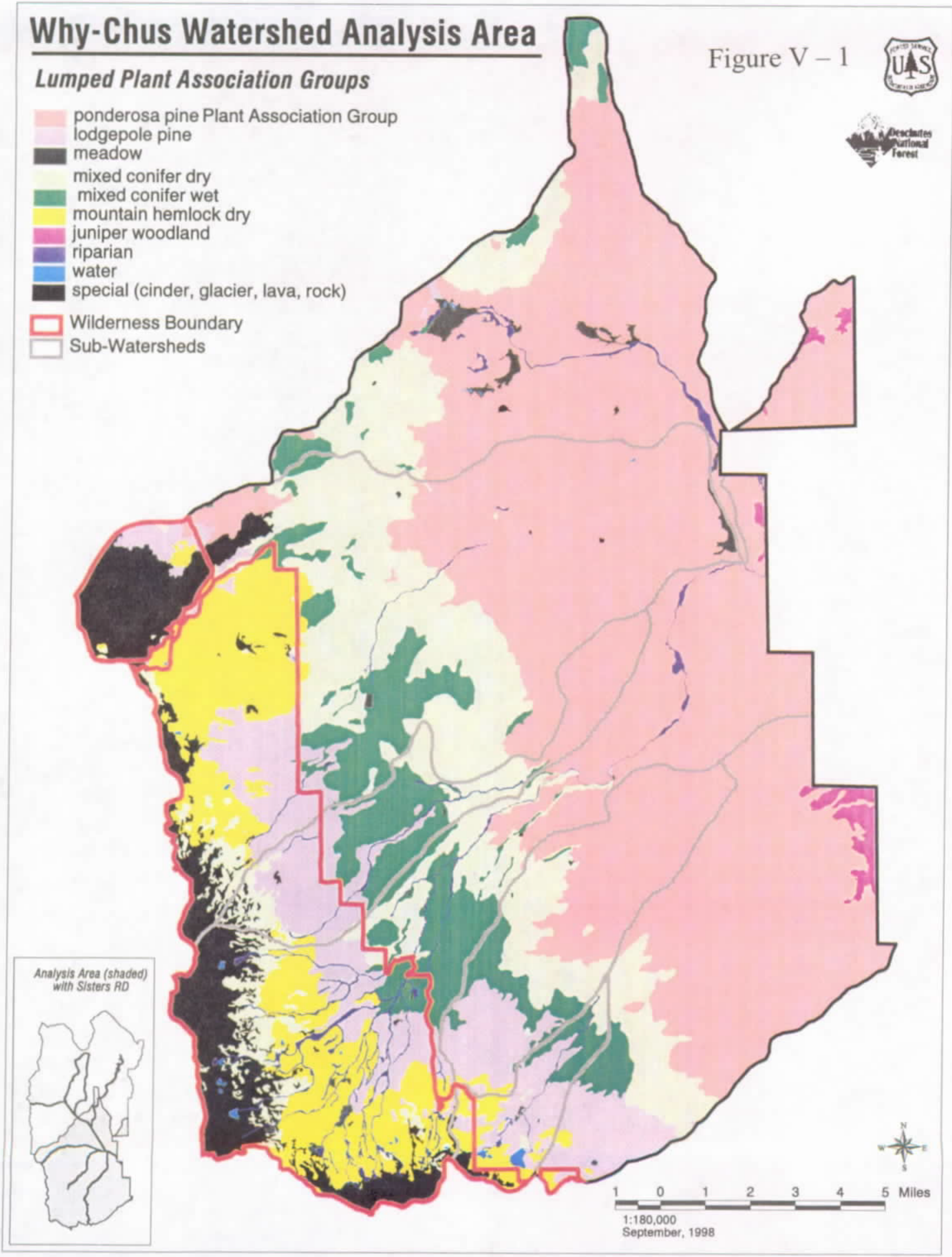
Potential natural vegetation is the vegetation that would be expected to be established on a given site in the absence of disturbance. Field mapping of the potential natural vegetation (PNV) to the plant association level was done by service contract according to Volland (1985), with considerable input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

Plant Association Group (PAG) Formation

Plant associations were grouped by climax species, site potential, and temperature and moisture similarities into plant association groups (PAGs) using the categories listed in the Deschutes WEAVE document, version 1.12. PAGs were then further combined into lumped plant association groups (LPAGs). **Table V-1** summarizes PAGs and LPAGs for the entire watershed and **Map V-1** displays the LPAGs.

Table V-1. *Plant Association Groups (PAGs) for the Why-chus Watershed Analysis Area.*

PLANT ASSOCIATION GROUPS (PAGs) SUMMARIZED FOR THE ENTIRE WHY-CHUS WATERSHED ANALYSIS AREA					
PLANT ASSOCIATION GROUPS (PAGs)			LUMPED PAGS FOR ANALYSIS (LPAGs)		
PAG	Code	ACRES	LPAG	ACRES	PERCENT OF THE WATERSHED
Ponderosa Pine Dry	PPD	73,695	Ponderosa Pine	78.335	44%
Ponderosa Pine Wet	PPW	4,640			
Mixed Conifer Dry	MCD	33,351	Mixed Conifer Dry	33,351	19%
Lodgepole Pine Dry	LPD	1,647	Lodgepole Pine	16.927	10%
Lodgepole Pine Wet	LPW	15,280			
Mountain Hemlock Dry	MHD	16,019	High Elevation, Mt. Hemlock	16,019	9%
Mixed Conifer Wet	MCW	15,578	Mixed Conifer Wet	15,578	9%
Cinder	CINDER	3,639	Special (Non-Forest)	12.306	7%
Glacier	GLACIE	1,068			
Lava	LAVA	4,540			
Rock	ROCK	3,059			
Riparian	RIP	2,593	Riparian	2,593	1%
Juniper Woodlands	JUN	1,365	Juniper Woodlands	1,365	1%
Alpine Meadow	AMDW	38	Meadow (Non-Forest)	1.120	1%
Meadow	MDW	1,082			
Water	WATER	235	Aquatic (Non-Forest)	235	<1%
GRAND TOTALS		177,829		177,829	100%


Why-Chus Watershed Analysis Area
Lumped Plant Association Groups
Figure V – 1
ponderosa pine Plant Association Group
lodgepole pine
meadow
mixed conifer dry
mixed conifer wet
mountain hemlock dry
juniper woodland
riparian
water
special (cinder, glacier, lava, rock)
Wilderness Boundary
Sub-Watersheds
Deschutes National Forest
Analysis Area (shaded) with Sisters RD
1 0 1 2 3 4 5 Miles
1:180,000
September, 1998

The climax species would be the dominant species if little or no disturbance occurred, and in most cases, except in ponderosa pine and lodgepole pine plant associations, other species would dominate after a disturbance event. These PAGs also respond in different ways to disturbance events such as fire and insects and provide different habitat characteristics for wildlife.

Grouping plant associations simplifies prediction, comparison, and analysis of potential disturbance patterns and the resulting successional pathways, vegetation size, structure, density and species composition, as well as, terrestrial wildlife species composition, and habitat conditions over time in different areas of the forest.

Plant associations vary due to a combination of environmental conditions. Elevation, precipitation, soils, and aspect seem to be major influences. In the watershed analysis area, elevation ranges from 2980 feet in Fremont Canyon at the northeast fringe of the watershed to 10,350' at the top of the South Sister in the Three Sisters Wilderness. Precipitation ranges from 90 to 100+ inches of annual precipitation in the far western portion of the watershed (Cascade Crest) to 10 to 15 inches in the eastern portion.

The ponderosa pine plant associations cover more acres in the watershed (44%) than any other plant association group. These associations are found primarily in the flatter eastern half of the analysis area from the lower slopes of Black Butte to the southern boundary of the Sisters Ranger District. In general, the weather in these areas is warmer and drier than the rest of the watershed. Ponderosa pine is the dominant species but white fir is increasing in the western higher and/or wetter mixed conifer/ponderosa pine ecotone areas due to fire exclusion and adjacent seed sources. The dry and wet ponderosa pine associations constitute 94% and 6% of the ponderosa pine associations, respectively or 41% and 3% of the watershed, respectively. The wetter ponderosa pine associations are found in the western portions of the PP LPAG in areas of higher site potential.

The mixed conifer dry and wet LPAGs cover 19% and 9% of the watershed, respectively. The dry mixed conifer LPAG is composed of the low to moderate productivity white fir series and the wet mixed conifer LPAG is composed of the high productivity white fir series and the Douglas-fir series. The wet associations are found on the moister, higher productivity sites. The dominant climax species in these associations are white/grand fir and Douglas-fir. In these associations, ponderosa pine, lodgepole pine, Douglas-fir, incense cedar, and larch may all be early seral species.

The lodgepole pine LPAG associations are found in high elevation areas with poor cold air drainage and in lower elevation frost pockets and/or in areas with poor soil drainage. These associations are found on approximately 9% of the watershed area and 78% of these acres are located in wilderness or roadless areas.

The high elevation/mountain hemlock LPAG is found at the higher elevations where the sites are coldest and wettest. This LPAG comprises approximately 9% of the watershed and 96% of these acres are located in wilderness or roadless areas. In the Mt. Hemlock series, lodgepole pine is the major seral species, common in areas that have had fires in the past 100 years. Areas that have not experienced fires in the past 100 years are dominated by mountain hemlock, subalpine fir, and pacific silver fir.

LPAGs that are special habitats include riparian, meadow, and juniper woodland LPAGs and constitute approximately 3% of the watershed or approximately 1% each.

Non-forested areas including cinder, glacier, lava, and rock constitute 7% of the watershed with 98% of these acres located in wilderness or roadless areas. Most of the acres in the wilderness are located above tree line around the peaks of the Three Sisters Mountains. Aquatic/Water, primarily in and adjacent to the wilderness, represents <1% of the watershed.

A summary of LPAGs by sub-watershed is found in **Table V-2.**

Table V-2. Summary of LPAGs by Subwatershed.

LUMPED PLANT ASSOCIATION GROUPS (LPAGs) SUMMARIZED BY SUBWATERSHED								
	SUBWATERSHED							
LPAG	**Indian Ford**	**Melvin**	**Pole**	**Squaw**	**Three Creek Butte**	**Three Creek Lake**	**Trout**	**TOTALS**
Ponderosa Pine	11%	4%	1%	8%	10%	---	10%	44%
Mixed Conifer Dry	3%	1%	1%	3%	2%	<1%	8%	19%
Lodgepole Pine	<1%	1%	2%	2%	1%	1%	2%	10%
High Elevation, Mt. Hemlock	---	<1%	<1%	4%	<1%	1%	4%	9%
Mixed Conifer Wet	1	1%	2%	2%	<1%	<1%	3%	9%
Special	<1%	<1%	<1%	3%	---	<1%	3%	7%
Riparian	<1%	---	<1%	1%	---	<1%	<1%	1%
Juniper Woodlands	---	---	---	<1%	1%	---	---	1%
Meadow	<1%	---	---	<1%	<1%	<1%	<1%	1%
Aquatic	<1%	---	---	<1%	---	<1%	<1%	<1%
TOTALS	16%	7%	6%	23%	14%	3%	31%	100%
TOTALS ACRES	28,248	13,131	10,662	40,743	25,219	4,466	55,360	177,829

GENERAL DESCRIPTIONS AND COMPARISONS OF CURRENT AND HISTORICAL VEGETATION CONDITIONS

Vegetation in this watershed has been categorized into simple, general, discrete categories in order to identify general trends in size/structure, species composition, tree densities, canopy cover, potential old growth and mortality related to natural/historical range of variability and sustainability. Vegetation within the watershed is actually very complicated and, in most cases, vegetation that has been lumped into simple, discrete categories actually is composed of extreme variability (especially the current condition), that is found in a continuum across the landscape. For example, stands categorized as dominated by small trees (9"-21" dbh) can actually range from pure single story stands of small trees to multi-storied stands with 2 or more layers above and below the dominant (small) size class.

What is the historical array and landscape pattern of plant communities and seral stages in the watershed (riparian and non-riparian)? What processes caused these patterns (e.g., fire, wind, mass wasting)?

What are the current conditions and trends of the prevalent plant communities and seral stages in the watershed (riparian and non-riparian)?

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 (e.g., hydrologic maturity, channel stability, shade, disturbance, species movements, soil and erosion processes)?

HISTORIC CONDITIONS

The historic or reference condition of vegetation across the Why-chus watershed was developed using known information and anecdotal information. Known information comes from photo interpretation of 1953 aerial photos (County Timber Type Maps). Anecdotal information comes from land surveyors notes from 1870-1902, Forest Conditions in the Cascade Range Forest Reserve Oregon (1903), historic photos and the Samuel Johnson archives.

The Cascade Forest Reserve (CFR) was established in 1893 and was the precursor to the Forest Service. At the time of establishment, the CFR represented 67% of the watershed while private lands represented 33% of the watershed. The CFR was located west of the east boundary of Range 9 East (all townships) and private lands were located east of this boundary. Over the course of the next 75 years, ownership within the watershed has changed through land exchanges and public (Forest Service) land now encompasses 75% of the watershed, an increase of 8%, while private lands encompass 25% of the watershed.

At the time of establishment of the CFR, very little, if any, timber harvesting had taken place in the watershed. However, by the 1920s, timber harvest on private lands in the eastern portion of the watershed had begun and most of this land was harvested by 1953. Timber harvest on the public lands within the boundaries of the Cascade Forest Reserve generally did not begin until after World War II (1947) and was not under taken in earnest until after 1953. Fire suppression in the watershed began in approximately 1910.

Current Conditions

The current condition of vegetation across the Why-chus watershed was developed using the following sources of information: photo-interpretation of 1995 aerial photos, recent stand exams (1996 and 1997), and local knowledge/expertise. Photo-interpretation (PI) was completed for the entire analysis area, including wilderness and private lands. PI work included delineating landscape components into homogeneous landscape units/polygons/stands. Each polygon then was classified as forest or non-forest. Forest stands were then attributed by vegetation/canopy layer (up to 3) according to percent canopy cover, size class, and species composition. PI information was used to estimate size/structure, species composition, canopy cover, and potential old growth. Stand exams covered approximately 20,000 acres in 767 stands or 11% of the watershed. Stand exam information was used to estimate/characterize stand densities and tree mortality.

Tree Size and Stand Structure

Size and Structure were mapped from 1953 photo interpretation (County Timber Type Maps) and current information using primarily photo interpretation of 1995 photos. The historic condition is characterized by using 1953 information from only the portion of the watershed located within the boundaries of the old Cascade Forest Reserve (CFR). The CFR is assumed to replicate the historical condition because in 1953 very little of this portion of the watershed had been harvested. The 1953 condition is the condition of all the acres in the watershed in 1953, not just the CFR portion as in the historic condition. The present condition is derived strictly from photo interpretation of 1995 aerial photos. Stands were classified to size class/structure based on the size class with the dominant canopy cover. A comparison between current size and structure for the historic condition, the 1953 condition, and the present condition is shown in **Table V-3** and displayed in **Map V-2 and Map V-3.**

Table V-3. Size and Structure Class.

SIZE / STRUCTURE CLASS	YEAR / TIMEFRAME			Change to Present	
	Historic*	1953**	Present**	Historic*	1953**
Percent of Watershed Acres					
Unclassified	7%	5%	6%		
Non-Forest	13%	12%	11%		
Forested	80%	83%	83%		
Percent of Classified Forested Acres***					
Grass / Forb / Shrub	<1%	1%	0%	0%	-1%
Seedling / Sapling (<5")	---	1%	6%	+6%	+1%
Pole (5"-9")	14%	19%	18%	+4%	-1%
Small (9"-21")	16%	22%	65%	+49%	+43%
Medium / Large (21"+)	70%	58%	11%	-59%	-47%
TOTALS	100%	100%	100%		

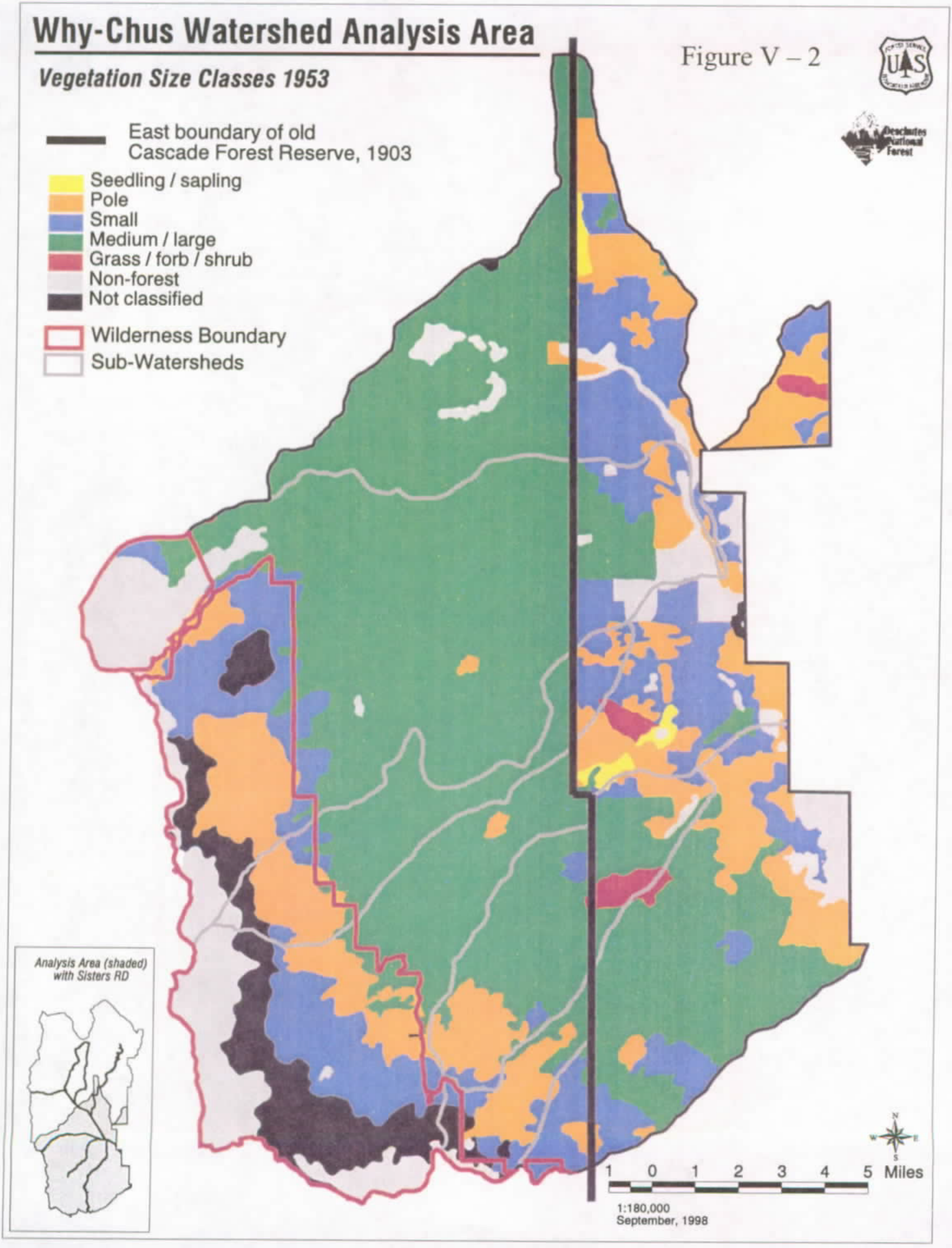
* Only includes acres that were within the boundaries of the old Cascade Forest Reserve from the 1953 data.
** Includes all acres in the Watershed.
*** Forested acres were classified by size class according to the size class with the dominant canopy cover.

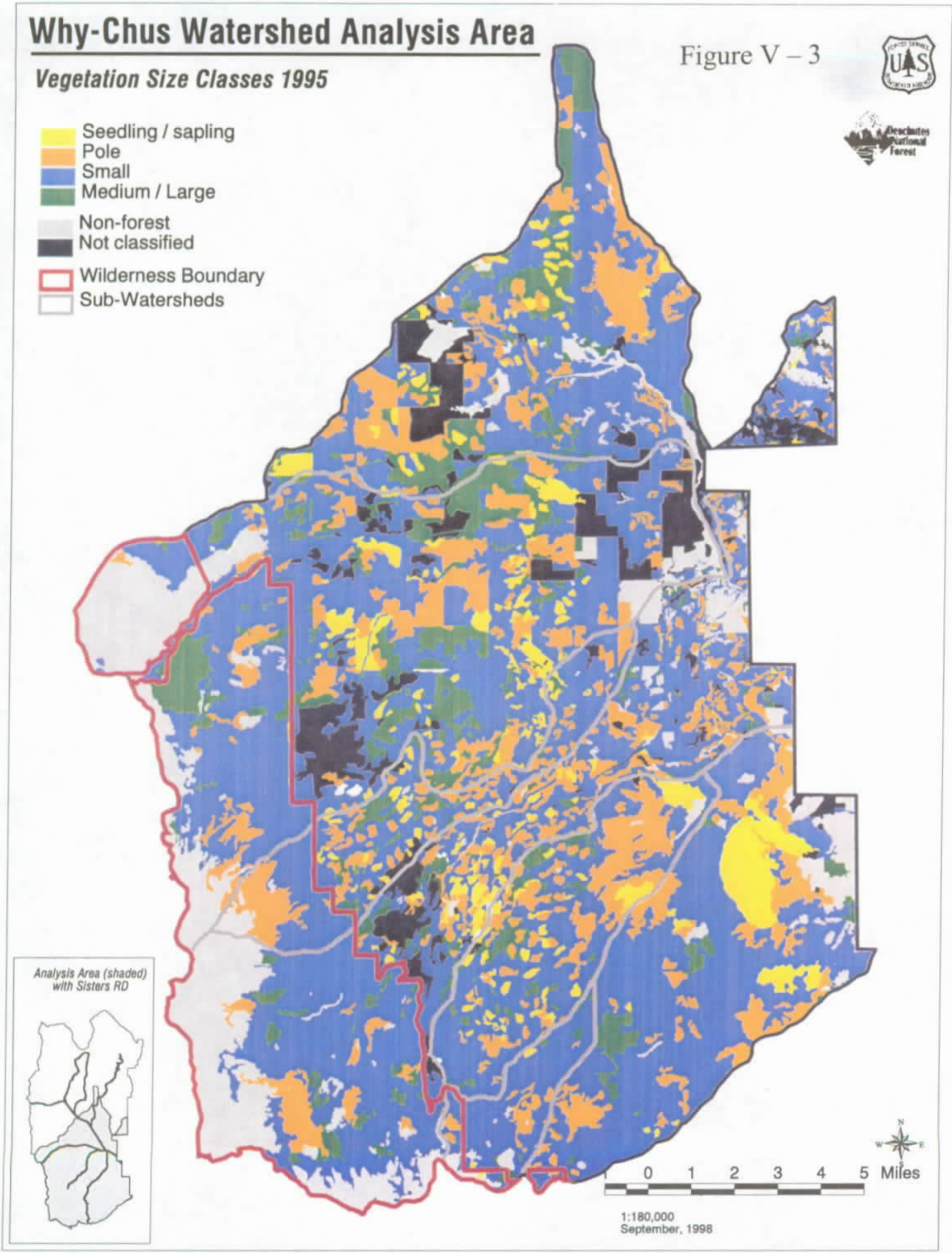
There have been dramatic shifts in size/structure class over the last 100 years from the historic condition to the present (1998). The most significant shift has been the decrease in the number of acres classified as medium/large size class and the increase in the small and the seedling/sapling and pole size classes. The acres dominated by medium/large trees under the historic condition have decreased from 70% to 11%. Acres dominated by small trees have increased from 16% to 65%. The acres dominated by the pole size class has increased from 14% to 18% while acres dominated by the seedling/sapling size class has increased from 0% to 6%.

The shifts in size/structure classes can be attributed primarily to harvesting a portion or all of the overstory component across most of the analysis area and to regeneration harvests on approximately 8% of the forested acres over the last 30-40 years. The exclusion of fire has also allowed a younger, smaller cohort to develop, which has contributed to the dramatic increase in the number of trees less than 21" dbh across the analysis area.

Potential Old Growth (POG)

Potential old growth (POG) for the watershed was estimated utilizing the photo interpretation data from 1995 aerial photos. Region 6 interim old growth definitions (USDA Forest Service, 1993) were used to classify potential old growth stands for the ponderosa pine series, grand fir/white fir series and lodgepole pine series. For each series, the interim old growth definition contains 6 attributes that are used to assess and classify old growth. For this analysis, only 1 attribute, "number of large trees per acre", was utilized. Consequently, because only 1 of the 6 old growth attributes was used, stands that have the minimum number of large trees per acre to qualify as old growth are labeled ***potential*** old growth. Actual old growth should be specifically identified on a project by project basis. The number of large trees per acre was estimated for each stand using percent canopy cover as a surrogate for large trees per acre. The old growth definition for mountain hemlock was not published in the Region 6 interim old growth definitions and was not available at the time of this analysis and there was not an old growth definition developed for the riparian vegetation series. Therefore, the old growth definition for the white fir series was used to identify potential old growth in the riparian and mountain hemlock series (High


Why-Chus Watershed Analysis Area
Vegetation Size Classes 1953
Figure V – 2
East boundary of old Cascade Forest Reserve, 1903
Seedling / sapling
Pole
Small
Medium / large
Grass / forb / shrub
Non-forest
Not classified
Wilderness Boundary
Sub-Watersheds
Analysis Area (shaded) with Sisters RD
1 0 1 2 3 4 5 Miles
1:180,000
September, 1998
Deschutes National Forest



Why-Chus Watershed Analysis Area
Vegetation Size Classes 1995
Figure V – 3
Seedling / sapling
Pole
Small
Medium / Large
Non-forest
Not classified
Wilderness Boundary
Sub-Watersheds
Deschutes National Forest
Analysis Area (shaded) with Sisters RD
0 1 2 3 4 5 Miles
N
W
E
1:180,000
September, 1998

Elevation LPAG). **Table V-4** displays the attributes used to classify potential old growth and **Table V-5** displays the percent of the forested acres estimated to be potential old growth by LPAG and 5th field watershed. **Map V-4** displays the potential old growth in the Why-chus watershed.

Table V-4. *Attributes used, by LPAG, to estimate* ***Potential*** *Old Growth for the Watershed.*

LUMPED PLANT ASSOCIATION GROUP (LPAG)	OLD GROWTH ATTRIBUTES		
	Tree Size (DBH)	Approx. Number Trees/ Acre	Aerial Photo Percent Canopy Cover
High Elevation*	21"+	15+	15%+
Lodgepole Pine	9"+**	60+	15%+
Mixed Conifer Dry	21"+	15+	15%+
Mixed Conifer Wet	21"+	15+	15%+
Ponderosa Pine	21"+	10+	10%+
Riparian	21"+	15+	15%+

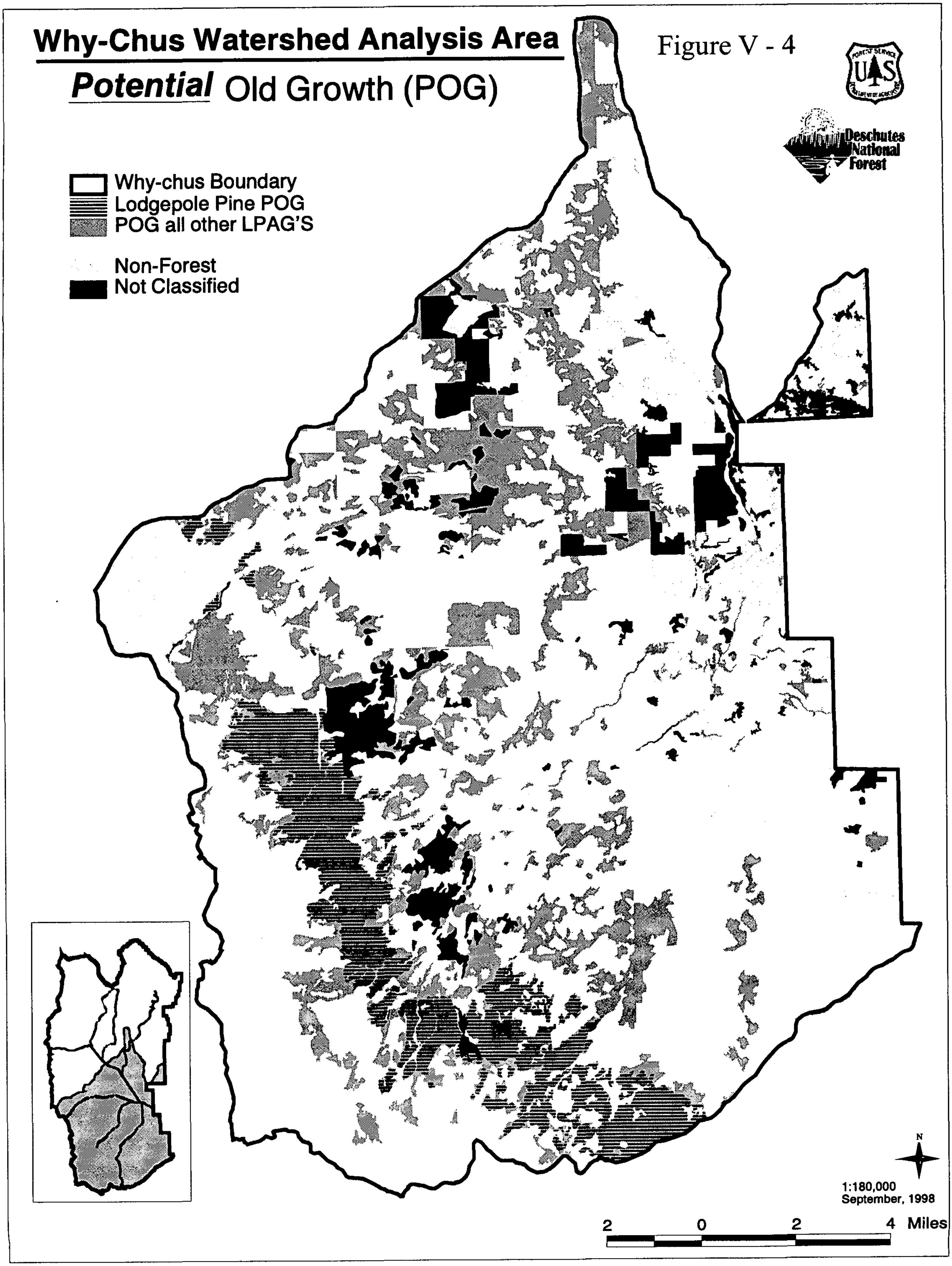
* The old growth definition for mountain hemlock was subsequently obtained after this analysis was completed and this definition identified 10 or more trees per acre for potential old growth in this series. Consequently, this analysis under estimates the amount of potential old growth for the mountain hemlock series.

** Tree size for the lodgeple LPAG was reduced from 12" to 9" based on advice from Hopkins (1998).

Table V-5. *Estimate of* ***Potential*** *Old Growth by LPAG and 5th Field Watershed.*

LUMPED PLANT ASSOCIATION GROUP (LPAG)	FIFTH FIELD WATERSHED			
	Indian Ford Creek	Squaw Creek	Three Creek	TOTALS
Percent of Total Forested Acres				
High Elevation	17%	10%	1%	29%
Lodgepole Pine	21%	29%	32%	83%
Mixed Conifer Dry	15%	2%	5%	22%
Mixed Conifer Wet	12%	13%	5%	30%
Ponderosa Pine	13%	2%	3%	18%
Riparian	---	12%	---	12%
TOTALS	33%	25%	25%	29%

In summary, approximately 29% of the classified forested acres in the watershed were identified as potential old growth when considering only trees/acre over a minimum dbh. All the LPAGs, except the lodgepole pine LPAG, have varying amounts of potential old growth ranging from 12% in the riparian LPAG to 30 % in the mixed conifer wet LPAG. Approximately 83% of the lodgepole pine LPAG was identified as potential old growth. This represents approximately 33% of the total potential old growth in the watershed. Due to its inherent instability, the condition of lodgepole pine old growth tends to be a relatively short-lived, ephemeral condition. Consequently, the amount of lodgepole pine old growth is expected to change significantly within a fairly short time frame, perhaps within 20-30 years or sooner, primarily through the mountain pine beetle as the disturbance agent.


Why-Chus Watershed Analysis Area
Potential Old Growth (POG)
Figure V - 4
Deschutes National Forest
Why-chus Boundary
Lodgepole Pine POG
POG all other LPAG'S
Non-Forest
Not Classified
N
1:180,000
September, 1998
2 0 2 4 Miles

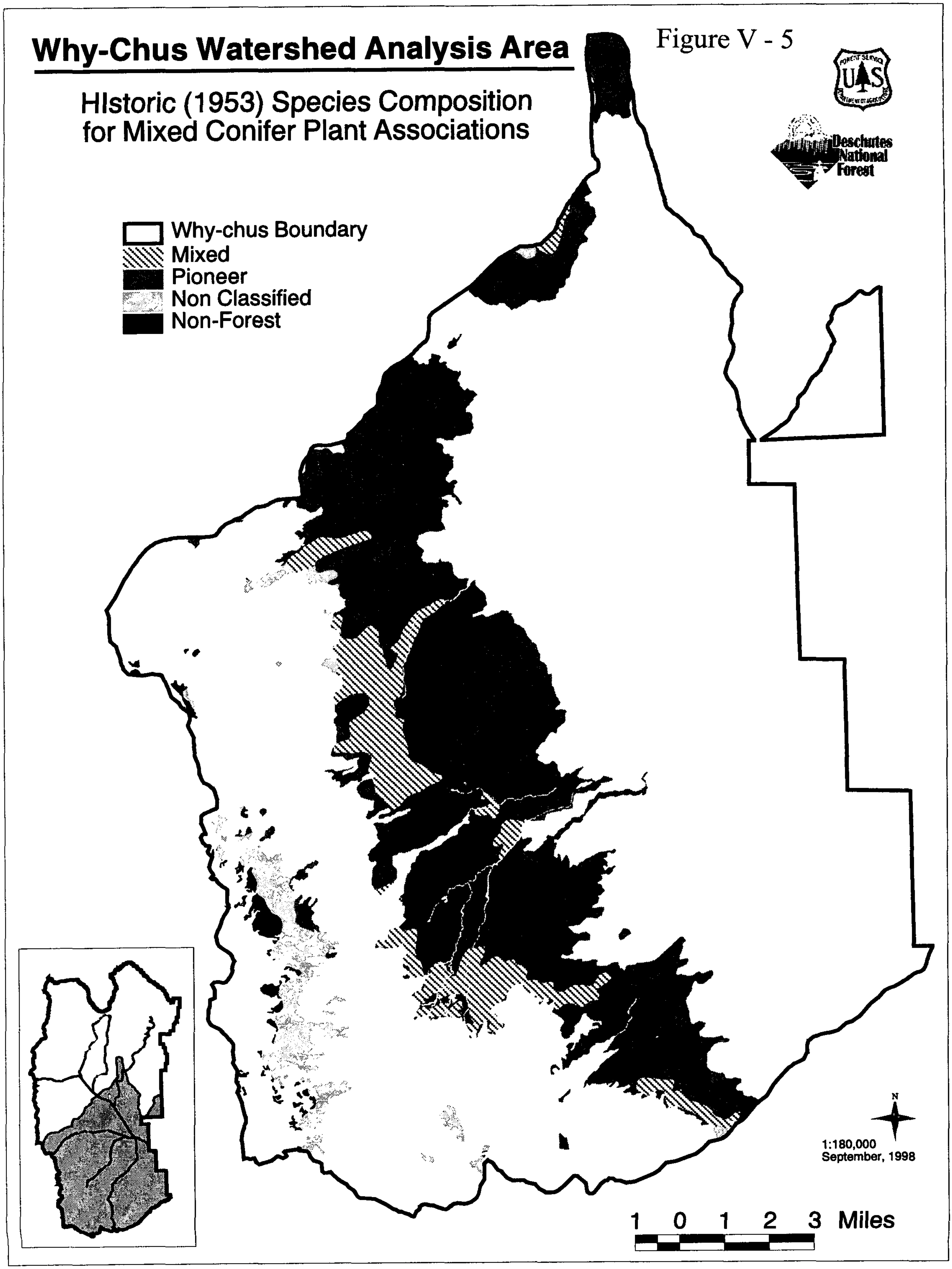
SPECIES COMPOSITION

The most dramatic changes in species composition have occurred in the mixed conifer (dry and wet) plant associations. In these plant associations, the acres dominated by ponderosa pine have decreased significantly while the acres dominated by white fir have increased significantly. These increases and decreases could have been more significant if of the acres of mixed conifer associations (approximately 15%) had not been regeneration harvested and reforested to early seral species, primarily ponderosa pine, over the last 30 years.

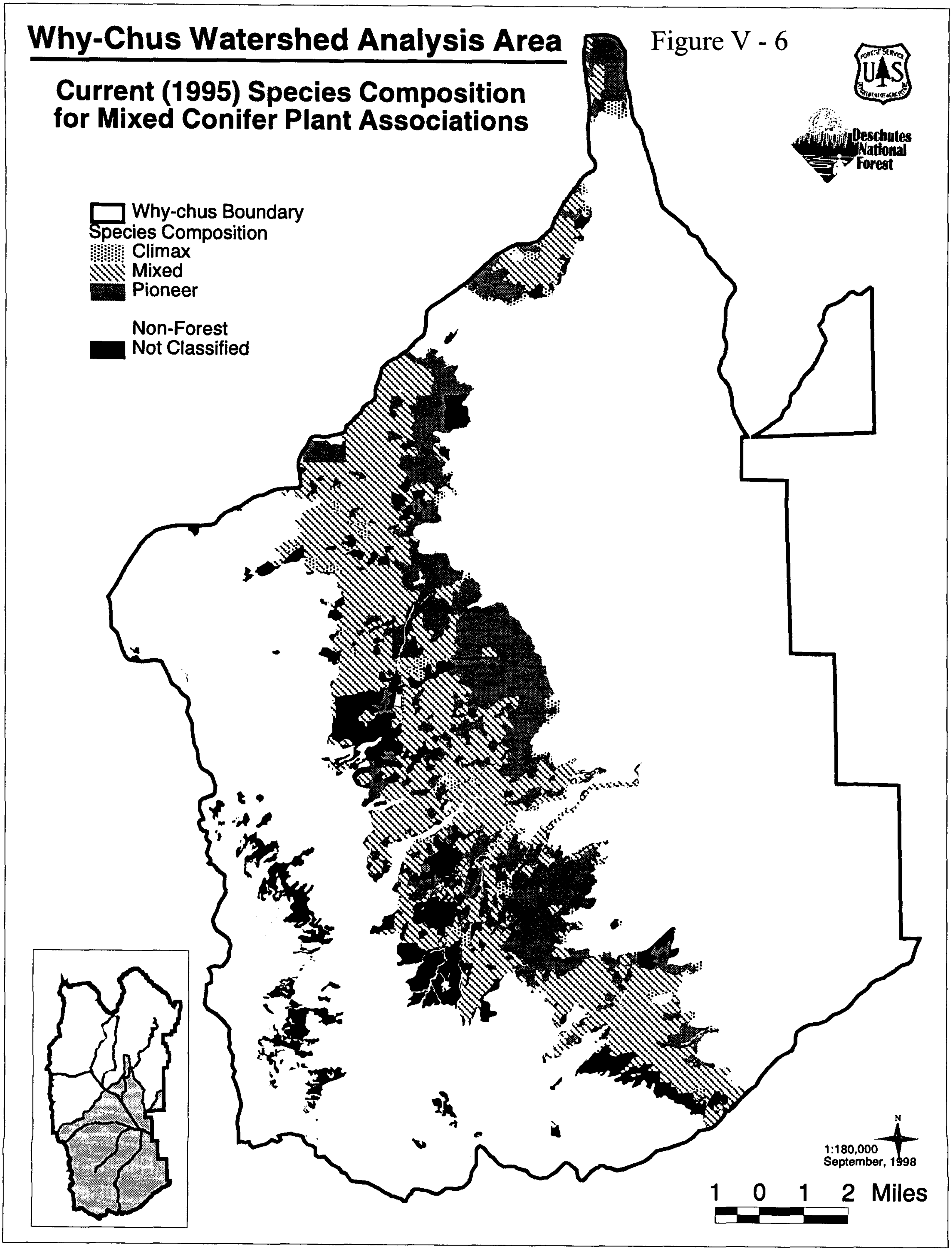
In general, these dramatic shifts in species composition that have occurred in the mixed conifer plant associations can be attributed primarily to the exclusion of fire which allowed the shade tolerant, fire intolerant white fir to reproduce and grow successfully to the exclusion of the early seral species such as ponderosa pine, and to the selective harvest of the early seral species (i.e., ponderosa pine) overstory component. **MapsV-5** and **V-6** display the species composition for the historic (1953) and current conditions (see the Mixed Conifer Dry section for explanation of pioneer, mixed, and climax).

There have also been species composition changes in the other LPAGs but these changes are not as significant as in the mixed conifer and riparian LPAGs. In ponderosa pine associations, especially at the lower elevations, western juniper has become a significant component on 17% of the acres. This can be attributed primarily to the exclusion of fire which allowed this fire intolerant species to become more prevalent today than historically. In lodgepole pine and high elevation mountain hemlock associations, fire has also been excluded and true fir and mountain hemlock are becoming well established on a number of acres.

See specific mixed conifer LPAGs for more detail.



Why-Chus Watershed Analysis Area
Figure V - 5
HIstoric (1953) Species Composition
for Mixed Conifer Plant Associations
Why-chus Boundary
Mixed
Pioneer
Non Classified
Non-Forest
Deschutes
National
Forest
N
1:180,000
September, 1998
1 0 1 2 3 Miles


Why-Chus Watershed Analysis Area
Figure V - 6
Current (1995) Species Composition for Mixed Conifer Plant Associations
Why-chus Boundary
Species Composition
Climax
Mixed
Pioneer
Non-Forest
Not Classified
Deschutes National Forest
N
1:180,000
September, 1998
1 0 1 2 Miles

CANOPY COVER

There are no historical records of canopy cover, but we can estimate that with lower densities maintained by frequent underburns in much of the watershed, historical canopy cover was lower than it is at present. Except in some of the budworm defoliated areas in mixed conifer stands to the west and north of Trout Creek Butte, canopy cover in current natural stands exceeds historical canopy cover levels. The thinned and regenerated stands are more representative of the lower canopy cover found historically in areas with frequent underburns, or in areas following stand replacement fires. **Table V-6** shows the percent distribution of acres by percent canopy cover group within each plant association group.

Table V-6. *Percentage Distribution of Acres by Percent Canopy Cover Class within Lumped Plant Association Groups.*

LUMPED PLANT ASSOCIATION GROUPS (LPAGs)	PERCENT CANOPY COVER					
	Not Classified	<10%	10-39%	40-59%	60-100%	TOTALS
Aquatic		100				100
High Elevation		1	43	24	32	100
Juniper Woodland	1	54	45			100
Lodgepole Pine	1	1	37	40	21	100
Meadow		100				100
Mixed Conifer Dry	3	6	58	26		100
Mixed Conifer Wet	17	3	34	25	20	100
Ponderosa Pine	3	13	71	13	1	100
Riparian	1	20	58	9	11	100
Special		98	2			100
TOTALS	3	16	53	19	9	100

Stand Densities

Stand densities were calculated for stand exams in plant associations for which a Upper Management Zone (UMZ - concept described by Cochran, 1994, also, see vegetation section titled "Sustainable Conditions") was established. **Table V-7** below shows the percent of stand examined acres in each PAG that are above and below the upper management zone (UMZ, i.e., above sustainable densities).

In summary, approximately 63% of the stand-examined acres in the watershed exceed the upper management zone and 73% of the mixed conifer dry acres exceed the UMZ. For ponderosa pine and mixed conifer wet LPAGs, the acres that are above UMZ are 64% and 45%, respectively. A very visible and current example of the consequences of trying to maintain densities above sustainable levels is the amount of mortality in the mixed conifer plant associations within the Cache Late-Successional Reserve and the Metolius watershed analysis areas to the north of the Why-chus watershed analysis area.

***Table V-7**. Percent of stand examined acres above and below UMZ for each LPAG.*

LUMPED PLANT ASSOCIATION GROUP (LPAG)	UPPER MANAGEMENT ZONE (UMZ) CLASS				
	Stand Exams with Established UMZ		Percent Stand Exam Acres		
	Acres	Percent LPAG Classified Forested Acres	Below UMZ	Above UMZ	Totals
High Elevation, Mountain Hemlock	0	0%	N/A	N/A	N/A
Lodgepole Pine	685	4%	40%	60%	100%
Mixed Conifer Dry	7,522	24%	27%	73%	100%
Mixed Conifer Wet	4,139	32%	55%	45%	100%
Ponderosa Pine	6,544	10%	36%	64%	100%
Riparian	0	0%	N/A	N/A	N/A
TOTALS	18,890	13%	37%	63%	100%
	TOTAL ACRES		6,926	11,964	18,890

Mortality

Tree mortality in the Why-chus watershed has on average been low. Two exceptions are the mixed conifer plant associations west of Trout Creek Butte to the northern boundary of the watershed and the lodgepole pine plant associations to the west of Three Creeks Lake in and around the Bear Wallows Roadless Area. In the mixed conifer associations, mortality is associated with the southern extent of the spruce budworm outbreak that occurred from 1985 to 1992. In the lodgepole pine area, mountain pine beetle is the likely causal agent. **Table V-8** below displays the levels of basal area mortality by PAG for the analysis area.

***Table V-8**. Percent of stand examined acres in each basal area mortality class for each LPAG.*

LUMPED PLANT ASSOCIATION GROUP (LPAG)	MORTALITY CLASS (Basal Area)*					Stand Exam Acres as a Percentage of the LPAG Classified Forested Acres
	Very Low <10%	Low 10%-29%	Moderate 30%-59%	High 60%+	Totals	
High Elevation, Mountain Hemlock	39%	57%	4%	---	100%	2%
Lodgepole Pine	31%	69%	---	---	100%	4%
Mixed Conifer Dry	53%	32%	12%	3%	100%	25%
Mixed Conifer Wet	40%	48%	10%	1%	100%	35%
Ponderosa Pine	90%	8%	2%	<1%	100%	10%
Riparian	53%	29%	18%	---	100%	5%
GRAND TOTALS	61%	30%	8%	1%	100%	14%
TOTAL ACRES*	12,276	5,934	1,565	286	20,061	

* Acreage's include all stands with a stand exam but does not include regeneration harvest units, non-forest areas or stands without a stand exam.

Mortality below 10% of the total stand basal area is considered normal, endemic levels of mortality. Considering all of the LPAGs within the Why-chus watershed, 39% of the stand examined acres have experienced elevated (>10%) levels of mortality with only 9% of the acres having significant mortality (>30%). The mixed conifer and riparian plant associations have experienced the most significant mortality primarily due to several landscape-wide factors including the presence of white fir, an extremely unstable component in East Cascade fire and drought adapted plant associations, high stand densities, and multi-storied stand structures. The ponderosa pine stands have experienced the least mortality of all PAGs and is considered within the normal, endemic range of mortality.

Landscape Patch Conditions

A comparison of historic and current habitat conditions was completed using 1953 aerial photo data, 1995 aerial photo data, the forest decline layer, and various wildlife habitat surveys.

Prior to 1953 (Historic) Condition:

In general, large unfragmented patches of ponderosa pine-dominated habitats (ponderosa pine, mixed conifer dry and mixed conifer wet) and lodgepole pine and high elevation mountain hemlock habitats dominated the landscape.

The ponderosa pine (44% of the landscape) and dry mixed conifer (19% of the landscape) areas were primarily a large patch of medium/large tree (21"+ dbh) ponderosa pine habitats with open canopies of 1-2 stories. The vertical structure of these stands was probably less complex than today because of low to moderate intensity fires. Wildlife species like the northern goshawk and white-headed woodpecker benefited from these conditions and probably reached high population levels.

The second and third largest patch types were in lodgepole pine and high elevation mountain hemlock habitats, respectively (10% and 9% of the landscape). These were fairly contiguous in nature, except where disturbance factors (i.e., insects, wind-throw, and fire) created smaller patches of early seral grass/forb habitats or dense stands of pole and small tree habitats of lodgepole pine and mountain hemlock.

Mixed conifer wet, the fourth largest patch type (9% of the landscape), was also primarily medium/large ponderosa pine habitats, but also provided a majority of the multi-storied, high canopied patches, however, this habitat condition was probably limited in the watershed. Species associated with late-successional mixed conifer habitats (e.g., northern spotted owl and pileated woodpecker) that were vertically complex, multi-storied, and high canopied may have been less abundant on the landscape than they are today.

Early seral patches and edge habitats were a small percentage of the landscape. The early seral patches, however, were much larger in size because they were created by occasional stand-replacement fires. Early seral wildlife species were probably less abundant than today.

Snags and down woody debris densities were probably lower than today because of the low to moderate intensity fires, and the absence of logging debris.

1953 Condition:

At this point in time, the watershed can be split into two sections, the portion within the boundaries of the old Cascade Forest Reserve (CFR) and the portion east of the CFR. The eastern boundary of the CFR was the boundary between Range 9 East and Range 10 East. Very little timber harvest had occurred in the portion of the watershed within the boundaries of the CFR. However, extensive timber harvest had occurred on the lands east of the CFR.

Within the boundaries of the CFR, habitat conditions were probably similar to those described in the pre-1953 condition, except that years of fire exclusion had increased the amount of mixed species, high canopied habitat. The ponderosa pine and dry mixed conifer areas were dominated by large unfragmented patches of open, medium-large ponderosa pine trees. The lodgepole pine, high elevation mountain hemlock were the next largest habitat patches.

Ponderosa pine patches were few in number but were large in size. A patch size analysis done for the Metolius Watershed Analysis determined that the mean patch size for the Metolius Watershed was 12,000 acres with a standard deviation of 30,000 acres. There were smaller sized patches representing 5% of the watershed interspersed throughout the larger, medium/large habitat. These patches were composed of open, 1-2 storied ponderosa pine habitats. The vertical structure of these stands was probably less complex than today because of frequent low to moderate intensity fires.).

Wildlife species such as the northern Goshawk and white-headed woodpecker benefited from these conditions and probably reached high population levels. The amount of multi-storied, high canopied habitat in wet mixed conifer increased from pre-1953 conditions providing additional habitat for species associated with late-successional mixed conifer habitats (e.g., northern spotted owl and pileated woodpecker. As in the historic condition, lodgepole pine and mountain hemlock habitats were fairly contiguous and composed of a few large patches. It can be assumed that similar conditions existed for the Why-chus Watershed.

Early seral seedling/sapling habitats were relatively large in size, were few in number and encompassed a small percentage of the landscape. These were generally the result of fire disturbance events.

East of the CFR boundary, approximately two thirds of the ponderosa pine habitats within the watershed boundary had been harvested at least once. Consequently, many of the medium/large ponderosa pine stands in this area had all or a portion of the medium/large overstory trees removed and the stands were thus converted to a variety of smaller tree dominated stands. Approximately one third of the acres were converted to pole-sized stands and one third to small sized stands. Approximately 5% of the stands were seedling/sapling sized with 3% this habitat 5% resulting from a fire event. Most of the mixed conifer stands in this area had not been entered and were similar to the same associations found within the boundaries of the CFR.

Present (1995) Condition:

Landscape conditions have changed dramatically from the historic condition to the present. Currently, the landscape has many more landscape patches of varying sizes and structural stages and is highly fragmented from the historic condition. The most common landscape patch type in all the LPAGs is now the small sized habitats with multi-storied canopies. Fragmentation has resulted primarily from timber harvest activities including road building, but has also occurred as the urban interface gradually expands into forested areas.

The largest unfragmented landscape patch is the small and pole sized lodgepole pine and mountain hemlock habitats located in the wilderness and roadless areas and along the Mckenzie Pass (19% of the watershed). This patch type, while not the most common (based on acreage), is the largest contiguous patch type within the watershed. The small sized ponderosa pine and mixed conifer are the second largest patch type. The pole and medium/large patch types are the third largest patch types while the seedling/sapling patch type is the fourth. The grass/forb/shrub is the smallest patch type and what does exist is classified as non-forest.

Several results of timber harvest are increased miles of edge, higher edge contrast, and a reduction in the size of late successional interior habitats or core area habitats. The increase in early/mid seral patches and edge have probably resulted in higher population levels for species such as mountain bluebirds, white-crowned sparrows, mule deer, and Roosevelt elk.

While interior habitats would not have been a concern in the pre-1953 landscape, they are an important consideration today. The medium/large ponderosa pine stands with less than 40% canopy cover habitat that dominated the historic landscape is now uncommon. In general, both mixed conifer and ponderosa pine areas contain late-successional interior habitats that are small.

RANGE OF HISTORICAL VARIABILITY AND SUSTAINABILITY

The primary assumption of Watershed Ecosystem Management is that landscapes within the natural or historical range of conditions are more likely to provide healthy sustainable ecosystems and habitats than landscapes outside of the historical range of conditions. In their report "Restoring Eastside Ecosystems in the Blue Mountains," the panel noted, "A key concept of SES (Sustaining Ecological Systems) is that when systems are "pushed" outside the bounds of natural variability there is substantial risk that biological diversity and ecological function will not be maintained, and therefore, ecological systems will not be naturally sustained." Therefore, it is important for managers to be able to estimate the natural range of variability in the components of ecosystems. Natural variability can be highly subjective ("natural when?") so managers may more readily be able to determine "historic" variability to use as a baseline. The vegetation management opportunities developed for the watershed are based on moving landscape vegetative conditions and disturbance patterns toward a balance within the historic range of variability. Historic vegetation is defined as what we believe existed prior to the significant human influence of the early 1900s.

The historical ranges of variability for vegetation within LPAGs, shown in **Tables V-9 through V-14**, were developed from vegetation information mapped from the late 1800's, historic (1920s, 1930s and 1953) maps of vegetation developed with fire exclusion and risk cutting, information on past disturbance events, successional pathways, current stand examination information, and historic ranges of variability already calculated for the Ochoco National Forest, the Metolius watershed on the Deschutes National Forest, and discussions among ecologists, silviculturists, fire managers, entomologists, and pathologists.

Area Ecologist, Bill Hopkins, offers this definition of Forest Health: *"Forest health is a function of desirable biological diversity as related to stand (forest) structure, composition and density, and growing at a rate that renders the stand (forest) largely immune to epidemic attacks from disease and insects."*

For Deschutes National Forest mixed conifer and ponderosa pine plant association groups, we describe species composition and structure, maximum densities, and historical fire periodicity focusing on stand-level considerations. Landscape level considerations, particularly involving structure and composition over the landscape, are considered by noting where the current conditions are outside the range of historical variability, and are integrated into the goals and opportunities for this watershed.

The Blue Mountains Forest Health Report (USDA Forest Service, 1991) referred to biodiversity, saying that: "Landscape diversity is promoted when patchiness of vegetation, size of patches, and the juxtaposition of the patches promote a diverse mosaic. By provision of a variety of communities exhibiting different seral stages and age classes across the landscape, the health of that vegetation and its associated fauna is promoted.

It is possible to temporarily have conditions that are outside the range of historical variability, such as in the denser spotted owl habitat within the Dry Mixed Conifer PAG on the east side of the Cascades. Because of limited moisture, these habitats cannot be maintained over time without some density reduction by thinning or burning, but can provide short-term habitat at high risk and probability of loss. Eventually, a combination of drought and some form of disturbance bring densities and species composition back to more historic levels. This has already occurred in many areas of the Sisters RD over the last 10 years due to insect and disease infestations. The risk is still currently very high for losing much of the remaining habitat to large catastrophic fires, or even more wide-scale insect and disease outbreaks.

SUSTAINABLE CONDITIONS

Maintaining stand densities at manageable levels is essential for promoting forest health and maintaining or creating large tree character and habitats in dry areas. Of particular importance is the maximum "healthy" density limit or upper management zone (UMZ). The UMZ is a site specific threshold density, above which forest health conditions and large tree health are likely to deteriorate. Several methods are available for determining site specific UMZs, however, the recommended method is Growth Basal Area or GBA as described by Hall (1987) in which UMZ is established at 67% of measured, site specific GBA.

Excessive numbers of small trees or vigorous brush species in the understory, even though they don't contribute significantly to the total basal area, do compete for moisture and can lower the vigor of larger trees in the stand, even if total basal areas are below critical levels. When the objective is to keep healthy large trees over time as a component of the landscape, the understories need to be thinned to reduce competition for moisture. These treatments may also decrease the risk of catastrophic crown fires.

For both lodgepole pine and ponderosa pine plant associations, lodgepole pine and ponderosa pine are the primary species, both at early seral stages and climax stages. For mixed conifer associations, determining species composition for long-term healthy conditions is more difficult. For most of these associations, ponderosa pine makes up the major early seral tree species. Maintenance of early seral species in mixed conifer sites is recommended in the Deschutes LRMP for biological and social reasons (LRMP page 4-47). Maintenance of stands at slightly higher densities is possible, but there would be a greater risk of losing medium and large ponderosa pine and Douglas-fir trees, and growth would be slower, making all trees more susceptible to insects and diseases.

CURRENT AND HISTORIC CONDITIONS AND TRENDS BY LPAG

The LPAG summaries in the following sections include discussion and analyses of current and historic size/structure, species composition, stand density, present levels of stand mortality, and trends and opportunities/recommendations for the major LPAGs (i.e., greater than 2000 acres). The mixed conifer associations also include a comparison of the present species composition of the overstory and understory components.

MIXED CONIFER DRY (MCD) LPAG — 19% of Total Acres

The MCD PAG includes moderate and lower productivity CW Series plant associations and one highly productive CP plant association that has the potential for white fir to become mixed with ponderosa pine. This PAG includes the following plant associations, CW-C2-13 (32%), CW-S1-15 (29%), CW-S1-12 (20%), CW-XX-XX (Unclassified MCD) (7%), CW-ROCK (4%), CP-G2-12 (3%), CW-C2-11 (3%), and minor amounts (less than 250 acres) of the following associations: CW-H1-11, CE-XX-XX, CR-S1-11, and CW-SX-XX. These plant associations are found on the slopes of the Cascades down to the flatter areas of pure pine stands to about the north/south center of the watershed. These associations have a moderate to high productivity and a mean annual precipitation of 35 to 75 inches per year (most sites are in the lower half of this range). Current tree vegetation consists of true firs, ponderosa pine, Douglas-fir, lodgepole pine and small amounts of other minor species.

Tables V-9a and V-9b show the distribution of size/structure, species composition and potential old growth in the MCD plant associations. **Table V-9a** compares the distribution of size/structure, species composition and potential old growth between 1) the estimated historical range of variability (HRV), the known historical reference point (1953/Historic), and the present. **Table V-9b**, compares the present distribution of species composition between the understory and the overstory component.

In **Table V-9a**, current size and structure was classified for each stand (acres) based on the size/structure class with the most canopy cover regardless of the total canopy cover in the stand. Consequently, stands that qualify as potential old growth may fall into pole, small, or medium/large size classes if they had the minimum number of trees/acre in the medium/large size class but the medium/large size class was not the dominant size class based on canopy cover (see also the section "Potential Old Growth" for additional information). In both **Tables V-9a and V-9b**, stands were classified as primarily pioneer species, climax species, or mixed (pioneer and climax) species. Stands were classified as primarily pioneer or climax species if pioneer or climax species represented <10% of the canopy cover, respectively. Stands were classified as mixed species if both pioneer and climax species represented 10% or more of the canopy cover. Major pioneer species include ponderosa pine and lodgepole pine. Major climax species include white fir, Douglas-fir and other true firs.

Table V-9a. Mixed Conifer Dry -- Overall Comparison of Size/Structure, Species Composition and Potential Old Growth.

MIXED CONIFER DRY LPAG (Total Acres = 33,351)		
Vegetation Type	**1953**	**Present**
Not Classified	6%	4%
Non-Forest	2%	2%
Forested	91%	94%

Percent of Classified Forested Acres

Size / Structure	Year or Time-frame*	Species Composition: Not Classified or Non-Forest	Pioneer (P)	Mixed (M)	Climax (C)	Totals	Potential Old Growth**
Grass / Forb / Shrub	HRV		1-7				
	1953/Historic	0	<1	0	0	<1	0
	Present	0	0	0	0	0	0
	Change	0	0	0	0	0	0
Seedling / Sapling (0-4.9")	HRV		2-15	1-10	0-1		
	1953/Historic	0	0	0	0	0	0
	Present	0	5	1	0	6	0
	Change	0	+5	+1	0	+6	0
Pole (5-8.9")	HRV		5-21	2-15	1-4		
	1953/Historic	0	2	0	0	2	0
	Present	2	8	9	0	20	1
	Change	+2	+6	+9	0	+18	+1
Small (9-20.9")	HRV		12-40	6-30	3-5		
	1953/Historic	2	1	0	0	3	0
	Present	6	20	33	1	59	10
	Change	+4	+19	+33	+1	+56	+10
Medium / Large (21"+)	HRV		15-42	5-28	3-5		
	1953/Historic	<1	84	11	0	95	95
	Present	<1	8	6	<1	15	11
	Change	+0	-76	-5	0	-80	-84
TOTALS	HRV						
	1953/Historic	2	87	11	0	100	95
	Present	8	41	50	1	100	22
	Change	+6	-46	+39	+1		-73

* HRV equals estimated Historic Range of Variability. Percentages for 1953/Historic were calculated from only Cascade Forest Reserve (CFR) acres (CFR acres are 91% of the total LPAG acres). Percentages for the present are calculated on the entire LPAG acres. Change equals the change from 1953/Historic to present.

** Acres were classified as ***potential*** old growth if it was estimated that they had at least 15% canopy cover (i.e., approximately 15 TPA) in trees 21"+ dbh. Acres were classified as only ***potential*** because TPA was the only variable considered out of the 6 variables identified in Region 6 interim definition of old growth for the white/grand fir vegetation series.

Table V9-b. *Percent distribution of total forested acres by overstory and understory species composition for the mixed conifer dry plant associations in 1995.*

MIXED CONIFER DRY						
UNDERSTORY SPECIES COMPOSITION	**OVERSTORY SPECIES COMPOSITION**					
	Pioneer	**Mixed**	**Climax**	**Sparse Overstory***	**Not Classified**	**Totals**
Pioneer	19%	1%	---	19%	---	39%
Mixed	13%	18%	<1%	16%	<1%	48%
Climax	<1%	1%	<1%	---	---	2%
Sparse Understory**	2%	<1%	---	---	---	3%
Not Classified	---	<1%	---	5%	3%	8%
GRAND TOTALS	34%	21%	1%	41%	3%	100%

* "Sparse Overstory" equals 1% or less canopy cover of overstory size classes. Overstory is defined as trees in photo-interpretation size classes 10 or greater. Size class 10 is a mix of size classes 9 (15"-20.9") and 11 (21"-31.9").

** "Sparse Understory" equals 1% or less canopy cover of understory size classes. Understory equals trees in size classes 9 and below.

Trends:

- General:
    - Historically, mature stands were primarily composed of early seral species. Ponderosa pine was the major species present, with minor amounts of lodgepole pine, Douglas-fir, and white fir. On a landscape scale, stands currently exist outside this range, being partially or totally composed of white fir, Douglas-fir, or lodgepole pine with varying levels of mortality.
    - Surveyor's notes from the late 1800's describe lots of heavy yellow pine (ponderosa pine) overstories. Hardly any of the understories in the lower elevations were described as dense. In some areas, laurel, manzanita, bunchgrass, and/or pinegrass were common. The entire area appeared to have been forested with contiguous stands. One of the surveyors noted sizes and species of many of the largest trees that were on his survey lines. In the western part of this PAG, he mentioned pines up to 40" and 50" dbh, although most trees noted ranged from 10"-30".
    - The current vegetation types have shifted from open, park-like stands of ponderosa pine to dense stands of white fir. Many of the largest ponderosa pine have been removed.
- Size/Structure **(Table V-9a):**
    - There has been a significant shift in overall size/structure.
    - The acres dominated (canopy cover) by the medium/large class has decreased by 80%.
    - The acres estimated to be potential old growth has decreased by 73%.
    - The small class has increased by 56%.
    - The pole class has increased by 18%.
    - The seedling/sapling/pole class has increased by 6%.
    - Fragmentation: Regeneration harvests have been implemented on 13% of the LPAG acres of which 16% of those acres have a residual overstory component remaining on site.
    - HRV: The number of acres dominated by medium/large trees, especially those dominated by pioneer species, is well below the historical range of variability (HRV). The number of acres dominated by small sized trees of mixed species composition is above HRV.

Species Composition:

- **Table V-9a** shows there has been a significant shift in overall species composition. In 1953/Historic, pioneer species, primarily ponderosa pine, were the dominant species on 87% of the acres and climax species were dominant on 0 acres. In 1998, climax species are a significant component on 51% of the acres.
- **Table V-9b** shows that there are significant differences in the species composition of stand overstories compared to stand understories.
  - On a majority of the acres, ponderosa pine, a long-lived, very stable component of the MCD plant associations is being replaced by white fir, a short-lived, very unstable component of the MCD plant associations.
  - After nearly 100 years of fire suppression, ponderosa pine is still the dominant over story species on 34% of the acres and mixed with climax species on the other 1%of the acres.
  - On 50%of the acres, climax species, primarily white fir, are a significant component of the understory. Climax species are the dominant species in the understories on 2% of the acres and mixed with pioneer species on the other 48% of the acres.
  - Pioneer species, both ponderosa pine and lodgepole pine, dominate the understories on only 39% of the acres.
- **Maps V-5 and V-6** show how species composition has changed in the mixed conifer dry and mixed conifer wet LPAGs from 1953 (historic) to the present.

- Stand Densities:
  - **Table V-7** shows that 73% of the mixed conifer dry acres are currently above the upper management zone (UMZ) and thus, at unstable densities.
- Mortality:
  - **Table V-8** shows that 15% of the MCD plant associations acres with stand exams have experienced >30% mortality and 32% of the acres have 10% to 30% mortality currently.
  - Overall, across the watershed, this LPAG has fairly low mortality. However, there is fairly significant mortality in this LPAG in the northern portion of the watershed from Trout Creek Butte to northern boundary of the watershed. This area encompasses the southern extent of the 1985-1992 spruce budworm outbreak. Most of the moderate and high mortality noted above can be found in this area.

MIXED CONIFER WET (MCW) LPAG

9% of Total Acres

The MCW PAG includes the CD Series and the most productive sites in the CW series. The CD Series plant associations in the PAG include only CD-S6-14 (2% of the LPAG acres). The CD associations are climax to Douglas-fir and white fir. The major early seral species is ponderosa pine. The CW plant associations in this PAG include CW-S1-13 (81%), CW-C2-12 (12%), and CW-S9-11 (5%). The MCW plant associations occur on the mid to upper slopes of the Cascades and on more moist sites with a mean annual precipitation of 35 to 75 inches per year. The productivity is generally higher than in the MCD PAG. Current vegetation consists of true firs, ponderosa pine, Douglas-fir, and lodgepole pine. Spruce can be found in the wetter uplands and riparian areas.

Tables V-10a and V-10b were developed the same way and describe the same information for the mixed conifer wet (MCW) PAG as **tables V-9a and V-9b** do for the MCD PAG.

Table V-10a. Mixed Conifer Wet -- Overall Comparison of Size/Structure, Species Composition and Potential Old Growth.

MIXED CONIFER WET LPAG
(Total Acres = 15,578)

Vegetation Type	1953	Present
Not Classified	<1%	17%
Non-Forest	<1%	<1%
Forested	100%	82%

Percent of Classified Forested Acres

Size / Structure	Year or Time-Frame	Species Composition: Not Classified or Non-Forest	Pioneer (P)	Mixed (M)	Climax (C)	Totals	Potential Old Growth**
Grass / Forb / Shrub	HRV		0-20				
	1953/Historic	0	<1	0	0	<1	0
	Present	0	0	0	0	0	0
	Change	0	-<1	0	0	-<1	0
Seedling / Sapling (0-4.9")	HRV		3-20	0-25	0-9		
	1953/Historic	0	0	0	0	0	0
	Present	0	7	1	0	8	0
	Change	0	+7	+1	0	+8	0
Pole (5-8.9")	HRV		1-11	5-30	1-10		
	1953/Historic	0	3	0	0	3	0
	Present	<1	4	5	<1	10	<1
	Change	+<1	+1	+5	+<1	+7	+<1
Small (9-20.9")	HRV		1-11	10-32	2-14		
	1953/Historic	<1	3	0	0	4	0
	Present	11	6	44	3	64	16
	Change	+11	+3	+44	+3	+60	+16
Medium / Large (21"+)	HRV		1-11	8-28	2-14		
	1953/Historic	0	69	25	0	93	93
	Present	1	6	11	1	18	14
	Change	+!	-63	-14	+1	-75	-79
TOTALS	HRV						
	1953/Historic	<1	75	25	0	100	93
	Present	12	22	62	4	100	30
	Change	+12	-53	+37	+4		-63

* HRV equals estimated Historic Range of Variability. Percentages for 1953/Historic were calculated from only Cascade Forest Reserve (CFR) acres (CFR acres are 96% of the total LPAG acres). Percentages for the present are calculated on the entire LPAG acres. Change equals the change from 1953/Historic to present.

** Acres were classified as ***potential*** old growth if it was estimated that they had at least 15% canopy cover (i.e., approximately 15 TPA) in trees 21"+ dbh. Acres were classified as only ***potential*** because TPA was the only variable considered out of the 6 variables identified in Region 6 interim definition of old growth for the white/grand fir vegetation series.

Table V-10b. *Percent distribution of total forested acres by overstory and understory species composition for the mixed conifer wet plant associations in 1995.*

UNDERSTORY SPECIES COMPOSITION	**MIXED CONIFER WET**					
	OVERSTORY SPECIES COMPOSITION					
	Pioneer	**Mixed**	**Climax**	**Sparse Overstory***	**Not Classified**	**Totals**
Pioneer	5%	<1%	---	13%	---	18%
Mixed	22%	23%	1%	14%	<1%	59%
Climax	1%	1%	1%	1%	---	5%
Sparse Understory**	3%	2%	---	---	---	6%
Not Classified	<1%	<1%	1%	1%	9%	12%
GRAND TOTALS	31%	27%	3%	29%	9%	100%

* "Sparse Overstory" equals 1% or less canopy cover of overstory size classes. Overstory is defined as trees in photo-interpretation size classes 10 or greater. Size class 10 is a mix of size classes 9 (15"-20.9") and 11 (21"-31.9").

** "Sparse Understory" equals 1% or less canopy cover of understory size classes. Understory equals trees in size classes 9 and below.

Trends:

- General:
  - Historically, mature stands in this series were primarily composed of early seral species mixed with climax species. Ponderosa pine was the major species present, with some lodgepole pine, Douglas-fir, western white pine, white fir, and western larch. Species composition included white fir regeneration, with mature trees usually making up 30% or less of stocking. On a landscape scale, stands currently exist outside this range, being largely composed of mature and immature white fir or Douglas-fir.
  - Surveyor's notes from 1870 describe lots of heavy yellow pine (ponderosa pine) and fir overstories, as well as spruce overstories. They described dense understories of pine, fir, willow, and chinquapin in some areas. The entire area appeared to have been forested with contiguous stands.
  - Historically, small amounts of Engelmann spruce and pacific silver fir occurred in these associations. White fir and Douglas-fir were present, but made up less than 30% of the stands. On a landscape scale, stands currently exist outside this range, being partially or largely composed of mature white fir or Douglas-fir.
- Size/Structure **(Table V-10a):**
  - There has been a significant shift in overall size and structure.
  - The acres dominated by the medium/large class have decreased by 75%.
  - The acres of potential old growth have decreased by 63%.
  - The small class has increased by 60%
  - The pole class has increased 7% overall.
  - The seedling/sapling class has increased 8% overall.
  - Fragmentation: Regeneration harvests have been implemented on 20% of the LPAG acres and 31% of those acres have a residual overstory component remaining on site.
  - HRV: The number of acres dominated by small sized trees, especially those of mixed species composition, is above the historical range of variability (HRV).

- Species Composition:
  - **Table V-10a** shows there has been a significant shift in overall species composition. In 1953, pioneer species, primarily ponderosa pine, were the dominant species on 75% of the acres and climax species were a component on 25% of the acres and dominant on 0% of the acres. In 1998, climax species are a significant component on 66% of the acres and were dominant on 4% of the acres.
  - **Table V-10b** shows that there are significant differences in the species composition of stand overstories compared to stand understories.
    - On a majority of the acres, ponderosa pine, a long-lived, very stable component of the MCW plant associations is being replaced by white fir, a short-lived, very unstable component of the MCW plant associations.
    - After nearly 100 years of fire suppression, ponderosa pine is still the dominant over story species on 31% of the acres and mixed with climax species on another 30% of the acres.
    - On 64% of the acres, climax species, primarily white fir, are a significant component of the understory. Climax species are the dominant species in the understories on 5% of the acres and mixed with pioneer species on another 59% of the acres.
    - Pioneer species, both ponderosa pine and lodgepole pine, dominate the understories on only 18%of the acres.
  - **Maps V-5 and V-6** show how species composition has changed in the mixed conifer dry and mixed conifer wet LPAGs from 1953 (historic) to the present.
- Stand Densities:
  - **Table V-7** shows that 45% of the mixed conifer wet acres are currently above the upper management zone (UMZ) and thus at unstable densities.
- Mortality:
  - **Table V-8** shows that 11% of the MCW plant associations acres with stand exams have experienced >30% mortality and 48% of the acres have 10% to 30% mortality.
  - Overall across the watershed, this LPAG has fairly low mortality. However, there is fairly significant mortality in this LPAG in the northern portion of the watershed from Trout Creek Butte to northern boundary of the watershed. This area encompasses the southern extent of the 1985-1992 spruce budworm outbreak. Most of the moderate and high mortality noted above can be found in this area.

<u>PONDEROSA PINE (PP), Wet and Dry, LPAG</u> <u>44% of Total Acres</u>

The PP LPAG includes the High, Moderate, and Lower Productivity Sites in the CP Series. This LPAG includes the following major plant associations: CP-S2-17 (37%), CP-S2-11 (35%), CP-S1-11 (10%), CP-S2-13 (9%), CP-S3-11 (4%), CP-S3-14 (2%), CP-S3-12 (2%) and minor amounts (less than 350 acres) of the following associations, CP-S2-14, CP-S2-12, CP-S2-16. Generally, in all of these associations, ponderosa pine is the main early seral and climax species. Lodgepole pine can be a major or minor early seral and western juniper is also an early seral species in some associations. Lodgepole pine as an early seral species generally occurs after disturbance or on colder sites. Minor amounts white fir and Douglas-fir may be present particularly in the ecotones with the mixed conifer plant associations.

These LPAG associations are generally found on the low elevation flats in the eastern half of the watershed, but can also be found on the lower elevation slopes of the Cascades. Annual precipitation ranges from 15 to 40 inches per year.

Table V-11 shows the distribution of size and structure for the PP LPAG.

Table V-11 was developed the same way and describes the same information for the ponderosa pine (PP) PAG as tables **V-9a and V-10a** do for the MCD and MCW LPAGs.

Table V-11. Ponderosa Pine -- Overall Comparison of Size/Structure, Species Composition and Potential Old Growth.

PONDEROSA PINE LPAG
(Total Acres = 78,335)

Vegetation Type	1953	Present
Not Classified	<1%	7%
Non-Forest	5%	4%
Forested	94%	88%

Percent of Classified Forested Acres

Size / Structure	Year or Time-frame*	Species Composition: Not Separated by Pioneer or Climax	Potential Old Growth**
Grass / Forb / Shrub	HRV	5-30	
	1953/Historic	<1	0
	Present	0	0
	Change	0	0
Seedling / Sapling (0-4.9")	HRV	3-21	
	1953/Historic	0	0
	Present	8	0
	Change	+8	0
Pole (5-8.9")	HRV	3-21	
	1953/Historic	1	0
	Present	22	2
	Change	+21	+2
Small (9-20.9")	HRV	20-50	
	1953/Historic	2	0
	Present	62	9
	Change	+60	+9
Medium / Large (21"+)	HRV	30-70	
	1953/Historic	97	97
	Present	9	7
	Change	-88	-90
TOTALS	HRV		
	1953/Historic	100	97
	Present	100	18
	Change		-79

* HRV equals estimated Historic Range of Variability. Percentages for 1953/Historic were calculated from only Cascade Forest Reserve (CFR) acres (CFR acres are 32% of the total LPAG acres). Percentages for the present are calculated on the entire LPAG acres. Change equals the change from 1953/Historic to present.

** Acres were classified as ***potential*** old growth if it was estimated that they had at least 10% canopy cover (i.e., approximately 10 TPA) in trees 21"+ dbh. Acres were classified as only ***potential*** because TPA was the only variable considered out of the 6 variables identified in Region 6 interim definition of old growth for the ponderosa pine vegetation series.

Trends:

- General:
  - Historically, stands were composed of mature ponderosa pine and ponderosa pine regeneration, in relatively even-age groups, with minor amounts of white fir and Douglas-fir present in the ecotones with the mixed conifer plant associations.
  - Historic surveyor's information describes the stands in this area as large even-aged stands of pure ponderosa pine, many with grass understories. Some fir is mentioned, and there are many references to "best bunchgrass." Most of the understories, if present, are not "dense", and include "sweet laurel" or "greasewood."
- Size/Structure (**Table V-11**):
  - There has been a significant shift in overall size and structure.
  - The acres dominated by the medium/large class have decreased by 88%.
  - The acres of potential old growth have decreased by 79%.
  - The small class has increased by 60%
  - The pole class has increased 21% overall.
  - The seedling/sapling class has increased 8% overall.
  - Fragmentation: Regeneration harvests have been implemented on 6% of the LPAG acres of which 46% of those acres have a residual overstory component remaining on site.
  - HRV: The number of acres dominated by medium/large trees is well below the historical range of variability (HRV). The number of acres dominated by small trees is well above the HRV. The number of acres dominated by pole sized trees is lightly above HRV.
- Species Composition:
  - In the ponderosa pine plant associations, ponderosa pine is generally both early and late seral. However, on 17% of the acres, primarily at the lowest elevations and in the ponderosa pine/juniper woodland ecotone, western juniper has become a fairly significant component of the stands. Historically, western juniper was not as large a component as it is now.
- Stand Densities:
  - **Table V-7** shows that 64% of the ponderosa pine acres are currently above the upper management zone (UMZ) and thus at unstable densities. This is a significant percentage of the acres over UMZ.
- Mortality:
  - **Table V-8** shows that mortality in the PP plant associations to be the lowest of any PAG with only 10% of the acres in this PAG having 10% or more basal area mortality and only 2% having 30% to 60% mortality.
- Dwarf Mistletoe:
  - Dwarf Mistletoe infestation in ponderosa pine is high over a fairly significant acreage in the southeast portion of the watershed. This disease will be a major factor to consider when contemplating future stand treatments in this portion of the watershed.

LODGEPOLE PINE (LP) LPAG — 10% of Total Acres

This LPAG includes the following high productivity CL plant associations, CL-G4-11 (57% of the acres) and CL-G4-12 (33%) and minor (less than 780 acres) of the following moderate and low productive plant associations, CL-G3-11 (5%), CL-XX-XX (3%), CL-G3-14 (1%), CL-S4-12 (1%), CL-S3-11 (1%), CL-S2-14 (<1%), CL-M1-11 (<1%). This vegetation type is found mostly at higher elevations where 79% the acres are within wilderness or roadless areas. The areas where lodgepole pine is climax tend to have poor cold air drainage, or soil or moisture conditions that other species can't tolerate.

Table V-12 shows the distribution of size and structure for the PP LPAG. **Table V-12** was developed the same way and describes the same information for the lodgepole pine (LP) PAG as tables **V-9a and V-10a** do for the MCD and MCW LPAGs.

Table V-12. Lodgepole Pine -- Overall Comparison of Size/Structure, Species Composition and Potential Old Growth.

LODGEPOLE PINE LPAG (Total Acres = 16,927)		
Vegetation Type	**1953**	**Present**
Not Classified	2%	1%
Non-Forest	1%	0%
Forested	98%	99%

Percent of Classified Forested Acres

Size / Structure	Year or Time-frame*	Species Composition: Not Separated by Pioneer, Mixed or Climax	Potential Old Growth**
Grass / Forb / Shrub	HRV	0-60	
	1953/Historic	0	0
	Present	0	0
	Change	0	0
Seedling / Sapling (0-4.9")	HRV	0-60	
	1953/Historic	0	0
	Present	2	0
	Change	+2	0
Pole (5-8.9")	HRV	10-80	
	1953/Historic	58	0
	Present	14	4
	Change	44	+4
Small (9-20.9")	HRV	0-80	
	1953/Historic	31	31
	Present	82	78
	Change	+51	+47
Medium / Large (21"+)	HRV	0-2	
	1953/Historic	11	11
	Present	2	1
	Change	-9	-10
TOTALS	HRV		
	1953/Historic	100	42
	Present	100	83
	Change		+39

* HRV equals estimated Historic Range of Variability. Percentages for 1953/Historic were calculated from only Cascade Forest Reserve (CFR) acres (CFR acres are 100% of the total LPAG acres). Percentages for the present are calculated on the entire LPAG acres. Change equals the change from 1953/Historic to present.

** Acres were classified as ***potential*** old growth if it was estimated that they had at least 15% canopy cover (i.e., approximately 60 TPA) in trees 9"+ dbh. Acres were classified as only ***potential*** because TPA was the only variable considered out of the 6 variables identified in Region 6 interim definition of old growth for the lodgepole pine vegetation series.

Trends:

- General:
  - There is a wide range of historical conditions due to the boom and bust cycles of fire and insects in these plant associations. Because of this, none of the size classes are shown as outside HRV.
  - Historically, for the high productivity sites, mature stands were composed mainly of lodgepole pine, with minor amounts of sub-alpine fir, mountain hemlock, or white pine present at higher elevations. Lodgepole pine associations are relatively simple in structure and most are relatively even-aged, even-sized stands.
  - Historically, for the moderately productive sites, mature stands were mainly composed of lodgepole pine, with minor amounts of ponderosa pine and white fir present. The moderately productive lodgepole plant associations also are composed of relatively even-sized, even-aged lodgepole pine. Scattered mature ponderosa pine is often present near the edges within mixed conifer and ponderosa pine associations.
- Size/Structure **(Table V-10)**:
  - There has been a significant shift in overall size/structure.
  - The small class has increased by 51%.
  - The acres of potential old growth have increased by 39%.
  - The pole class has decreased by 44%.
  - The medium/large class has decreased by 9%.
  - The seedling sapling class has increased by 2%.
  - HRV: The number of acres dominated by small sized trees is above the historical range of variability (HRV). The number of acres dominated by small trees is well above the HRV. The number of acres dominated by pole sized trees is lightly above HRV.
- Species Composition:
  - Generally, in the lodgepole pine plant associations, lodgepole pine is the early and late seral species replacing itself on a boom and bust cycle of insects and fire. Currently, lodgepole pine is the dominant species on most acres. However, there are some stands that have a fairly large component of true fir and Mt. Hemlock. True fir and Mt. Hemlock are also reproducing fairly heavily in most stands.
- Stand Densities:
  - **Table V7** shows that 60% of the LP acres are currently above the upper management zone (UMZ) and thus, at unstable densities.
- Mortality:
  - **Table V8** shows that mortality in the LP plant associations has been fairly low with 31% of the acres having <10% mortality and 69% of the acres having between 10% and 30% mortality. There are some exceptions to this, especially the area east of Three Creeks Lake in and around the Bear Wallows Roadless area. Also, a significant number of acres, 80%+ are reaching physiological maturity (80 to 120 years of age and greater than 8" dbh) and in lodgepole pine stands this is a very unstable condition. Consequently, it is expected that many of these acres will experience significant changes from mountain pine beetle within a relatively short time-frame, perhaps within 20-30 years or sooner.

HIGH ELEVATION MT HEMLOCK (MH) LPAG — 9% of Total Acres

This LPAG includes the following plant associations: CM-S1-11 (41% of the acres), CM-G2 (25%), CA-XX (13%), CM-G3 (11%), CM-G2-11 (8%), and minor amounts (<200 acres) of the following plant associations, CM-XX, CM-ROCK, CM-S2-13. Generally, these associations are of low to moderate productivity. This plant association is found at the higher elevations with 97% of the acres in wilderness and roadless areas. In these plant associations, lodgepole pine is the major early seral species and sub-alpine fir, whitebark pine, and western white pine are minor early seral species.

Table V-13 shows the distribution of size and structure for the high elevation/mountain hemlock LPAG. **Table V-13** was developed the same way and describes the same information for the lodgepole pine (MH) PAG as tables **V-9a and V-10a** do for the MCD and MCW LPAGs.

Table V-13. *High Elevation/Mt. Hemlock -- Overall Comparison of Size/Structure, Species Composition and Potential Old Growth.*

HIGH ELEVATION/MT. HEMLOCK LPAG (Total Acres = 16,019)		
Vegetation Type	**1953**	**Present**
Not Classified	31%	<1%
Non-Forest	2%	1%
Forested	67%	98%

Percent of Classified Forested Acres			
Size / Structure	**Year or Time-frame***	**Species Composition** Not Separated by Pioneer, Mixed or Climax	**Potential Old Growth****
Grass / Forb / Shrub	HRV	0-5	
	1953/Historic	0	0
	Present	0	0
	Change	0	0
Seedling / Sapling (0-4.9")	HRV	0-8	
	1953/Historic	0	0
	Present	<1	0
	Change	+<1	0
Pole (5-8.9")	HRV	0-35	
	1953/Historic	21	0
	Present	11	0
	Change	-10	0
Small (9-20.9")	HRV	5-53	
	1953/Historic	74	0
	Present	73	14
	Change	-1	+14
Medium / Large (21"+)	HRV	5-20	
	1953/Historic	5	5
	Present	16	14
	Change	+11	+9
TOTALS	HRV		
	1953/Historic	100	5
	Present	100	29
	Change		+24

* HRV equals estimated Historic Range of Variability. Percentages for 1953/Historic were calculated from only Cascade Forest Reserve (CFR) acres (CFR acres are 100% of the total LPAG acres). Percentages for the present are calculated on the entire LPAG acres. Change equals the change from 1953/Historic to present.

** Acres were classified as ***potential*** old growth if it was estimated that they had at least 15% canopy cover (i.e., approximately 15 TPA) in trees 21"+ dbh. Acres were classified as only ***potential*** because TPA was the only variable considered out of the 6 variables identified in the Region 6 interim definition of old growth for the white/grand fir vegetation series.

Trends:

- General:
  - Historically, mature stands were composed mainly of mountain hemlock, with minor amounts of lodgepole pine, sub-alpine fir, western white pine and whitebark pine.
- Size/Structure **(Table V-13):**
  - There has been a moderate shift in overall size and structure.
  - The acres dominated by the medium/large class have increased by 11%.
  - The acres of potential old growth have increased by 24%.
  - The small class has decreased by 1%.
  - The pole class has decreased 10% overall.
  - HRV: The number of acres dominated by small sized trees is well above the historical range of variability (HRV).
- Species Composition:
  - The biggest change in species composition is probably the increase in the amount of mountain hemlock and true fir found in most stands as succession continues due to a lack of disturbance (e.g., fire).
- Stand Densities:
  - An estimate of stand density was not available for any stands in these plant associations. However, it can be assumed that a majority of the stands have high densities due to the lack of density reduction either through fire or mechanical means.
- Mortality:
  - For this LPAG, mortality information was available on only 2% of the acres and this acreage shows fairly low mortality with 31% of the acreage having <10% mortality, 57% of the area between 10% and 30% mortality, and 4% of the area > 30% mortality.

RIPARIAN LPAG **1% of Total Acres**

This LPAG includes various plant associations identified by Kovalchik (1987). None of the riparian acres in the watershed have been classified as to specific plant associations. Generally, these associations are of fairly high productivity. These plant associations are found at all elevations along a moisture gradient that ranges from less than 14"/year to over 100" of precipitation per year. Because riparian plant associations are found along a steep environmental gradient, they also span the range of potential natural vegetation or dominance groups identified by Kovalchik. These dominance groups include high elevation, coniferous, deciduous, shrub, graminoid, and forb associations.

Table V-14 shows the distribution of size and structure for the PP LPAG. **Table V-14** was developed the same way and describes the same information for the lodgepole pine (LP) PAG as tables **V-9a and V-10a** do for the MCD and MCW LPAGs.

Table V-14. *Riparian -- Overall Comparison of Size/Structure, Species Composition and Potential Old Growth.*

RIPARIAN LPAG (Total Acres = 2,593)		
Vegetation Type	**1953**	**Present**
Not Classified	16%	3%
Non-Forest	16%	21%
Forested	68%	76%

Percent of Classified Forested Acres			
Size / Structure	**Year or Time-frame***	**Species Composition** Not Separated by Pioneer, Mixed or Climax	**Potential Old Growth****
Grass / Forb / Shrub	HRV	***	
	1953/Historic	0	0
	Present	0	0
	Change	0	0
Seedling / Sapling (0-4.9")	HRV	??	
	1953/Historic	0	0
	Present	0	0
	Change	0	0
Pole (5-8.9")	HRV	??	
	1953/Historic	23	0
	Present	24	0
	Change	+1	0
Small (9-20.9")	HRV	??	
	1953/Historic	35	0
	Present	75	11
	Change	+40	+11
Medium / Large (21"+)	HRV	??	
	1953/Historic	42	42
	Present	1	1
	Change	-41	-41
TOTALS	HRV		
	1953/Historic	100	42
	Present	100	12
	Change		-30

* HRV equals estimated Historic Range of Variability. Percentages for 1953/Historic were calculated from only Cascade Forest Reserve (CFR) acres (CFR acres are 80% of the total LPAG acres). Percentages for the present are calculated on the entire LPAG acres. Change equals the change from 1953/Historic to present.

** Acres were classified as ***potential*** old growth if it was estimated that they had at least 15% canopy cover (i.e., approximately 15 TPA) in trees 21"+ dbh. Acres were classified as only ***potential*** because TPA was the only variable considered out of the 6 variables identified in the Region 6 interim definition of old growth for the white/grand fir vegetation series.

*** HRV was not estimated for the riparian LPAG because of the high variability in this LPAG and the uncertainty of how much riparian area there was historically.

Trends:

- General:
  - The amount of riparian habitat has probably not changed much from historic conditions. The quality of riparian habitats, however, has probably changed over the decades. In the early 1900's, sheep grazing, and to a lesser degree, cattle grazing were common. More recently, timber harvest activities and recreational uses have impacted many of the riparian habitats in the watershed.
- Size/Structure **(Table V-14):**
  - There has been a significant shift in overall size and structure.
  - The acres dominated by the medium/large class have decreased by 41%.
  - The small class has increased by 40%.
  - The pole class has increased 1%.
- Species Composition:
  - The biggest change in species composition is probably the increase in the amount of true fir found in most stands as succession continues due to a lack of disturbance (e.g., fire).
- Stand Densities:
  - An estimate of stand density was not available for any stands in these plant associations. However, it can be assumed that a majority of the stands have high densities due to the lack of density reduction either through fire or mechanical means.
- Mortality:
  - For this LPAG, mortality information was available on only 3% of the acres and this acreage shows fairly low to moderate mortality with 53% of the acreage having <10% mortality, 29% if the area is between 10% and 30% mortality, and 18% of the area has >30% mortality.

Biological Domain
Disturbance Processes- Insects and Diseases

Characterization

What are the major insects and diseases found in the Why-chus watershed?

Insect and disease disturbance agents are closely linked with the vegetation on the landscape. Factors such as species composition, stand density, and tree size have a profound effect on how these agents operate in the forest. Each set of vegetative conditions is unique in terms of the habitat it provides for insects and diseases, and in the degree to which these agents express themselves. As changes occur in the vegetation, either through plant succession or through management activities, there are also changes in the insect and disease disturbance agents.

The key insects and diseases capable of affecting stand development in this watershed include the following organisms and their hosts:

Western spruce budworm, *Choristoneura occidentalis*	White fir, Douglas-fir
Armillaria root disease, *Armillaria ostoyae*	White fir, Ponderosa pine
Annosus root disease, *Heterobasidion annosum*	White fir
Fir engraver, *Scolytus ventralis*	White fir
Western pine beetle, *Dendroctonus brevicomis*	Ponderosa pine
Mountain pine beetle, *D. ponderosae*	Ponderosa and lodgepole pine
Western dwarf mistletoe, *Arceuthobium campylopodum*	Ponderosa pine

Historic Conditions

What are the historic patterns of insects and disease disturbances?

Historic stands in both the ponderosa pine and dry mixed conifer PAGs would have been composed primarily of fairly open stands of ponderosa pine, probably with 20-30 large diameter trees per acre, and occasionally denser thickets of smaller trees. The **western pine beetle** would have been the primary biological disturbance agent in these stands, attacking isolated trees which were either injured or weakened by some other agent. The level of tree mortality was probably fairly low most of the time (around one tree per six acres per year). This rate of mortality would probably result in an average of 1.6 snags per acre. However, there were periodic outbreaks triggered by drought, where the level of mortality was elevated for several years and larger groups of trees were killed each year until the outbreak subsided. Records from 1945 indicate an average of five large snags per acre at that time, suggesting that large scale tree mortality had occurred in the preceding decade. The periods shortly after a large outbreak probably had reduced levels of mortality below the "endemic level" for a period of years until the stands once again reached a susceptible state, or until another drought episode occurred.

Western dwarf mistletoe would have been present in stands, but at lower levels than we find now. The disease would have been regulated in some measure by the frequent naturally occurring fires which often removed the infected trees.

In the dry mixed conifer PAG, there would have been considerably less evidence of **western spruce budworm, fir engraver, Armillaria root disease**, and **annosus root disease** due to the reduced abundance of their habitat.

Current Conditions

What are the current patterns of insects and disease disturbances? Why have they changed?

During the late 1980's and early 1990's, the **western spruce budworm** caused significant defoliation of white fir and Douglas fir within the watershed. Most of the budworm activity was concentrated in mixed conifer stands from Trout Creek Butte extending northward to the edge of the watershed past Highway 242. Repeated defoliation was apparent from 1989 through 1992 in a two- to three-mile swath in the mid-elevation to upper slopes. In 1992, the year of the heaviest defoliation, the forested areas around Black Crater were also affected. Defoliation has not been noted since the disappearance of budworm in 1993, and the overall effects have been substantially less dramatic than in the Metolius watershed further north. Nonetheless, tree mortality has occurred and many surviving white firs and Douglas firs have some degree of topkill. (Within the wet and dry mixed conifer PAGs, about 25% of the white firs larger than 4.5 feet to all have top-kill). In many cases, the level of top-kill is severe and will limit the degree to which the affected trees can increase in height in the coming years.

The same area also shows evidence of two important root diseases, **Armillaria root disease** and the **S-strain of annosus root disease**. Both of these diseases attack the white fir host and produce gaps in the forest when the affected trees die. Again, the effects of these fungi are less dramatic than in the Metolius watershed. Armillaria root disease is also common in the ponderosa pine type, particularly in young plantations along Road 16.

White firs have also been affected by the **fir engraver** since 1989. Tree mortality has been most significant around Three Creek Butte, the North Fork of Squaw Creek, Pole Creek Spring and Melvin Butte. The period of bark beetle activity coincided with a regional drought in the early 1900's and was typical of the disturbances that occur in dense fir stands during dry years.

The **bark beetles** of pines have been even more significant and more widespread than the fir engraver. In particular, the mountain pine beetle has been associated with its lodgepole pine host within the watershed in most years since 1989. In 1989 and 1990, most of the mountain pine beetle activity in lodgepole pine was around Three Creek Lake. In 1993, the beetles were affecting lodgepole stands along Alder Creek and Trout Creek southwest of Trout Creek Butte. Additional lodgepole pines were killed in 1994 in the same general areas and near the Squaw Creek Falls, Pole Creek Ditch, and Millican Crater.

Even though bark beetle activity is usually a testimonial to high stocking density of host tree stands, this is not the case in lodgepole pine. In this host, high levels of bark beetle activity usually mean that the stands have reached their physiological limits and they are being naturally altered by their most important disturbance agent. Once lodgepole pine stands have a large number of trees greater than 9" dbh, they are mature and will experience dramatic changes. Typically, these changes induced by the **mountain pine beetle** occur over a short time period and result in the death of virtually all of the larger trees in the stand. This change has recently occurred in the stands east of Three Creek Lake, and many dead lodgepole snags remain in the area.

The **mountain pine beetle** has also been noted in young stands of ponderosa pine throughout the watershed. There has been considerable mountain pine beetle activity around Trout Creek Butte, Pole Creek, Squaw Creek Falls, and Melvin Butte. Other areas with beetle activity in young ponderosa pine stands have included Millican Crater and Sage Falls near Henkle Butte. In the ponderosa pine host type, we can make the general assumption that the presence of mountain pine beetle in indicative of a dense stand condition. Even though bark beetles act as "thinning agents" in ponderosa pine, they often delay the rate at which the stands develop to a large-tree character because the beetles kill some of the largest trees in the stand.

Each year there are a number of large ponderosa pines killed by the **western pine beetle**. Typically, 30-60 newly dead trees are mapped each year in this watershed during the aerial detection survey. This number of probably represents about 25% of the large tree mortality that occurs each year. Most of the western pine beetle activity between 1989 and 1997 has been around Black Butte. Other significant levels of pine mortality have been noted along Road 16 and along Highway 20.

Even low levels of tree mortality are significant when they occur in the large tree component of ponderosa pine stands. In some cases the loss of three or four large trees will alter the structure of a stand from one dominated by large trees to one dominated by smaller trees. When dealing with the large tree component in ponderosa pine stands, there is not the clear connection between stand density and tree mortality that exists in younger stands. Individual old trees are often stressed by agents other than stand density and the trees may be weakened for western pine beetle by these other factors instead.

The most significant disease of ponderosa pine in this watershed is **western dwarf mistletoe**. This parasite kills heavily infected trees, and slows the growth rate on more lightly infected trees. Affected stands will undergo a completely different pattern of stand development than stands which are free of the parasite. The greatest concentrations of dwarf mistletoe have been noted in stands along Road 16.

The differences between the current and historic conditions for disturbance agents will be greatest where the vegetative changes have been the greatest. Over the past six decades, the vegetation in two of the Plant Association Groups in the watershed has undergone significant changes in stand density and structure (Ponderosa pine and dry mixed conifer). The latter group (MCD) has also had a change in species composition over the same period. As a result, the disturbance regimes have also been altered from their historic forms.

TRENDS:

Human intervention has brought about changes within the ponderosa pine and dry mixed conifer PAGs which have resulted in an array of conditions which are not within the natural range of variation for those PAGs. As such, the current vegetation is subjected to disturbances which are also beyond the natural range of variation. Changes are greatest in ponderosa pine and dry mixed conifer.

- There are increased habitats of organisms such as Armillaria root disease, western dwarf mistletoe, western spruce budworm, mountain pine beetle, and western pine beetle and hence, the potential for greater populations of these organisms.

Biological Domain
Disturbance Processes- Fire

Characterization

Fire is a natural process that shaped the landscape in the Why-chus watershed. Fire suppression and exclusion have also played a role in shaping the current landscape patterns. "Fire changes ecosystem, community and population structure either by selectively favoring certain species or creating conditions for new species to invade. It usually favors early successional species but sometimes can "accelerate" succession to favor late-successional species." (Agee, 1993).

Fires within the Why-chus watershed generally burn from west to east/southeast in the northern and western subwatersheds. In the headwaters of Squaw Creek and Pole Creek subwatersheds, fire generally burns in a west to east or northeast pattern. This is due to the influence of afternoon (diurnal) down slope or down canyon winds.

This report discusses the role of fire in different forest types by discussing "fire regimes". Fire regimes are based upon historic conditions and are a generalized description of the role fire played in an ecosystem. The fire regime identifies potential fire effects and historic size, frequency, and intensity of fires. They are described according to plant association group (PAG).

Native Americans used fire to manage landscapes to improve hunting and foraging. After European settlement humans starting putting out fires to protect homes and other resources. This has affected both vegetation and fire behavior. The natural beneficial role of fire is now recognized by fire ecologists and forest managers. In the past 15 years the Forest Service has ignited prescribed fires in this area. However, the benefits and visual effects of fire are still not well understood or accepted by the general public.

General Historic Reference Conditions

Early visitors to Central Oregon described the conditions they found here. Fredrick Colville's 1898 report ,"Forest Growth and Sheep Grazing in the Cascade Mountains of Oregon" indicate that forest composition was quite different a century ago. He described the general forest types as "*yellow pine forests and the heavy west slope forest*". Regarding the yellow pine forest, he wrote, "*the principal species is the yellow pine, Pinus ponderosa. The individual trees usually stand well apart, and there is plenty of sunshine between them.*" He also recognized the role of fire, "*the scant grass and underbrush do not make a destructive burn, whole the bark of the yellow pine is so thick and so nearly devoid of resin that only under exceptional circumstances is a mature tree killed. The saplings, however, up to an age of fifteen or twenty years are readily killed by fire.*"

Colville also seemed to recognize the differences in higher, wetter, mixed conifer forests. "*At their upper elevations the yellow pine forests are denser, and often contain a considerable amount of Douglas spruce (Pseudotsuga macronata) and California white fir (now treated as a form of Abies concolor*)." He also recognized the different role of fire in this zone; "*in the higher elevations of the yellow pine* *zone, where there is a large admixture of white fir and Douglas spruce, the underbrush is thicker, a forest fire is often extremely destructive to the timber, and is followed by a very dense growth of shrubs."*

The Historic and Current Role of Fire Disturbances and Trends

What role did fire play historically in the Why-chus forests? What role does fire currently play? What are the significant changes and trends and why have they occurred?

Historic Conditions and Fire Regimes in the Ponderosa Pine PAG

Fires in this area were primarily lightning caused . They could burn for many days under the right conditions and often burned southwesterly into the juniper. Historically, fires were of low intensity, rarely scorching the crowns of the mature trees. This can be inferred from the pattern of scarring found on residual trees and from early accounts of wildfires in this forest type. *"Ordinarily, a fire in yellow pine woods is comparatively easy to check. Its advance under usual conditions may be stopped by a patrolman on a fire line a foot or so wide, either with or without backfiring. The open character of the woods makes the construction of fire lines relatively easy, and in many cases, horses may be used to plow them"* (Munger 1917).

Frequent underburns killed most of the small understory trees which colonized areas during fire-free intervals, maintaining open, park-like stands. To maintain the grass understory described in historical records, frequent low intensity fires would have been necessary. Frequent, light burning allowed bunchgrasses and most forbs to recover rapidly, so the herbaceous vegetation dominated the understory.

Fires interacted with other disturbance agents such as insects and mistletoe. Fires flared up and burned with higher intensity when trees in patches became senescent or when mistletoe infested trees torched.

Fires were probably large, 5 to 500+ acres, due to the lack of suppression and the buildup of fine fuels (needles) that occur in ponderosa pine stands. Low intensity fire sizes are difficult to estimate because the fires left little evidence. The natural landscape pattern was a seemingly unbroken parkland of widely spaced tree clumps and continuous herbaceous understory.

Fuels were rarely at high levels because the frequent fires consumed forest floor fuels and pruned residual trees. Fire fuels were produced by needle fall or understory vegetation. *"In pre-settlement stands, downed logs were probably clumped at the same scale as the live tree components from which they were created, as such clumps contributed to local increase in fire behavior. It is doubtful that logs remained long on the forest floor to provide wildlife habitat, rooting media for seedlings, or sites for nitrogen fixation by microorganisms, as they were probably consumed by the next several frequent fires on the site"* (Agee 1993).

Little fire regime research has been completed in this area but information from similar sites has been complied. The historic fire return interval for ponderosa pine forest on the Warm Springs Reservation is 11 to 16 years (Weaver 1959). Soeriaatmadja (1966) found mean fire return intervals of 3-36 years in the same area the following decade. In 1985, Bork found an average fire return interval of 16 years on sites near Cabin Lake and Pringle Falls on the Deschutes National Forest. Bill Hopkins, Area 4 Ecologist, estimates fire return intervals of 8 to 12 years for low intensity fires and 150 years for stand replacement fires. Hopkins estimates stand replacement fires to be 150 acres in size while the Deschutes

NF Watershed Evaluation and Analysis for Viable Ecosystems (WEAVE) estimates them to be 100 to 1,000 acres in size.

Current Conditions in Ponderosa Pine PAG

Fire now has the potential of being a major disturbance in ponderosa pine forests. The vegetation has changed significantly in the last century or so. There is a high percentage of small to medium sized ponderosa pine with a heavy brush component that has developed after stand replacement fires and fire exclusion. Within this area, to a couple of miles west of the town of Sisters, juniper trees have invaded and include heavy undergrowth of decadent bitterbrush. This whole area is fully occupied by both trees and brush, and creates a dense multi-storied forest.

Fire exclusion has increased the expected fire intensities. Fires are generally carried by the brush component and the small diameter trees to create moderate to high intensity wildfires. Flame lengths of 4 to 12 feet could be expected during typical summer conditions. Where once frequent surface fires were carried through pine stands by needle litter and grass, they are now carried by needle and branch fuels. The vertical continuity of fuels is also higher than historically, which allows surface fires to develop into understory or crown fires under less severe weather conditions.

All of the large fires, over 100 acres, that have been recorded this century in this watershed have been located within the ponderosa pine PAG. Most of the areas within these fires have been stand replacement. At the same time that average fire intensity, due to fuel buildup, is increasing, average fire tolerance of stands has dramatically decreased as a function of overstocking and stagnation (Agee 1992).

TRENDS:

- The fire regime has been converted from a frequent, low severity fire regime to one of a less frequent, moderate to high severity fire regime.
- Fire sizes and intensities within the pine plant associations have been increasing in the last decade.
- Most of the large fires within the watershed are found in this forest type

Historic Conditions and Fire Regimes in the Juniper Pine Interface

This area is located primarily east of the town of Sisters. Vegetation in this area was typified by large, open grassy areas, interspersed with low density, large diameter juniper. The early surveyors described much of this land as a prairie. There were a variety of grasses present, many of them perennials. Bitterbrush was not mentioned by the early surveyors. Historical surveyor's information records show that the most westerly junipers were found near the location of the town of Sisters.

Fires were frequent, low intensity burns. They occurred on a 3 to 10 year basis. These fires were fast moving and variable in size depending on weather conditions and fuel loading buildup since the previous fire. These fires usually didn't kill large juniper trees as they were often located in rocky or isolated areas that fires could not reach.

Current Conditions and Trends in the Juniper Pine Interface

Vegetation has changed significantly in the last 120 years, primarily due to fire exclusion and human development. In many areas, there are hundreds of small juniper with many large decadent bitterbrush and sage present.

Fires are carried primarily by bitterbrush, sage, and grasses. Because of the heavy accumulation of these fuels and afternoon wind patterns, these fires can be fast moving. It is common for fire to go into the crowns of the juniper and kill both the trees and shrubs.

TREND:

- Similar to ponderosa pine. Cheatgrass has accelerated fire spread.

Historic Conditions and Fire Regimes in Dry and Wet Mixed Conifer PAGs

"*The most complex set of forest types in the Pacific Northwest includes those called mixed conifer....They differ in their specific mix of species, their fire regime, and the successional patterns likely after disturbance..*" (Agee 1992). Historically, the mixed conifer forests show the most frequent fire activity of all Eastside forests, although cooler, wetter sites had longer fire return intervals . The dry mixed conifer plant associations would have shorter fire return intervals while wet mixed conifer plant associations would have longer fire return intervals.

More frequent fires in dry mixed conifer plant associations are presumably due to the higher productivity of these sites, compared to ponderosa pine plant associations. The elevation and weather conditions would be similar in dry mixed conifer and ponderosa pine plant associations but mixed conifer sites would produce more vegetation (trees and shrubs). Once a fire started, the mixed conifer sites would have more fuel to allow the fire to continue to burn and increase in size. The fires would not generally be as large as fires in the ponderosa pine as there are wetter sites in the mixed conifer that would slow the fires and keep them smaller. After a fire, the fine dead fuels needed to carry fire are more rapidly replaced in the mixed conifer plant associations. This would allow fires to burn more frequently.

In the wet mixed conifer plant associations, the fire return intervals would be longer than in the dry mixed conifer. These sites have wetter, more productive site conditions that allow vegetation to grow rapidly but also retards the effects of fires. The wetter soils and fuel conditions reduce the spread and intensity of fires on these sites. These conditions increase the length of time between fires, thereby increasing the fire return interval.

Surveyor's notes from the 1870's describe lots of yellow pine (ponderosa pine) and fir understories in wet mixed conifer sites. They describe some lodgepole overstories and many dense thickets of ponderosa pine and fir. There was a well-developed brush and grass understory. "Buckbrush" was common. Stands did not appear to be "old". They appeared to be homogeneous, two-storied stands. The entire area appeared to be forested with contiguous stands. Many marshy, wet areas are described (brooks, streams, and marshes). There is very little evidence of fire as the stands appeared to all have dense understories. Where fires were documented, they were stand replacement and were large in size. One fire noted southwest of Trout Creek swamp covered the length of one section line.

Fire return intervals in the mixed conifer plant association groups were estimated by Bork (1985) at 9 to 25 years while Hopkins (1995) estimates them to be 30 to 50 years in the lower elevations (1500 to 4000 feet) and 50 to 80 years in the higher elevations (4000 to 5000 feet) of the mixed conifer on the east side of the Oregon Cascades. McNeil and Zobel (1980) found an increasing fire-return interval with elevation. The average fire return interval was 9 to 42 years along an elevation gradient. The average fire size for low intensity fires ranged from 50 to 150 acres and stand replacement fires were 100 to

1,000 acres in size. Fire return intervals for mixed conifer plant associations are quite variable and depend upon many other site specific conditions.

The mixed conifer plant association groups of the Why-chus area have a moderate severity fire regime with a mix of low, moderate and high intensity fires all common. Historical fire intensities and frequencies ranged from frequent, low intensity fires to infrequent, high intensity fires. Most mixed conifer plant associations were more open in appearance than they are today and were dominated by ponderosa pine. *"Frequent, low intensity fires kept such sites open so that they were less likely to burn intensely even under severe fire weather."* (Agee, 1993) As these low intensity fires burned they removed understory ladder fuels and consumed debris on the forest floor. Fires that occurred after an extended fire-free period were generally more intense and consumed more trees and forest floor debris (fuels). These fires created patches and openings where 70 to 80 percent of the overstory trees were killed. The openings varied in size based on the weather, fuel and vegetative conditions on the site.

Current Conditions and Trends in the Dry and Wet Mixed Conifer PAG

Lack of fire has allowed fire sensitive true firs to expand their range into stands that were historically pure ponderosa pine. Vegetation has gotten older and more dense, a natural process of increasing stand age with no disturbance. Lack of fire has caused localized areas with more insects and disease. Selective harvest have made stands more susceptible to both fire and insects and diseases by removing ponderosa pine and leaving true firs.

Fires are generally lightning caused. There have been no fires greater than 100 acres in size within the last 100 years. However, within the last two decades there have been several fires in the 10 to 50 acre size.

TREND:

- There has been a shift from a complex historic moderate fire severity regime to one of high fire severity.

Historic Conditions and Fire Regimes in the Lodgepole Pine PAG

Fire is one of the major disturbance factors in this PAG. Lightning is the most common cause of fires in the higher elevations. Typically, these stands persist in locations of poor soils or cold air pockets that other species cannot tolerate and become, essentially, the climax species. The normal fire regime is a high intensity, stand replacement fire associated with dry, late summer conditions, high winds, and lightning. The fire return interval is 100 to 150 years; on the edge of the range, pine beetles often intervene and cause extensive mortality, followed by stand replacement fires. Patch sizes are usually small, ranging from 10-100 acres. Lodgepole pine usually regenerates easily on burned sites, and the cycle begins again.

Current Conditions and Trends in the Lodgepole Pine PAG

Many lodgepole stands are in late-successional stages of development and are likely to be altered by insects or fire in the near future (e.g., a 600 acre stand replacement fire, Park Meadow, occurred in 1996). This will provide young replacement stands and dead standing trees.

TREND:

- Lodgepole areas are reaching the endpoint of their fire return interval and are likely to experience insects or fires in the near future.
- Stands are increasing in age and density

Historic Conditions and Fire Regimes in the High Elevation Forest PAG

This area is in the upper slopes of the Cascades, mostly within the wilderness area. Historic vegetation is very similar to the current vegetation present today. Stands were very dense. The area appeared to all be forested and have a continuous canopy. There was no evidence of recent fires. The high elevation forest has the coolest temperatures, the shortest growing season, and the longest fire return intervals. Hopkins (1995) estimates fire return intervals of 100 to 300 years with fire sizes of 5 to 10 acres. Regeneration in this forest type occurs after stand replacement fires that may be 50 to 100 acres.

Current Conditions and Trends in the High Elevation Forest PAG

Fire is the primary large-scale disturbance in the high elevation forest. Most other disturbances operate at the tree or small stand scale. Due to the lack of fire resistance of the major tree species in these forests, most fires are stand replacement fires. The estimation of fire intensity in high elevation forests are complicated by the erratic, often weather-driven nature of these fires. Crown fires can occur when needle moistures are low and may be aided by lichen drape within the canopy.

Lightning is the most common cause of fire. Fire occurrence was, and continues to be, infrequent with moderate to high fire intensities once they do start. Weather conditions and a short fire season, due to elevation, also reduces probability of large fire occurrences. As the stand age increases, tree mortality within the stand increases and more trees fall to the ground. This increases the amount of woody debris on the ground. This has the potential to increase wildfire intensity in these stands.

"*The changes of the last century have been least significant, of all the elevation zones, in the eastside high elevation forests.... Although a fire exclusion policy has been in effect for almost a century, the naturally long fire return intervals have resulted in little noticeable change in these ecosystems at the stand level. At the landscape level, the absence of fire has probably resulted in a slight shift towards later seral communities and away from earlier seral communities*" (Agee 1992).

TRENDS:

- Fire exclusion has had the least effect because of very long natural fire return intervals. Similar to lodgepole. Meadows may have decreased in size to fire exclusion.

Human Influence on Fire Processes

The use of fire by Native Americans is well documented in other areas and may have occurred in this watershed but has not been documented. Fire suppression by early European settlers probably started in around 1870 with the establishment of the first homesteads. More organized fire suppression began in the early 1900's with the establishment of the Cascade Forest Reserve and the Forest Service. Systematic detection and suppression of fires accelerated around 1910 when a fire lookout was built on Black Butte. The establishment of other lookout stations on Black Crater, Trout Creek Butte, Tam McArthur Rim, and Cache Mountain followed through the 1940's. The town of Sisters even built its own lookout in a tall pine tree in the 1920's.

Forest areas now contain subdivisions surrounded by National Forest. It is unlikely that we will ever be able to let natural fire starts burn near these areas but prescribed burns are being done in the urban interface to reduce fuels and lessen the risk of wildfires which might burn homes. Fuels reduction tools such as thinning and mowing are being introduced and often will be followed by fire. Fuels reductions including prescribed fire are also done to improve safety for fire fighters, and protect important habitats and recreational areas. The reintroduction of fire is also being planned for the wilderness. We now understand that many local species have evolved with the process of fire and benefit from its reintroduction. It is recognized that the scope of these prescribed fires and other fuel modifications needs to occur at a larger scale to mimic historic landscape patterns.

Large fire suppression activities require fire camp areas where personnel and equipment can be staged and mobilized. Fire camps sites are limited in this area. It is beneficial to locate fire camps in the vicinity of fires to reduce driving time, improve traffic safety, reduce costs and limit resource impacts. Some historic fire camps have been abandoned because of other resource concerns such as sensitive plants.

TREND:

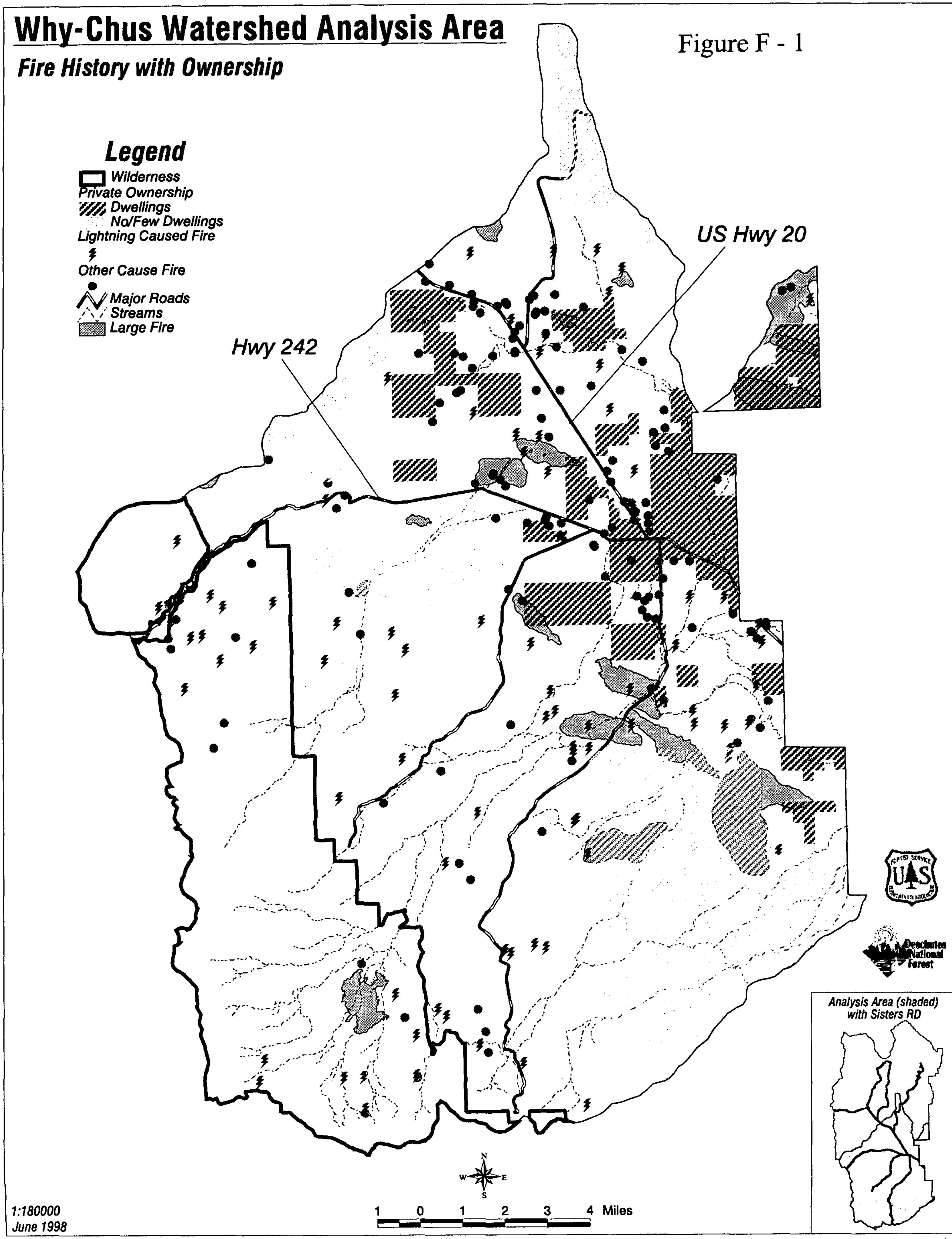
- People have suppressed fires and will continue to do, but reintroduction of fire to reduce fuels, benefit ecosystems and reduce wildfire risk is increasing.
- Fuels modification projects include thinning, mowing and/or burning and will continue to increase in scale.
- A fire camp site is needed in the local area.

Fire Risk and Occurrence

There have been 222 fires within the Why-chus watershed on National Forest lands between 1982 and 1996 that required suppression action for a fire occurrence of 1.7 fires per 1000 acres. However, there is a large area of private land, approximately 44,000 acres, where fire data was not analyzed.

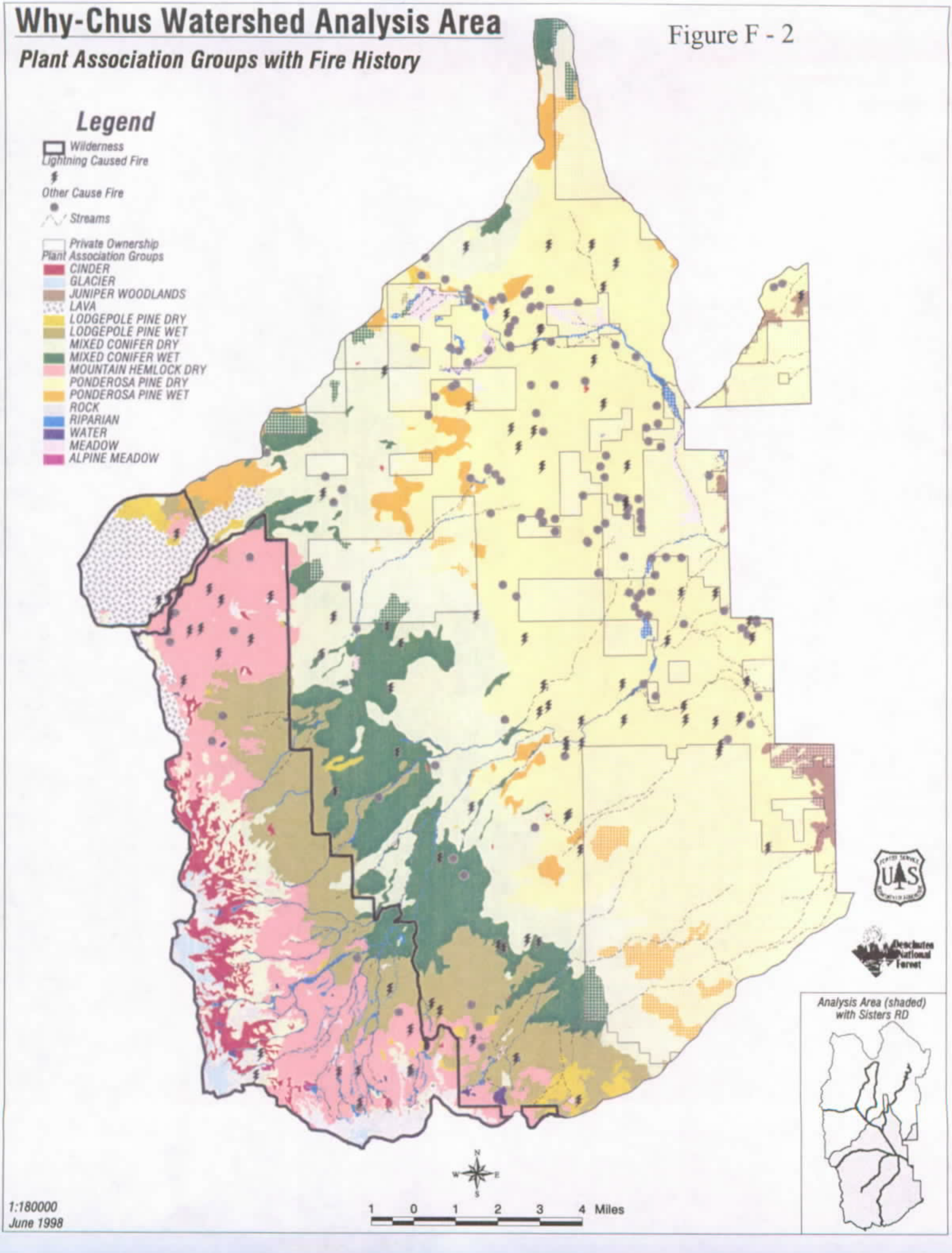
There is an average of 15 fire starts per year in the Why-chus watershed ranging from 10 starts in the pine stands to 3 starts in the higher elevation lodgepole and mountain hemlock stands per year.

There have been 145 fires, both lightning and human caused, within the ponderosa pine PAG. **Seventy percent of these (102) were human caused starts that have occurred near and between present day subdivisions and developed areas that are bordered by National Forest lands. This equates to 65% of the total fires that have occurred within the watershed**. See **Table F-1** and **Figure F-1**.



Why-Chus Watershed Analysis Area
Fire History with Ownership
Figure F - 1
Legend
Wilderness
Private Ownership
Dwellings
No/Few Dwellings
Lightning Caused Fire
Other Cause Fire
Major Roads
Streams
Large Fire
US Hwy 20
Hwy 242
Deschutes National Forest
Analysis Area (shaded) with Sisters RD
N
W
E
S
1 0 1 2 3 4 Miles
1:180000
June 1998

Figure F - 2



Why-Chus Watershed Analysis Area
Plant Association Groups with Fire History
Legend
Wilderness
Lightning Caused Fire
Other Cause Fire
Streams
Private Ownership
Plant Association Groups
CINDER
GLACIER
JUNIPER WOODLANDS
LAVA
LODGEPOLE PINE DRY
LODGEPOLE PINE WET
MIXED CONIFER DRY
MIXED CONIFER WET
MOUNTAIN HEMLOCK DRY
PONDEROSA PINE DRY
PONDEROSA PINE WET
ROCK
RIPARIAN
WATER
MEADOW
ALPINE MEADOW
Analysis Area (shaded) with Sisters RD
Deschutes National Forest
N
W
E
S
1 0 1 2 3 4 Miles
1:180000
June 1998

Table F-1. Fire Occurrence within the Why-chus watershed.

PAG	Number of Lightning Caused Fires	Number of Human Caused Fires	Total Fires	Percentage of Total Fires	Percent Fires that are Human Caused
Ponderosa Pine	43	102	145	65%	70%
Mixed Conifer	20	19	39	18%	48%
Lodgepole Pine	7	5	12	5%	42%
High Elevation	16	19	26	12%	38%

Large fires Large fire occurrences (over 50 acres) have been recorded since the early 1900's. Little is known about some of the earlier fires because records did not indicate their cause. There have been 19 fires since 1900. Of the 19 large fires this century, 16 have been located within the ponderosa pine PAG. Two large fires have occurred in the mixed conifer PAG and only one within the lodgepole pine and high elevation PAGs. A quick look at the location of these fires show that 13 of these fires were located in the Squaw Creek and Trout subwatersheds. See **Figure F-2**.

Fuel Loadings

Information about fuel loadings within this watershed is old and inaccurate for specific questions on tons per acre of fuel by size classes. Based on timber sale fuels inventories completed in the late 1980's, relative estimates can by made. No fuel loading information has been collected in the wilderness.

Fuel loadings within the ponderosa pine PAG range generally from 5 to 15 tons per acre, while the mixed conifer PAG ranges from 15 to 45 tons per acre depending on harvest activity and stand condition. Regeneration units within the mixed conifer PAG generally have lower fuel loadings than adjacent untreated stands (5 to 15 tons per acre). Fuel loadings in the high elevation forests range from 2 to 3 tons per acre in the grass meadows to greater than 30 tons per acre in decadent hemlock stands where there are large quantities of down material.

TRENDS:

- Most fires are human caused and are concentrated in the pine forest near the city and subdivisions.
- Fire risk and potential has increased with increased fuel loads and stand densities
- Most large fires have occurred in ponderosa pine forests and in the Squaw Creek and Trout Creek subwatersheds.

Biological Domain
Disturbance Processes- Wind

Blowdown potential for this watershed was analyzed considering 3 different variables, soil type, plant association and vegetation management activities.

- Soil Type: Only 85 acres contains soil types considered to be susceptible to blowdown. This represents an extremely small percentage of the watershed that is susceptible to blowdown as a result of soil type.

- Plant Associations: Volland (1985), rates plant associations found in this watershed by windthrow risk. Approximately 6% of the watershed acres are moderate to high risk for windthrow based on plant association. Of those acres, approximately 79% are in the high elevation mountain hemlock plant associations and of the remaining acres, 11% are in the lodgepole pine associations, 9% are in the mixed conifer wet (Englemann spruce bottomlands) and 1% are ponderosa pine plant associations.

- Management Activities: Vegetation management activities related to timber harvest have the potential to exacerbate windthrow potential in areas that already have moderate to high potential such as those mentioned above. Treatment unit design and layout related to topography and prevailing winds also have the potential to increase windthrow potential. In some recent timber harvest units in the lodgepole pine, larger scale blowdown has been occurring to residual trees in regeneration units and along the edges of those units as well as in some commercial thinning units.

In general, blowdown in the Why-chus watershed has been limited to individual trees or small groups of trees. Wind is responsible for creating small scale disturbance patches throughout the watershed. Small scale blowdown patches provide small openings/canopy gaps which can provide for wildlife and plant diversity. Wind is also an important contributor of large down woody material into riparian areas and stream channels especially in areas of high soil moisture. It appears that the majority of the large-scale blowdown potential is related to higher elevation mountain hemlock and lodgepole pine stands as well as areas of high soil moisture. Future vegetation management activities will need to carefully consider the above prior to implementing treatments.

TRENDS:

- Wind is a factor in creating small- scale disturbances that develop for habitat for some species.
- Susceptible soils and plant associations are limited.
- Management activity has increased blowdown in lodgepole pine stands.

Biological Domain-
Plant Species of Concern

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

What are the current habitat conditions and trends for the species of concern identified above?

What are the historical relative abundance and distribution of species of concern and the condition and distribution of their habitats in the watershed?

The Why-chus/Sisters Analysis Area contains a variety of habitats and within these habitats there are many rare, uncommon, and sensitive plant species. Protection status for these species vary, however, each species has been identified because of its unique contribution to biological diversity.

The plant species known to occur in the Why-chus watershed analysis area are listed in **Table SP-1**. Much of the area has not been surveyed and other rare species have the potential to occur. Species with potential to occur in the Why-chus analysis area are listed in **Table SP-2**.

No Threatened or Endangered plants are known to occur in the watershed. Three Sensitive plants identified by the Regional Forester are known:

1) Peck's penstemon - the southern most population of a rare endemic wildflower found only in Sisters,
2) Newberry's gentian - the northern most population of a regional endemic, sub-alpine meadow wildflower, and
3) Pumice Grapefern - the northern most population of a Central Oregon endemic occurring in alpine and lodgepole habitats.

Also present are twelve Survey and Manage Plants (seven fungi and five lichens), identified in the Northwest Forest Plan, which have a strong association with old growth forests. Three plants identified as Watch List by Oregon Natural Heritage Database are also known.

Table SP-1. Plant Species of Concern found in the Sisters/Why-chus Watershed:

SPECIES	TYPE	STATUS	OCCURRENCE	PAG	HABITAT NOTES
Astragalus peckii	Vascular plant	Sensitive	Central Oregon endemic	Juniper	Exposed areas and sandy pumice. East off Hwy 20 and near Henkle Butte.
Botrychium pumicola	Vascular plant	Sensitive	Central Oregon endemic	LP, Alpine	Pumice substrate in dry exposed habitats. West ridge of Broken Top. Northern most population.
Carex capitata	Vascular plant	Watch list	Circumboreal	Alpine	High montane areas. Three Creeks Lake.
Carex hysterica	Vascular plant	Watch list	North America	Riparian	Wet ground near streams, lowlands to mid-montane, rare in our area. Cold Springs.
Castilleja chlorotica	Vascular plant	Sensitive	Central Oregon endemic	PP,LP	Dry open ponderosa forests, frequently growing on lava scab. Site may be mis-mapped. Generally found south of Sisters.
Draba aureola	Vascular plant	Watch list	Regional endemic	LP, Alpine	On volcanic rock above timberline. Three Sisters and Broken Top.
Gentiana newberryi	Vascular plant	Sensitive	Regional endemic	Riparian	Moist subalpine and alpine meadows in the Three Creeks Lake area and nearby.
Penstemon peckii	Vascular plant	Sensitive	Sisters endemic	PP, MCW, MCD	Patchy distribution, at lower ends of watersheds, Larson soil type 8 is often an indicator.
Elaphomyces subviscidus	Rare truffle	SM 1,3	1 of 2 known sites in OR,	LP, High Elev Forest	Mycorrhizal association with lodgepole Hemlock. Three Creek.
Helvella crassitunicata	Rare cup fungus	SM 1,3	North America	Riparian MCW	Montane forests containing *Abies* species. Three Creek.
Nivatogastrium nubigenum	False truffle	SM 1,3	Regional endemic	MCD MCW	Surface rotten Abies logs at high elevations >4000 ft. Three Creek.
Rhizopgon flavo-fibrillosus	Rare false truffle	SM 1,3	Regional endemic	MCW MCD	Mycorrhizal association Pinus spp, PSME, or ABCO. Three Creek.
Rhizopogon evadens var. subalpinus	Rare false truffle	SM 1,3	Regional endemic	High elev forest	Mycorrhizal association with high-elevation TSME and Abies.. Soap Creek.
Calicium sp.	Pin lichens	SM 4	N. Europe, PNW	PP, MCW	On medium to large snags without bark, generally near water. Trout Creek Swamp and Round Lake.
Cladonia norvegica	Lichen on soil	SM 3	PNW	PP, MCW	On rotten wood in humid forests Snow Creek.
Lobaria pulmonaria	Nitrogen -fixing lichen	SM 4	PNW	MCW	Large foliose lichen found on vine maple, cottonwoods and mossy rock. Pole Creek.
Peltigera collina	Nitrogen -fixing lichen on soil	SM 4	PNW	MCW, MCD	Found on mossy bark and rock. Or riparian settings on mossy bark of cottonwoods and vine maple and some sites on mossy rock on the desert fringe. Pole Creek.
Pseudo-cyphellaria anomala	Nitrogen fixing lichen	SM 4	PNW	MCD MCW	Moist forests, most often on hardwoods and shrubs or rocks. Pole Creek.

Table SP-2. Plant Species of Concern that have potential to occur in the Sisters/Why-chus watershed:

SPECIES	TYPE	STATUS	OCCURRENCE	PAG	HABITAT NOTES
Agoseris elata	Vascular plant	Sensitive	PNW endemic	PP	Meadows and open woods, dry edges of moist ecotones. Metolius River.
Allotropa virgata	Vascular plant	SM 1,2	North America	MCD, MCW, LP	Symbiotic w/ conifers and their ectomycorrhizal fungi. Associated with closed canopy Douglas fir or old growth ponderosa pine.
Arnica viscosa	Vascular plant	Sensitive	OR and CA	High elev. forest &, lava	Rocky places, scree and talus slopes, at or above timberline.
Collomia debilis var. larsenii	Vascular plant	Watch list	Cascades WA to CA	Lava rock	Talus slopes on the high peaks of the Cascades. Cache Mountain.
Cypripedium montanum	Vascular plant	SM 1,2	Within the range of the NWFP	MCD, PP	Can be found in scattered sites on both sides of the Cascades. Mainly in moist woods. Abbot Creek.
Lobelia dortmanna	Vascular plant	Sensitive	1 known site in OR Sisters RD	Lake, Riparian	In shallow water.
Alpova alexsmithii	Rare false truffle	SM 1,3	Cascade endemic	High elevation foreset	With roots of conifers, particularly Hemlock. Near Cabot Lake in the Mt. Jefferson Wilderness.
Cantharellus subalbidus	Fungi	SM 3,4	Regional endemic	MCD, MCW	On ground, often with *Armillaria ponderosa.*
Elaphomyces anthracinus	Rare truffle	SM 1,3	Sisters	PP	One known site in N America, near the Metolius River, associated with old growth ponderosa pine.
Gastroboletus ruber	Rare Boletus fungi	SM 1,3	Cascade endemic	High elevation forest	Above 4,000 ft with the roots of conifers, esp. mountain hemlock, silver and noble fir and western white pine. Near Cabot, Carl and Shirley Lakes in the Mt. Jefferson Wilderness.
Gomphus floccosus	Fungi	SM 3	North America	MCD	Conifer forests.
Hygrophorus caeruleus	Uncommon gilled mushroom	SM 1,3	PNW endemic	MCW	Mid-elevation to montane conifer forests. May be restricted to *Abies.* Jack Creek.
Hydnotryna inordinata	Rare truffle	SM 1,3	Rare local endemic	High elevation forest	With the roots of silver fir, Douglas fir, lodgepole, and mountain hemlock. Shirley Lake, Mt Jefferson Wilderness.
Gymnomyces abietis	Rare false truffle	SM 1,3	Rare local endemic	High elevation forest	With the roots of Abies and other conifers above 3,000 feet. Shirley Lake, Mt Jefferson Wilderness.
Collema sp.	Riparian lichen	SM 4	Americas	Riparian	Moist riparian forests, often on hardwoods.
Hydrothyria venosa	Aquatic lichen	SM 1,3	North American endemic	Aquatic	On rocks in very cold clean streams.
Lobaria halli	Nitrogen-fixing lichen	SM 1,3	Regional endemic	MCW, Riparian forests	With old cottonwoods, maple, moist forest areas.

Nephroma helveticum	Nitrogen-fixing lichen	SM 4	PNW	MCW	Moist riparian forests. First Creek.
Nephroma resupinatum	Nitrogen-fixing lichen	SM 4	PNW	MCW	Moist riparian forests. First Creek.
Pseudo-cyphellaria anthrapsis	Nitrogen-fixing lichen	SM 4	PNW	MCW	Moist riparian forests. First Creek.
Buxbaumia viridis	Moss	PB	Interruptedly circumboreal	Riparian, MCW	Shady humid forests, rotten logs Stream terraces, floodplains.
Marsupella emarginata var. aquatica	Aquatic Liverwort	SM 1,2	1 known site Waldo Lake/ Central Cascades	Aquatic	Submerged in shaded, cold perennial streams.
Tetraphis geniculata	Moss	PB	Interruptedly circumboreal	Riparian, MCW	Dense shady humid forests rotten logs , Stream terraces, floodplains.
Tritomeria exsectiformis	Liverwort	SM 1,2	PNW, 1 site Okanogan, 6 sites Deschutes	Riparian	On peaty or humic soil, or rotting wood, often on creek banks where perpetually shady and moist.
Ulota megalospora	Moss	PB	PNW endemic	Riparian, MCW	Epiphytic on conifers and hardwoods.

* Sensitive= Region 6 USFS List, SM = Survey and Manage Species List, Protection Categories 1,2,3,4, NW Forest Plan, PB= Protection Buffer Species, NW Forest Plan, Watch List= Oregon Natural Heritage Database List

The following is a summary of the status and habitat conditions of major habitat types found in the watershed and their focal plant species. Focal species represent a variety of other species with similar habitat needs.

Low Elevation Old Growth Pine / Forest Floodplains: Ponderosa Pine, dry mixed conifer forests and meadow openings

Focal Species: Penstemon peckii (Peck's penstemon)

Other potential species: *Elaphomyces anthracinus* (Truffle), *Agoseris elata* (Tall Agoseris)

Characterization: Peck's penstemon is endemic to approximately 325 square acres, centered around Black Butte on the Sister's Ranger District. It requires seasonally moist old growth pine forest habitats, including low elevation moist and wet meadows. It is also an indicator of seasonally inundated floodplains, seasonally moist habitats or channels. The Species Conservation Strategy identifies the five most important abiotic and biotic variables involved in the viability of Peck's penstemon to be:

1) abundant moisture,
2) light,
3) abundant pollinators,
4) periodic fire, and
5) flooding for seed dispersal and germination.

Habitat requirements for Peck's penstemon may be similar to requirements for other species which are likely to be fire adapted such as morel mushrooms, sensitive vascular plants, such as Tall Agoseris, or *Elaphomyces anthracinus*, a rare truffle.

Reference Conditions The historical distribution and abundance of Peck's penstemon and other plant species of concern associated with this habitat are unknown. However, we do know that historically the area had complex functioning floodplains that provided more habitat for species such as Peck's penstemon. Periodic high water on Squaw Creek flowed freely across the landscape creating complex channels supporting riparian and ephemeral wet areas in forest areas.

Many species found in this habitat type are known or believed to be fire adapted, benefiting from periodic low intensity fire. Naturally occurring fires played a large role in maintaining plant habitat. With frequent fire cycles of low intensity fires, these forests were open and sunny with fire maintained meadows. Fires left areas of bare mineral soil where seeds could germinate. Many historic accounts describe open stand conditions with large trees and little underbrush.

Current Condition and Human Caused Changes

Most known populations of Peck's penstemon are on National Forest land. There are 26 occurrences within the analysis area. Four of the 26 are under other ownership. One population is owned by the City of Sisters at the City Park, one population is owned by the Sisters School District, and two others are under private ownership. Several populations on private lands are not mapped or described.

A total of 98,000 plants, or 40% of the global population, is within the analysis area, which encompasses the southern extent of the global population. A population associated with Glaze Meadow is the second largest population on the Sister's Ranger District. Nine of the twenty-five designated "protected populations" in the Species Conservation Strategy, crucial to long term species survival, are found within this watershed (O'Neil, 1992).

Presently, sixteen of the occurrences of Peck's penstemon in the Why-chus watershed are termed "managed populations", meaning they are to be managed for the enhancement of Peck's penstemon habitat with existing or experimental forest management tools suspected to be of benefit to the species. Loss of more than 20% of a population that exceeds 500 individuals is not recommended. Losses of individuals less than 500 plants should not exceed 10%. Permanent loss of habitat is not recommended.

The Species Conservation Strategy recommends that no permanent habitat loss is allowed in the "protected populations" and that loss of individual plants due to active resource management not exceed 0.2% in populations greater than 2000 individuals and 0 in populations less than 2000. Two populations have lost federal protection through land exchanges. One of these populations is now protected by a conservation easement through a local land trust. Several other population areas may be proposed for exchanges in the future.

In the early 1900's to 1930's, grazing in this area by thousands of sheep and some cattle may have consumed many plants and grasses during their flowering season and prevented seed production. Grazing continued in some areas at a lesser, more controlled scale through the late 1970's. The long-term effects of grazing on Peck's penstemon are unknown. However, intensive grazing can limit sexual reproduction and restrict plants to clonal reproduction. This is not believed to be beneficial for the long-term survival of rare plant species (Dr. Ed Guerrant, personal communication).

Severe ground disturbance, including timber harvest activities that uproot plants can extirpate populations. Peck's penstemon populations in otherwise contiguous habitat have been observed to stop at private land boundaries where the soil was severely disturbed (Pogson 1979). If the seed bank is depressed from canopy closure before harvest or conditions are too dry for germination, the population is in particular danger of being lost. Moderate to light disturbance, which does not destroy plants, can create bare soil where new plants can grow. Plants are often found in skid trails. However, there is no evidence that timber harvest is beneficial to populations. Only one comprehensive study has been completed on study of the effects of timber harvest on Peck's penstemon (Ingersoll 1993). It showed the abundance of plants declined significantly at all harvest sites. See Metolius Watershed Analysis (1996).

Fire exclusion has changed habitats and reduced the size and quality of meadow habitats. Other human caused changes are summarized below.

Trends

- **The historically open park-like ponderosa forest and interspersed meadows have been altered through fire suppression and selective harvest of large trees.** This has favored a forest with more canopy cover, more fir and juniper tree species, fewer large live and dead trees, with more organic material on the forest floor. Fire exclusion has allowed shrubs to increase. Small trees are invading meadows. These conditions reduce success for fire adapted species which require bare mineral soil for germination. Increased shade decreases flowering success for species such as Peck's penstemon.

- **Altered stream channels have reduced floodplains, swamps, and meadow habitats. Future flood control on Trout Creek may effect penstemon populations.** A large population is located in a floodplain area that the Oregon Department of Transportation has proposed for channelization to protect Highway 20. *Also see Riparian habitats, this section.*

- **The introduction of invasive non-native plants called noxious weeds threatens these habitats.** Diffuse and Spotted knapweed are spreading rapidly along roadsides and disturbed sites in the downtown Sisters, Indian Ford, and the Tollgate area. Noxious weeds can out compete native species and reduce habitat quality.

- **Changes in land ownership have cumulatively reduced the amount of pine forest floodplains in federal ownership. Some private lands are being protected by a local Land Trust.** Three parcels of national forest land near the Sisters urban area have been exchanged in the past 10 years. Two parcels have contained populations of Peck's penstemon. One of these parcels was protected with a conservation easement designed to restrict activities that might harm the plant. Several other parcels with Peck's penstemon near downtown Sisters may be considered for land exchange in the future. The plant has no legal status requiring protection on private lands and it may be destroyed by developments.

- **Changes in land use have cumulatively reduced the amount of pine forests and floodplains.** Several pine forest habitats on private land have been developed into housing areas, i.e. Black Butte Ranch, Indian Ford area, and Buck Run. Houses and infrastructure have replaced habitats where plants such as Peck's penstemon once grew.

- **Dispersed camping is affecting penstemon populations in a few localized area.** Of special concern is the overflow area at Cold Springs Campground and large campsite off Rd 1012.

Juniper/Pine Forests: Juniper woodlands, grasslands, pine forest fringe

Focal Species: *Astragalus peckii* (Peck's milkvetch)

Characterization This plant is a Central Oregon endemic growing on exposed areas and rocky pumice.

Reference Conditions The juniper/grasslands east of Sisters pine forests was historically more open because of low intensity frequent fires. There was less small juniper and shrubs and more grass. Cheatgrass is reported to have been introduced to the area in 1910 in contaminated wheat seed (Wilson and Scott, 1974).

Current Conditions Several populations of Peck's Milkvetch occur on private juniper grasslands east of Sisters. Fire exclusion and cheatgrass have changed these habitats and reduced their quality for many plants. Many of these areas are being sold and developed. Potential unsurveyed habitat exists on federal lands.

Changes and Trends

- **Loss of habitat is occurring on private lands.** Development of former agricultural lands for housing continues.
- **Alteration of juniper/grassland habitats has occurred with fire exclusion.** Fire exclusion has increased shrubs and juniper and decreased grasses and forbs.
- **The introduction of invasive non-native plants and noxious weeds threatens these habitats.** Cheatgrass, Diffuse, and Spotted knapweed are spreading rapidly along Highway 20 and disturbed sites in downtown Sisters. Noxious weeds and aggressive non-natives such as cheatgrass, can out compete native species and reduce habitat quality.

Riparian: including cottonwood galleries, swamps, and meadows

Focal Species: Nitrogen-fixing lichens: *Peltigera collina*, *Lobaria pulmonaria*; and *Pseudocyphellaria anomala*, *Lobaria hallii*, *Penstemon peckii*

Other associated Species: Lichens - *Cladonia norvegica*, Caliciales (Pin Lichens); Sedges - *Carex hysterica*

Characterization: Survey and Manage riparian lichen species reported to occur in the analysis area include: *Peltigera collina*, *Lobaria pulmonaria* and *Pseudocyphellaria anomala*. These component 4 lichens were found on rocks on a slope above Pole Creek. *Lobaria hallii*, a component 1 & 3 survey and manage lichen species, found in cottonwood galleries in drainages north of the analysis area, may also occur here. None of these lichens have been reported from elsewhere on the Deschutes NF. They require more moisture and perhaps milder wetter winters than the rest of the forest provides. They are extremely sensitive to air pollution and valuable contributors of nitrogen which is scarce in old growth settings. They have epiphytes of their own including invertebrates and microfungi, which contribute greatly to species diversity in old growth stands (Sillett & McCune, 1998).

Rotting wood can also be habitat for Survey and Manage lichens. *Cladonia norvegica* was reported on rotting wood along the banks of Snow Creek. Potential habitat and more occurrences are highly likely along other riparian areas with abundant dead woody material (McCune & Geiser, 1997). Caliciales are a group of tiny, pin-like lichens that grow on the boles of large snags that have lost their bark. They have been found near Trout Creek Swamp and are probably present on many snags in wet areas throughout the analysis area.

Carex hysterica (porcupine sedge) was found at Cold Springs Campground. Porcupine sedge is uncommon and on the ONHP watch list.

Reference Conditions Reports from early European explorers describe streams such as Indian Ford Creek (known as Swamp or Slough Creek) lined with dense brush and mires (Abbot, 1855). The wet meadows around what is now Black Butte Ranch were wetter and had an abundance of shrubs that prevented the expedition from crossing them. There were many types of berries growing at the edges of the wet meadows including whortleberry, serviceberry, and elderberries. Maps from 1920 indicate the wet areas near Black Butte may have been larger than they are today. Streams within the analysis area were unaltered until the late 1880's when water began to be diverted for agricultural and domestic uses. There were many springs and small tributaries running into Squaw Creek, carrying water even in early September. With more brush cover along stream banks and unaltered stream flows, cottonwood galleries and riparian hardwood species were possibly more plentiful, perhaps providing more habitat for riparian lichen species.

Current Conditions, Changes and Trends

- **Altering and channeling stream flows has reduced and dried cottonwood galleries, floodplains, swamps, and meadow habitats.** The once dense, complex riparian habitat within the watershed have been dried and simplified through many human activities. Wet meadows and swamps, such as Black Butte Swamp, Trout Creek Swamp, Pole Creek Swamp, and Big Slough were channeled to divert water and dry them out to make grazing easier. Willows and other shrubs have been removed from streambanks. Cottonwood galleries were cut off from stream flows and isolated, limiting disturbance from flooding which aids regeneration. There are few cottonwood galleries or areas with heavy shrub cover, thus reducing habitat for riparian lichen species such as *Lobaria hallii, Lobaria pulmonaria, and Pseudocyphellaria anomala.* Grazing and the planting of other grasses, such as Kentucky bluegrass, have altered species composition.

- **Changes in land use and ownership, especially the conversion of farmland and forest lands into developed lands, has impacted plant species of concern directly by altering habitat or indirectly by increasing pressures on existing habitat.** Pressures include competition from non-native species, less available water, soil compaction, and exposure to trampling. Alterations in habitat, such as ditching and exclusion of fire, have altered species composition, changing substrates available to lichen species as well as eliminating some species.

- **Dead woody material is missing** from the meadow-like appearance of many pastures along Indian Ford Creek. Removing dead woody material from streambanks reduces potential Caliciales, *Tritomeria exsectiformis*, and *Cladonia norvegica* habitat.

Higher Elevation Wet Meadows and Springs

<u>Focal Species</u>: Gentiana newberryi (Newberry's Gentian), Tritomeria exsectiformis (Liverwort), Caliciales (Pin Lichens)

Characterization High elevation wet meadows have potential for containing several rare species. Three

Creeks Meadow contains the northern-most occurring population *of Gentiana newberryi* (Newberry's gentian) on the Deschutes NF. Twin meadows and the riparian area surrounding North Pole Creek, which flows from the spring-fed wet meadow, may support a small, very rare liverwort, *Tritomeria exsectiformis*, which requires rotten wet wood (Christy & Wagner, 1996). *Tritomeria exsectiformis* is also a component 2 survey and manage species. Pin lichens were found along a forested swamp edge. The Caliciales group or pin lichens are survey and manage component 4. They are common in moist sites with stage 5 (big barkless) snags.

Reference Conditions Channelization to dry meadow habitats for grazing and diversion of water began in the early 1900's. Removal of large trees (subsequent downed wood) adjacent to streamside meadows and forests began early with a water powered mill along upper Pole Creek. In the early 1900's to 1930's, extensive grazing in this area by thousands of sheep and some cattle consumed many plants and grasses during their flowering season. Grazing continued in some areas at a lesser, more controlled scale through the late 1970's. No road existed to the Three Creeks lake area until the 1920's and human use was light.

Current Conditions, Changes and Trends

- **Disturbances such as flooding and fire have been excluded or altered.** Lodgepole are encroaching into the meadow areas. The spruce/cottonwood swamps show indications of past flooding events, but shows no evidence of such an event recently. What appears to be otherwise good potential habitat for large leafy lichen species such as *Lobaria* and *Pseudocyphellaria* is not occupied by these species. Possibly, the lack of seasonal flooding has altered the microclimate, thus rendering the area unsuitable for the large leafy lichens. Other factors, such as prevailing weather patterns and lichen populations available as origins for dispersal, may be more significant. Trout Creek Swamp does support Caliciales on the large standing, barkless snags next to the creek, however.

- **Water diversions and channelization have affected wet meadows and swamps.** Trout Creek Swamp was dammed and ditched. Twin Meadows has also been ditched. Woodcutting has eliminated much of the dead woody material that might otherwise line the edges of this wet meadow. A thick hedgerow of lodgepole lines the northwest edge of the meadow next to the ditch. It is possible the species composition of the meadow has been altered through ditching.

  Three Creeks Meadow, Trapper Meadow, and Little Three Creeks Lake all have populations of Newberry's gentian. Diverting water from the creek flowing from Little Three Creeks Lake has removed water that once fed the meadows between Three Creeks Lake and Trapper Meadow, altering habitat for Newberry's gentian.

- **Recreational use by hikers and horses affects these meadows, especially around Three Creeks Lake.** A popular horse camp is situated on the edge of Trapper Meadow and near the wilderness attracting horse use to sensitive subalpine meadows and adding a vector for the introduction and spread of noxious weeds. Hikers and campers use these areas extensively during the summer months, compacting soils and damaging vegetation. Illegal actions by off-road vehicles periodically damage wet meadows.

High Elevation Forest/Alpine Habitats: Dry and wet mixed conifer forests, lodgepole forests, and alpine areas.

Focal Species: *Ramaria* species (coral fungi), *Allotropa virgata* (candy stick), *Rhizopogon evadens* var. *subalpinus* (rare false truffle), *Nivatogastruim nubigenum* and *Rhizopogon flavofibrillosus* (rare false truffles), *Elaphomyses subviscidus* (rare truffle), as well as, *Helvella crassitunicata* (rare elfin saddle), *Draba aureloa* (golden alpine draba), *Carex capitata* (capitate sedge), and *Botrychium pumicola* (pumice grapefern).

Characterization The southwestern edge of the analysis area is wilderness containing subalpine and alpine vegetation. The northern most population of the Central Oregon endemic, Pumice Grapefern, is found on the high alpine slopes of the Three Sisters. Other rare plants include *Draba aureola,* found on volcanic rock at timberline, and *Carex capitata*, which is found in high montane areas. High elevation mixed conifer and mountain hemlock forests may also contain *Allotropa virgata*, a component 1& 2 survey and manage species.

At least one rare false truffle, *Rhizopogon evadens var. subalpinus*, is found along the lower slopes of the North Sister. *Rhizopogon evadens var.subalpinus* has been found in the PNW within the range of the spotted owl very rarely (Castellano & O'Dell, 1997). The Three Creeks Lake area is known to support a variety of rare fungi. Within high elevation old growth forests there are rare false truffles, *Nivatogastrium nubigenum* and *Rhizopogon flavofibrillosus*, a rare truffle, *Elaphomyces subviscidus*, as well as, a rare elfin saddle, *Helvella crassitunicata.* Three rare truffles, *Elaphomyces subviscidus, Nivatogastrium nubigenum,* and *Rhizopogon flavofibrillosus* are hypogeous (grow underground) around Three Creeks Lake. All of these fungi, except the elfin saddle, are presumed to rely on mycophagy (being consumed by animals) for spore dispersal. All of the mentioned fungi (except for *Nivatogastrium nubigenum*, which lives on rotten wood) are ectomycorrhizal formers, meaning they form a mutually beneficial association between a fungus and a plant root. Mycorrhizal associations aid in tree growth and resistance to disease. Threats would include any activity that would cause loss of habitat through disturbing the soil or duff or in the case of *Nivatogastrium nubigenum,* the removal of dead rotting woody material (Castellano & O'Dell, 1997). There is a potential habitat for other rare fungi such as some *Ramaria* species.

Reference Conditions The high elevation forest was much as it is today, but without as much human use. Lightning fires burned freely. In the early 1900's to 1930's, grazing in this area by thousands of sheep and some cattle may have consumed many plants. Grazing continued in some areas at a lesser, more controlled scale through the late 1970's. Grazing allotment improvement plans included "rodent control" in wilderness meadows such as Park Meadow. No road existed to the Three Creeks lake area until the 1920's and human use was light at this time.

Current Conditions, Changes, and Trends

- **Increased recreational use of the wilderness puts rare truffles and other mycorrhizal fungi at risk from trampling and camp developments.** This trend has been tempered by increasing controls on users, such as limiting campsites in some sensitive areas and the wilderness permit system.
- **Continued suppression of fire will affect high elevation forest dynamics and plant ecology**.
- **Elimination of grazing from wilderness areas has improved habitat** and has eliminated such practices as rodent control, which could have reduced mycophagy and spore dispersal of rare truffles and other fungi.

Biological Domain-
Wildlife Species of Concern

Characterization

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

There are approximately 349 wildlife species known or suspected to occur in the watershed **(Appendix W-1).** Several species have been identified as Federally Threatened, Endangered or Sensitive. The State of Oregon has identified several species as State Sensitive because they are likely to become threatened or endangered. In addition, the Forest Service has a list of Regional Sensitive species and the Deschutes National Forest has several Management Indicator Species (MIS). All have specific management guidelines. Management indicator species are species the Deschutes National Forest has selected to provide specific Standards and Guidelines for their management **(Appendix W-1)**. Focal species are guild representatives. For example, providing habitat for a specific guild (of focal species) will provide habitat for a number of species that have similar habitat requirements.

The quality and quantity of wildlife habitats within the watershed are diverse. Wildlife habitats are provided in juniper woodlands, ponderosa pine, mixed conifer (dry and wet), lodgepole pine, high elevation mountain hemlock, and riparian plant association groups (PAGs). Within these PAGs are unique and special wildlife habitats. Old growth remnant patches, wet meadows, lava flows, rock outcrops, bridges, alpine and subalpine lakes are habitats that are limited in size and rare in the watershed. These habitats provide unique microclimates and floral species that may not be found anywhere else in the watershed. In addition, some wildlife species are found in these unique areas and nowhere else. For example, a cave on the district provides hibernaculum for bats, one of only a few on the Forest. The number of acres of old growth is unknown, however there are 2800 acres (2%) in the watershed allocated to managing old growth (MA-15 and MA-27) and 776 acres (15%) of LSR 26.

There are a variety of seral stages and forest structures associated with each PAG. In general, the watershed has changed from a fairly homogeneous, large tree landscape composed primarily of widely spaced large and medium trees to a heterogeneous landscape with dense stands of small, early, and mid-seral patches. There are significant amounts of edge habitat with high edge contrast. Late-successional interior forest habitats are highly fragmented and poorly connected.

Historically, early seral patches and edge habitats comprised a small percentage of the landscape. The early seral patches may have been larger in size because they were created by occasional stand-replacement fires or other disturbance events. Early seral wildlife species were probably less abundant than today.

Historically, snag densities compared to today's levels are unknown because the effects of insects and diseases on the forest vary through time. Down log densities were probably lower than today because of the frequent low to moderate intensity fires, and the absence of logging debris. Road densities have changed from very few to many, increasing access for resource management and recreation.

Wildlife Habitat: Plant Association Groups (PAGs) and Associated Terrestrial and Avian Species

PAGs are used to delineate general wildlife habitats because they contain similar vegetation, soils, rainfall, and elevation. Focal species are species that are closely tied to the PAG for all their habitat needs. If populations of these species are present and in good health, other species requiring the PAG will also be in good health. Essentially, management for the focal species provides for most of other species needs **(Table W-1).**

Table W-1. *Focal species and the plant association groups (PAG) they use in the watershed. Deschutes National Forest, Sisters Ranger District, Sisters, Ore. 1998.*

Focal Species	Plant Association Group*					
	MCD	MCW	PP	LP	MH	RIP
Bald Eagle			X			X
Spotted Owl	X	X				X
Northern Goshawk	X	X	X			X
Marten	X	X		X	X	X
Wolverine		X		X	X	X
Fisher		X		X	X	X
White-headed Woodpecker	X		X			X
Black-backed Woodpecker	X			X	X	X
Pileated Woodpecker	X	X				X
Williamson's Sapsucker	X					X
Cascades Frog						X
Tailed Frog						X
Spotted Frog						X

- * - **MCD** - Mixed Conifer Dry, **MCW** - Mixed Conifer Wet, **PP** - Ponderosa Pine, **LP** - Lodgepole Pine, **MH** - Mountain Hemlock, and **RIP** - Riparian Habitat.

Reference Conditions, Current Conditions, and Trends

What are the historical relative abundance and distribution of species of concern and the condition and distribution of their habitats in the watershed?

What are the current habitat conditions and trends for the species of concern identified in above?

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?

Wildlife Habitat Assessment by Plant Association Groups (PAGS)

Juniper/bitterbrush/bunchgrass

Management Indicator Species: deer and elk

Juniper woodlands comprise approximately 1% of the watershed. Prior to livestock grazing and fire suppression, juniper and bitterbrush were minor components of this PAG and native grasses dominated the area. Grassland species such as pronghorn antelope may have utilized this area (Bailey 1936).

Fire suppression has allowed bitterbrush and junipers to increase while forbs and grasses have declined. Bitterbrush is widely distributed and in many age classes. The large quantity of bitterbrush provides critical winter and transition range for mule deer and elk. Introduced cheatgrass has proliferated.

TREND: With fire suppression, the increase in juniper and bitterbrush has greatly improved forage and cover for deer, elk, and numerous bird species. Unfortunately, this PAG is at risk to hot fires if not maintained by cooler, prescribed fires. Cheatgrass has increased fire risk.

Ponderosa Pine PAG

Focal Species: northern goshawk, white-headed woodpecker, and northern bald eagle

Historically, large unfragmented patches dominated the landscape. In 1953, 97% of this PAG was dominated by med/large size class trees. Most of the PAG had open canopies of one or two stories. The vertical structure of these stands was probably less complex than today because of frequent, low to moderate intensity fires. Cover and forage (dense thickets and bitterbrush) would have been less common and forage, in the form of grasses and forbs, would have been abundant with frequent fires.

Currently the watershed is dominated by ponderosa pine PAG (44%). Only 9% of this PAG is dominated by medium to large trees (>21" dbh). **The acres dominated by big trees (trees over 21") have decreased by 88%.** Much of this PAG (62%) is dense stands of small size class trees (9-21" dbh). Bitterbrush, snowbrush, and manzanita now dominate some sites.

Landscape conditions changed drastically from 1953 to the present. The landscape has more patches of varying sizes and structural stages and is heavily fragmented. The large unfragmented ponderosa pine forests have been significantly reduced on the landscape.

TREND: Stand structure has changed from the large patches of open large tree habitat to smaller patches of large tree habitat with numerous patches of small dense trees. Late-successional habitat is limited and poorly connected. Focal species populations are probably lower than under historic conditions. The distribution of these species is dictated by the location of medium and large tree habitat, as well as, other interspecific and intraspecific competition factors, like predation, etc. Loss of the large tree component along riparian reserves has reduced nesting habitat for bald eagles. Focal species, such as goshawks and white-headed woodpeckers, that utilize open, park-like stands of medium and large tree habitat have lost approximately 80% of their habitat. Population levels are probably reduced due to this. Other species such as deer, small mammals, and shrub/ground nesting birds that utilize denser understories with numerous shrubs and small trees have benefited from timber harvest and fire suppression. Edge related species that have benefited from an increase in habitat are now declining because smaller predators (corvids, coyotes, raccoons, bobcats, etc.) have increased in the absence of larger predators (wolves, bears, and goshawks).

Dry Mixed Conifer PAG

Focal Species: northern goshawk, northern spotted owl, white-headed woodpecker, Williamson's sapsucker, pileated woodpecker, and American marten.

Approximately 19% of the watershed is in the dry mixed conifer PAG. Historically, ponderosa pine and Douglas-fir dominated with some white fir. Understories were mostly open but with some small trees and shrubs. In 1953, 95% of this PAG was dominated by trees in the med/large size class compared to 15% today. **The acres dominated by big trees (trees over 21") have decreased by 80%.** Today, white fir is very common on many sites and understories are dominated by dense thickets of small trees and shrubs.

Portions of this PAG are on north facing slopes and function as spotted owl habitat. There are 13,655 acres of nesting, roosting, and foraging habitat (NRF) occurring within this watershed. Forty-three percent (5930 acres) of this NRF habitat occurs in this PAG. This results in 19% of the dry mixed conifer PAG being in a NRF condition. NRF habitat contains components of late seral and old-growth forests. Small size classes dominate most of the remaining acres in this PAG. Bitterbrush, snowbrush, and manzanita now dominate some sites.

TREND: The landscape is more heterogeneous with many small habitat patches and more edge effect (ecotones lack vegetative and climatic conditions found in the interior of the stand). The forest landscape has changed from the large patches of ponderosa pine and Douglas-fir dominated habitat to smaller fragmented patches with a mixed and climax species composition. Smaller tree sizes are more prevalent. Late-successional habitat structure is more complex (more canopy cover and multi-storied) where it occurs due to fire suppression. Species dependent on medium to large tree habitat and old and late structure forests have lost approximately 80% of their habitat. Focal species populations are probably lower than under historic conditions because of habitat fragmentation, increased edge, loss of somewhat open understories, and less large tree habitat. Similar to the ponderosa pine PAG above, other species such as deer and small mammals that utilize denser understories with numerous shrubs and small trees have benefited.

Wet Mixed Conifer PAG

Focal Species: northern goshawk, northern spotted owl, wolverine, fisher, American marten, and pileated woodpecker.

The watershed is approximately 9% wet mixed conifer. In 1953, 93% of this PAG was dominated by trees in the med/large size class. The wet mixed conifer PAG provided a majority of the multi-storied, high canopied patches. Species associated with late-successional mixed conifer habitats (i.e., northern spotted owl and pileated woodpecker) that were vertically complex, multi-storied and high canopied may have been more abundant than today and a minor component in the watershed.

Currently, 18% of this PAG is dominated by med/large size classes and 14% is classified as potential old growth. **The acres dominated by big trees (trees over 21") have decreased by 75%.** Trout subwatershed has the most wet mixed conifer, the most nesting-roosting-foraging habitat (NRF), and the most northern spotted owl nest sites (2) in the watershed. However, most of the PAG (64%) is dominated by small tree size classes. White fir dominates sites once dominated by ponderosa pine and Douglas-fir. Fire suppression has allowed understories to flourish similar to those of dry mixed conifer and ponderosa pine PAGs. However, the change is relatively less because fires may have been less frequent than in the drier PAGs.

Increased stand densities have raised concerns for significant loss of habitat to stand replacing fires. Most of this PAG is under the management guidelines outlined in the Northwest Forest Plan for the northern spotted owl. Managing for old-growth characteristics and fire requires acceptance of a variety of risks. Suppressing low intensity fire has allowed white fir to compete with ponderosa pine reducing pine vigor and has increased fuel loadings which increases the risk of high intensity fires. Of the 14% of this PAG that is considered potential old growth, 87% has been delineated as nesting-roosting-foraging habitat (NRF). NRF habitat comprises 28% of the wet mixed conifer PAG.

TREND: Similar to dry mixed conifer PAG, the landscape is more heterogeneous with many small habitat patches and more edge effect. Late-successional habitats are heavily fragmented and poorly connected. Focal species population levels associated with late-successional mixed conifer habitats (spotted owls, etc.) are probably lower than historic levels because of the conversion of large tree habitat to small tree habitat, loss of structure and complexity within stands, and fragmentation. The location, size and connectivity of late-successional habitats limit focal species distribution in the watershed.

Lodgepole Pine PAG

Focal Species: wolverine, fisher, Canada lynx, American marten, and black-backed woodpecker.

Approximately 10% of the watershed is in the lodgepole pine PAG. It occupies higher elevations associated with mountain hemlock plant associations. In 1953, 11% of the PAG was dominated by the med/large tree size class, 31% was in small, and 58% in grass/forb/seedling/pole. Stand replacement fires were not suppressed so early to mid seral stands were more common.

There are more large trees today than occurred historically because of fire exclusion. Approximately 82% of the PAG is dominated by small size classes (9-21" dbh) compared to 31% historically. Approximately, 83% of the acres has enough trees >9" dbh to be considered potential old growth. Focal species dependent on lodgepole probably require diversity in stand age classes and tree sizes. Lodgepole pine is generally subjected to stand replacement fires which creates habitat for small mammals (e.g., snowshoe hare which wolverine, marten, and lynx prey upon). In addition, fire-killed trees attract bark beetles which black-backed woodpeckers forage on. Fire suppression in lodgepole pine has reduced optimal habitat characteristics for some focal species.

TREND: There has been an increase in lodgepole old growth.. However, this old growth is very unstable and likely to be lost soon. Fire or insect and disease disturbances would benefit some focal species by creating more habitat and prey. Focal species were more numerous historically than they are today. American marten population levels have probably not declined much as a result of these habitat changes. Black-backed woodpecker populations, which are associated with the small tree sizes, may have declined. The decline in lynx populations is probably associated more with trapping but habitat loss for snowshoe hare (which needs early seral patches) has also had an impact.

High Elevation Mountain Hemlock PAG

Focal Species: wolverine, American marten, Canada lynx, fisher, and black-backed woodpecker.

This PAG comprises 10% of the watershed and is mostly in the wilderness. Mountain hemlock was historically fairly contiguous, except where disturbance factors (e.g., fire, blowdown) created early seral grass/forb habitats or dense stands of pole and small tree habitats of lodgepole pine and mountain hemlock.

Approximately 16% of this PAG is now dominated by med/large trees and is relatively unfragmented and 29% is considered potential old growth. In 1953, 5% was dominated by med/large size classes. **There are more large trees today than occurred historically.** The fire return interval is 100-300 years (Hopkins 1992). With fire suppression beginning <100 years ago, current conditions may be within the historic range. This condition is similar to the lodgepole pine PAG.

TREND: This PAG is a lightly fragmented patch of high elevation habitat associated with the wilderness. There is more old growth than there was historically. The habitats are in late-successional stages of development and are subject to a large-scale stand replacement disturbance that could significantly change the habitat composition of this PAG. The shift from early seral to late seral habitat and the increase in stand age, tree sizes, and amount of woody debris may have improved habitat conditions for some focal species. Others need the fire caused changes in habitat. The concerns for wolverine, fisher, and marten are primarily a result of the fragmentation and human disturbances in the higher elevation mixed conifer PAGs.

Riparian PAG

Focal Species: wolverine, fisher, American marten, northern goshawk, Cascades frog, tailed frog, and spotted frog.

Riparian habitat is the smallest PAG within the watershed. It accounts for <1% . In 1953 , 42% of the trees in this area were med/large trees (over 21"). Currently only 1% of the trees in these streamside areas is over 21". **The acres dominated by big trees (trees over 21") have decreased by 41%.**

Historically, more areas were dominated by riparian forests because stream meanders and oxbows where cottonwood galleries flourished were more numerous. Fire helped regenerate stands of both aspen and cottonwood. Recent channelization, side channel blocking, and diversions of stream channels for irrigation and flood control has reduced these habitats.. However, the amount of shrubs associated with riparian areas may have been less than today because frequent fires may have kept them from growing into the dense stands we have today in some areas. In addition, some of today's riparian habitat may have more plant species and greater structure than historically because of fire suppression. In the early 1900s, sheep grazing, and to a lesser degree, cattle grazing were common and reduced the complexity of many riparian habitats. The extent of these changes in riparian habitat conditions is not known. When cattle and sheep left the watershed in the mid-1900s, riparian habitat probably recovered.

There are an estimated 282 wildlife species known or suspected to occur in riparian habitats in the watershed. These riparian habitats are a relatively small portion of the watershed but contribute significantly to habitat and wildlife species diversity.

The riparian areas and associated uplands are important connectivity habitats (corridors) between late-successional interior habitats in this fragmented landscape. This is especially true in the ponderosa pine and mixed conifer PAGs. The riparian corridors in the watershed vary in size and length. Many of the corridors are associated with larger blocks of forested habitat, and others are simply narrow stream buffers less than 200 feet wide. Riparian corridors less than 800 feet wide are considered all edge habitat and are not effective corridors for interior wildlife species. Human use has increased in riparian areas causing habitat deterioration at some heavily used sites. The extent of these impacts on wildlife species is not known, but negative impacts to amphibian species are likely.

Many amphibian species (i.e., Cascades Frog) require riparian habitats and the associated adjacent uplands for dispersal and linkages between adjacent populations. Amphibians are closely associated with riparian habitats. Little is known about amphibian populations so it is difficult to estimate the impacts of past activities or their current population levels. Species like the American marten, fisher, lynx, and wolverine are known to use riparian corridors for denning, foraging and as movement pathways. Goshawks, spotted owls, and other raptor species are using riparian areas for nesting and foraging due to the relatively high amount of potential prey species occurring in this PAG.

TREND: This PAG is limited in size, but contributes significantly to habitat and species diversity. Riparian habitat has been altered by channelization, cattle grazing, timber harvest practices, and fire suppression. The amount of large tree habitat associated with these riparian areas has decreased as it has across the landscape. As a result, the effectiveness of these riparian areas as late-successional corridors has been reduced. This is especially true where this PAG overlaps with the ponderosa pine and mixed conifer PAGs. Human use has increased in riparian areas causing habitat deterioration at some heavily used sites. The extent of these impacts on wildlife species is not known, but negative impacts to amphibian species are likely. Areas where fire has been excluded may have improved habitat structure through diversity of plant species and structure. Currently, riparian reserves are being buffered via the ROD. Riparian reserves should improve over time.

Special Habitats and Features

Snags and Down Woody Material In the early 1940's, virgin stands were surveyed for affects of insect attacks (Whiteside 1945). Within the Why-chus watershed, a pine beetle hazard survey was conducted. In this survey, 270 acres were cruised and a density of 5.3 snags/acre were encountered. The volume was 417 board feet/acre. Average diameters of these trees were >21" dbh. Snag densities for the four areas on the District ranged from 4.07 to 5.30 and averaged 4.93 snags/acre. All snags encountered were ponderosa pine.

Snags are used by a wide variety of wildlife species **(Table W-2).** Snag and down log densities across the watershed are not known. However, snag densities were estimated in six project areas in Trout and Melvin subwatersheds **(Table W-3).** In Trout, snags were counted in 605 1-acre plots. Density of snags in the ponderosa pine PAG ranged from 1.28-2.24 snags/ac. In mixed conifer, snag densities ranged from 1.0 to 11.1 snags/ac (Darden 1994).

Table W-2. Number of birds and mammals that utilize snags (Thomas et. al. 1979).

User	Birds	Mammals	Total
Cavity Users	39	23	62
Primary Excavators	16	0	16
Secondary Users	27	18	45
Under Loose Bark	1	10	11
Use Decay Cavities	25	23	48

Table W-3. Snag density estimates from one acre plots in several project areas on the Sisters Ranger District, Deschutes National Forest, Ore. (Darden, 1994).

Trout Subwatershed							
Project Areas	Snags/Acre		Combined Snag Density	Acres Sampled		Number of Plots	
	PP	MC		PP	MC	PP	MC
Underline	1.28	N/A	N/A	6828	N/A	227	N/A
Robo	1.69	1.0	1.63	3964	334	145	13
Crumbs	2.24	11.08	8.18	1122	2467	41	84
Snowgate	N/A	4.37	N/A	N/A	3013	N/A	108
Melvin Subwatershed							
Project Areas	Snags/Acre		Combined Snag Density	Acres Sampled		Number of Plots	
	PP	MC		PP	MC	PP	MC
Nova One	1.21	2.40	1.38	1572	212	58	10
Broken Rim	1.67	2.32*	2.29	56	1689*	5	144*

* - Lodgepole Data

In general, snag densities are highest in the mixed conifer and lodgepole pine PAGs and lowest in the ponderosa pine PAG. Snag densities vary on a stand by stand basis, but are usually absent or few in past even-aged harvest units and wildfire areas. In the ponderosa pine habitats, they average approximately 1.62 snags per acre (range 1.21 to 2.24 per acre compared to historic levels of 4.9; Whiteside, 1945); in the mixed conifer they average 4.23 snags per acre (range 1.0-11.08 per acre). The lodgepole pine and mountain hemlock PAGs are estimated to have snag densities >5 snags/ac.

In ponderosa pine PAGs, snags are distributed in small patches across the landscape and are primarily 20"+ dbh and hard. The intermediate (12-20" dbh) snag sizes are limited in these habitats. In mixed conifer and mountain hemlock PAGs, snags are more evenly distributed. Snags are primarily in the 10-20" dbh class (usually white fir), and Douglas-fir snags in the >20" dbh class can be found throughout the mixed conifer PAG. However, many of the snags are white fir and soft. Lodgepole pine snags are generally 8-12" dbh and hard.

Down log densities are similar to snag densities. They are highest in the mixed conifer, mountain hemlock and lodgepole pine PAGs (14 to 37 per acre, except in clearcuts), and lowest in the ponderosa pine PAG (0 to 15 per acre). Tree mortality from insects and disease is a contributor of down logs. The logging debris from past timber activities contributes large amounts of woody debris to most managed stands.

TREND: Snag and down log densities vary on a stand by stand basis. Snag and log densities have changed with fire suppression, in some areas logs have been reduced and snags cut down to prevent lightning strikes from causing fires. In other areas, densities have declined because of timber practices, harvest, firewood cutting, and prescribed fire. Snag sizes are probably smaller today than historically. Snags and down woody material are now required to be left in harvest units to meet ROD standards and guidelines. However, they may be reduced in other areas due to OSHA requirements and reducing hazards to the public along roadways, in campgrounds, or other public use areas.

Roads and Habitat There are several factors involved in how roads impact on wildlife:

1) roads reduce habitat effectiveness (disrupting movement patterns, cause displacement and avoidance, increase direct mortality and mortality by hunters, direct habitat loss, harassment by humans and dogs);
2) roads increase habitat fragmentation (disruption of movement patterns, reduced continuity of habitat types, increased predation on edge-related species);
3) roads increase the potential of human caused fires; and
4) roads facilitate an increase in the introduction of exotic plant species that adversely alter wildlife habitats and ecosystems.

This analysis considers different types of roads and locations than the Transportation Section. It does not include wilderness acres in road density calculation and does not include inactivated roads. Outside wilderness and private lands, there are approximately 675 miles of open Forest Service roads in the watershed or a density of 4.7 miles of roads/mi^2 of Forest Service land **(Table W-4).** Open roads are roads available for motor vehicle traffic and do not include roads that have been blocked or obliterated. Roads on private lands have not been included, including Forest Service roads on private land. Trout subwatershed has the highest road density with 6.0 mi/mi^2 followed by Pole with 5.3 (all secondary), and Melvin with 5.0 mi/mi^2. Secondary roads (roads maintained for high clearance vehicles) account for 89% of all roads (604 of 675 mi). Road densities are over twice as high as the density of 2.5 mi/mi^2 recommended in the Deschutes Forest Plan. Road densities on private land within the watershed are not known.

Table W-4. Miles of open roads and road densities by subwatershed on Forest Service land outside wilderness. Sisters Ranger District, Deschutes National Forest, Ore., 1998.

Subwatershed	Secondary Roads[A]		Primary Roads[B]		Total	
	Miles	Mi/Mi^2	Miles	Mi/Mi^2	Miles	Mi/Mi^2
Indian Ford	104	3.3	19.5	0.6	123.5	4.0
Melvin	69	4.5	7.5	0.5	76.5	5.0
Pole	58	5.3	0	0	58	5.3
Squaw	110	4.2	6.0	0.24	116	4.4
Three Creek Butte	25	2.2	0	0	25	2.2
Three Creek Lake	8	1.4	5.6	1.0	13.6	2.3
Trout	230	5.2	31.6	0.7	262	6.0
Total/Average	604	4.2	70.2	0.5	675	4.7

[A] - Secondary roads are maintained for high clearance vehicles and includes "other" roads. See Transportation Secion.
[B] - Primary roads are maintained for passenger cars
[C] – Road densities exclude acres of land inside wilderness and private land

An index of the amount of habitat affected can be estimated by applying a 1/8 mile buffer on each side of the road (**Figure W-1**). Habitat close to roads was found to be avoided by big game (Ward 1976). There are approximately 63,758 acres of land within 1/8 mile of open roads. For the 132,947 acres of Forest Service land, this equates to 48% of the watershed being within a 1/8 mile of an open road. There is an additional 5,871 miles of closed roads in the watershed. Some of these have re-vegetated on their own while others have not.

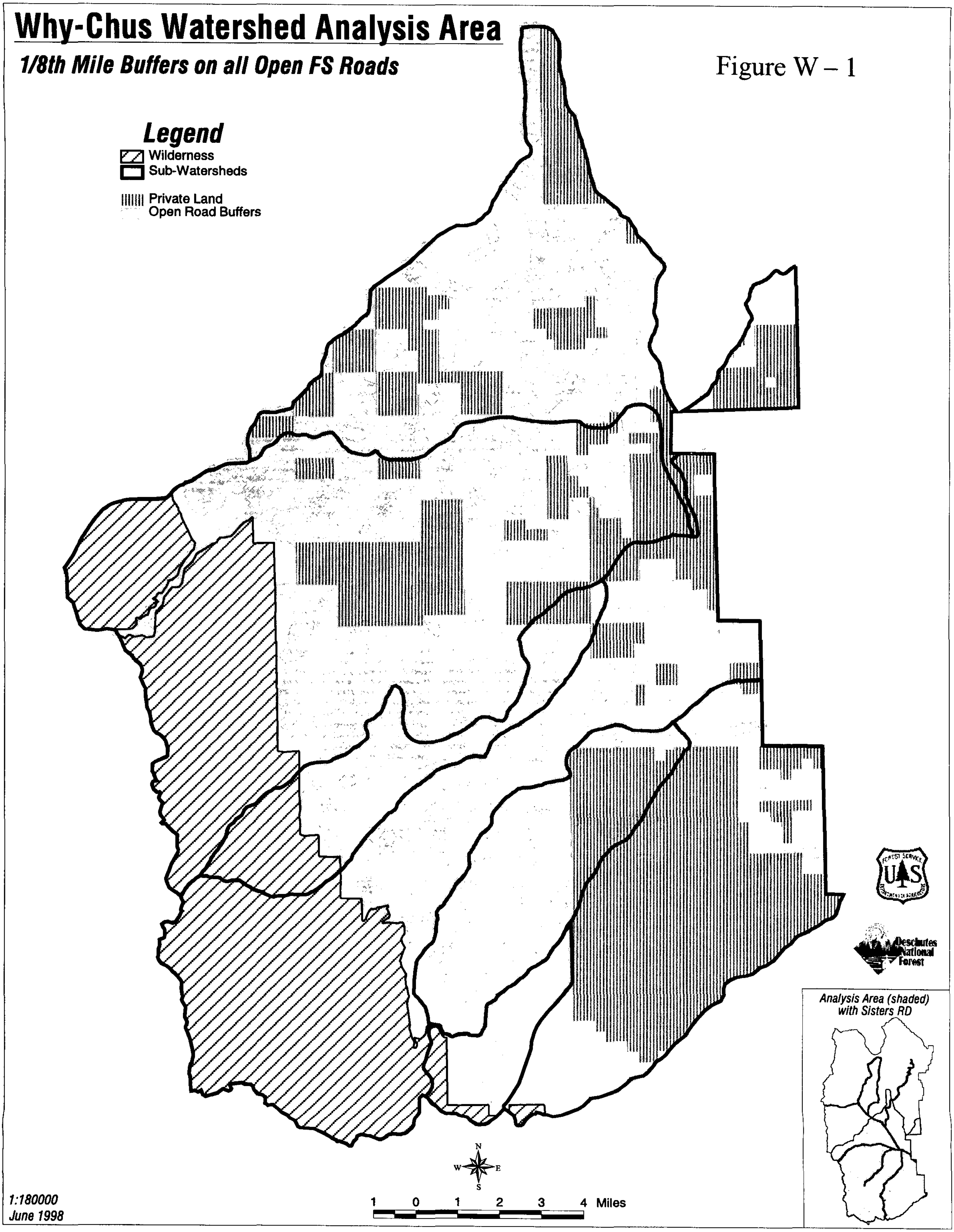
Although half the watershed is impacted by roads, many roads are rarely used so their impact on habitat is minimal. However, as human populations increase in the area, road use will also increase. Road density management is essential to maintaining quality forests not only for wildlife and in critical wildlife habitats, but also for the forest visitor as well. See Transportation section, Social Report for more information.

Land Exchange Habitats

There are two potential land exchanges in the watershed:

1) A portion of T.15S., R.10E., Section 9 which is approximately 260 ac. on the south border of Sisters could be exchanged to the City of Sisters for a sewage treatment facility. It is currently ponderosa pine/bitterbrush and in deer winter range.
2) A portion of T.16S., R.10E. and T.17S., R.10E. may be acquired in the land exchange with Crown-Pacific. The Forest Service would acquire approximately 7,130 acres of ponderosa pine second growth <14" dbh. Portions have been burned by wildfire and are brush fields that have been planted with little success. Most of the area is deer winter range. High road densities and low numbers of snags and logs are assumed. Habitat enhancement may be necessary.

TREND: The exchange of 260 acres to the City of Sisters may reduce the amount of available pine forest habitat and move the urban interface farther into the forest depending on how the area is developed. However, a series of sewage treatment ponds could enhance habitat for many species.


Why-Chus Watershed Analysis Area
1/8th Mile Buffers on all Open FS Roads
Figure W – 1
Legend
Wilderness
Sub-Watersheds
Private Land
Open Road Buffers
N
W
E
S
1 0 1 2 3 4 Miles
1:180000
June 1998
Analysis Area (shaded) with Sisters RD
Deschutes National Forest
Forest Service

Expanding the urban interface will reduce habitat effectiveness on adjacent lands. On the Crown Pacific land, habitat could be enhanced through silvicultural treatments, snag creation, prescribed fire, and road closures.

Terrestrial Wildlife Species

Extirpated Species/Locally Extinct Wolves, grizzly bears, white-tailed deer, and pronghorn antelope may have occupied portions of the watershed in the recent past. Wolves were occasionally seen in the late 1800s (Williams 1992). Jesse Scott, a trapper from Sisters reported seeing a wolf in 1926 near Big Lake (Wilson and Scott 1976), local resident Jess Edgington saw one near Sisters in the 1930's, and Ingles (1965) reported the "last" one in Oregon was shot near Fort Klamath in 1927. Wolves were killed to protect people, livestock, and trap lines.

Grizzly bears disappeared from Oregon about 1933 (Ingles 1965). Judge Waldo reported seeing one at the base of Mt. Jefferson, several miles north of this watershed in 1881 (Williams 1992). Bears were killed to protect people, livestock, and trapping lines.

White-tailed deer were reported by several trappers and explorers in the 1800's and as recent as 1915 in willow areas in the Metolius and Deschutes Basins (Bailey 1936, Thomas 1873). Most of these habitats were lost to agriculture, livestock grazing and possibly from the loss of beaver to trapping.

There are several reports of pronghorn antelope using portions of the Deschutes basin and the Deschutes National Forest in the early 1900s (Bailey 1936). Competition with grazing, conversion of grasslands to shrublands, and hunting has reduced their numbers and distribution.

Although not extirpated, there is some evidence that mountain goats may have occupied habitats in the high Cascades in Oregon. It is assumed they did because John Merriam discovered bones on Mt. Shasta in California. For goats to have gotten that far south of the Canadian and Washington Cascades, where they are known to inhabit, they would have had to use the Cascades of Oregon (Bailey 1936).

Threatened, Endangered and Sensitive Species

Peregrine Falcon The peregrine falcon is a federally listed endangered species. There were no known historic nest sites within the watershed. Some habitat may exist. Three peregrine falcon observations were documented in 1994 outside the watershed along Green Ridge (Hawk Watch International Inc.).

TREND: Neutral. There is limited habitat in the watershed.

Bald Eagle The bald eagle is a federally threatened species within High Cascades Recovery Zone 11. There is one known bald eagle nest site with several nest trees in the watershed. Historically, bald eagles may have foraged on the spawning anadromous fish that moved up Squaw Creek from the Deschutes River. Habitat included more numerous widely spaced large diameter pine and juniper for nesting and roosting. Irrigation canals and ponds were absent which now provide good foraging areas.

A draft Bald Eagle Management Plan has been written. The Bald Eagle Management Area (BEMA) is approximately 565 acres (USDA 1994). The Bald Eagle Consideration Area (BECA), surrounding the BEMA, is approximately 30,000 acres. Eagles have nested at this site since 1986 when they took over a golden eagle nest site. At the site is a large irrigation pond stocked with trout. In addition, there are bald eagles nesting adjacent to the watershed at Suttle Lake, on the Metolius River, and on Lake Billy Chinook.

The BECA is within a ponderosa pine/bitterbrush-sagebrush/fescue plant association. Fire suppression and selective harvest practices during the last 100 years have altered the plant species composition and structure. The pine stands are even-aged, single-storied with intermediate sized trees. Western juniper is found throughout. Virtually all large old pines and junipers have been removed. The BEMA is in a similar condition. However, there are a few scattered old pines, which are used for nesting and roosting. The known nest trees are 45 and 43 inches dbh and 99 and 109 ft. tall, respectively. In addition, there are approximately 23 dominant/co-dominant trees 21-43" dbh near the nest trees that may function as future nest trees. Management through thinning of understory trees and removing brush may be necessary to reduce the risk of losing these future nest trees to stand replacing fires or stress.

This watershed drains into Lake Billy Chinook where the eagle pair and their offspring may winter. Winter surveys (November-April) indicate bald eagle use of Lake Billy Chinook has increased. **Table W-5** shows the peak counts for bald eagles on Lake Billy Chinook.

Table W-5*. Bald Eagle Counts from 1990 to 1995 at Lake Billy Chinook.*

Year	Number of Eagles Detected
1991 - 1992	35
1992 - 1993	41
1993 - 1994	137
1994 - 1995	215

TREND: Stable in the watershed, but recovery goals have still not been met in the Recovery Zone. All known nest sites are essential to recovery goals. Large nest trees are at risk from high incidence of human caused fires. Replacement nest trees are needed.

Northern Spotted Owl The northern spotted owl is a federally threatened species. The west half of the watershed is within the range of the northern spotted owl as designated by the Record of Decision (ROD), 1994. There are 2 known spotted owl nest sites in the watershed and one U.S. Fish and Wildlife Service (USFWS) Critical Habitat Unit (CHU); it is almost entirely Late-Successional Reserve (LSR). The spotted owl is a species that is used to represent many late-successional/old growth associated species and meeting the needs of the spotted owl aids in meeting the needs of many other species.

A common conclusion is that spotted owl densities were probably lower historically than they are today and that the range of the owl may have expanded because fire exclusion has created more suitable habitat on the eastside. However, this watershed has probably always provided some suitable spotted owl habitat, especially in the wet mixed conifer PAG and north facing slopes in the dry mixed conifer PAG. The role frequent low to moderate intensity fires (within the dry mixed conifer and ponderosa pine PAGs) played in the structure and configuration of suitable habitat in east-side Cascade ecosystems is not clear. Using historic acres of these two PAGs, it appears there was more habitat historically **(Table W-6).**

Table W-6. Current and historic (potential) owl habitat by subwatershed. Sisters Ranger District, Deschutes National Forest, 1998.

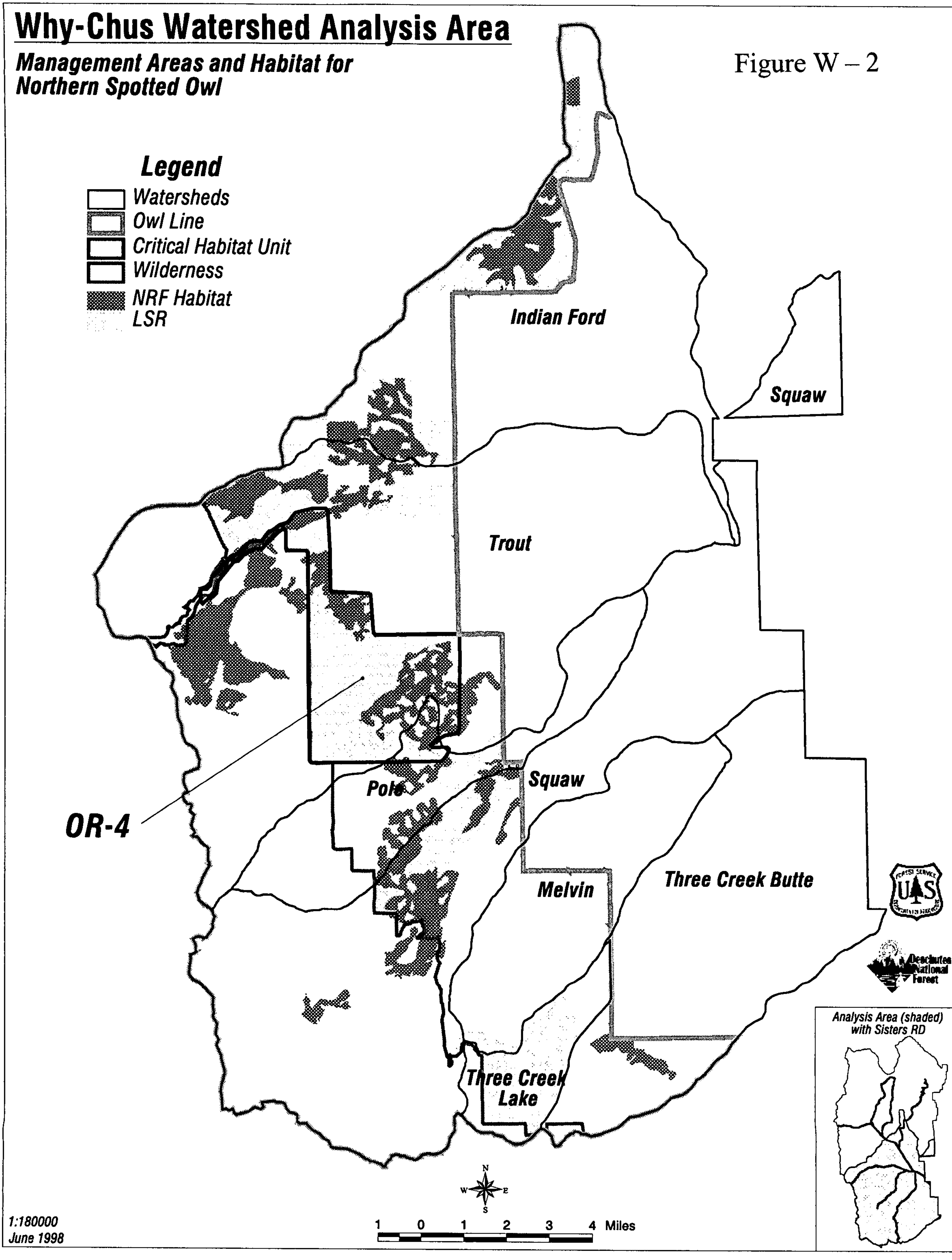
	Current		Historic (Potential)		
Subwatershed	**NRF (AC)**	**Percent of Historic**	**MCW (AC)**	**MCDN (AC)**	**Total (AC)**
Indian Ford	2711	86	1360	1802	3162
Melvin	0	0	1516	1518	3034
Pole	1248	40	2695	417	3112
Squaw	1012	27	3097	702	3799
Three Creek Butte	391	13	791	2000	2791
Three Creek Lake	0	0	778	190	968
Trout	4319	42	4602	5733	10,335
Total	9681	36	14,839	12,362	27,201

Historically, most stands were older than 40 years, tree diameters averaged much greater than 11" dbh, and canopy closure was probably greater than 40%, especially in the mixed conifer wet PAG (see discussion on PAGs for historic conditions). Mixed conifer stands have lost a majority of their large trees (trees over 21") since 1953, greatly affecting suitable owl habitat.

The two owl nests have not been monitored on an annual basis, so productivity of these sites is not well known. Both owl home range circles are within the Trout subwatershed. Each home range contains approximately 850 acres of nesting-roosting-foraging habitat (NRF; **Table W-7**). The 850 acres represents 30% of a 2880 acre home range circle. The minimum amount of habitat considered necessary to ensure viability of a pair is 40% of that home range in NRF habitat. Less habitat reduces the ability of the owls to survive and successfully reproduce.

Table W-7. Habitat conditions within 1.2 mile radius (2880 ac) home range circle for two northern spotted owls in the Why-Chus watershed. Plant association groups (PAG) that provide habitat for spotted owls include: Mixed conifer wet (MCW) and Mixed Conifer Dry, north aspect (MCDN). Sisters Ranger District, Deschutes National Forest, 1998.

Owl #	Existing Habitat (Acres)					Historic Potential NRF (Acres)		
	Allocation		NRF					
	Matrix	LSR	Acres	% Circle	% Hist.	MCW	MCDN	Other
#113	0	2880	871	30	40	1916	261	703
#307	713	2167	847	29	62	569	804	1507



Why-Chus Watershed Analysis Area
Management Areas and Habitat for Northern Spotted Owl
Figure W – 2
Legend
Watersheds
Owl Line
Critical Habitat Unit
Wilderness
NRF Habitat
LSR
Indian Ford
Squaw
Trout
OR-4
Pole
Squaw
Melvin
Three Creek Butte
Three Creek Lake
Analysis Area (shaded) with Sisters RD
N
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June 1998

The following minimum habitat conditions were present at these spotted owl nest sites: mixed conifer, multi-storied stands with at least 60% canopy cover and 40 contiguous acres; at least 8 TPA (trees per acre) greater than or equal to 21" dbh; and at least 82 TPA in the understory less than or equal to 21" dbh.

Owl #113 nested in 1990, was present in 1993, but was not located in 1998. Owl #307, was known to occupy its home range from 1980-1993. In 1998, a pair with one juvenile was discovered at the activity center.

The 2 pairs of spotted owls are estimated to need a minimum of 2364 acres of suitable spotted owl habitat combined (1,182 acres of suitable habitat/pair within a 2880 acre home range). There are an estimated 1718 acres of suitable habitat or NRF habitat currently available (**Figure W-2**) in the watershed. This NRF habitat is a newly defined habitat database (1998) and has not been critically examined or ground truthed. Considering the amount and configuration of suitable habitat in the watershed, it is likely that spotted owls are probably nesting, roosting and foraging in habitat that may not meet many standard suitable spotted owl habitat definitions (multi-storied stands of old growth with high canopy closure; >80%).

NRF habitat exists in approximately 12 highly fragmented and unconnected blocks. These blocks range in size from <200 acres to approximately 2000 acres. Most NRF habitat is found within the LSR. However, some occurs in matrix and an additional large block occurs within the Three Sisters wilderness in the Trout subwatershed. There is no NRF habitat in the Three Creek Lake LSR. Connectivity is poor within the analysis area. A priority would be to improve connectivity north to south between the large blocks of habitat and around known activity centers. This would improve or provide dispersal in and out of the watershed, as well as, a corridor to move north and south within the watershed.

The USFWS Critical Habitat Unit (0-45) in the watershed is designated for recovery of the spotted owl. CHU 0-45 is approximately 8529 acres in size. All activities proposed within these areas must consider impacts to the northern spotted owl and requires consultation with the USFWS. It contains 5196 acres of mixed conifer wet and mixed conifer dry (north aspect) PAGs, considered to be the best potential for growing late-successional owl habitat. Of the 5196 acres, 2497 acres (48%) has been classified as acceptable NRF habitat within the CHU.

TREND: Unknown, but species viability may be at risk due to habitat fragmentation and habitat loss. Suitable habitat has been harvested and stand densities and fire risk have increased. The potential for catastrophic wildfire increases the risk of habitat loss, downward population trends, and loss of species viability.

Late-Successional Reserves and Owl Habitat

Late-successional reserves (LSR's) are to be managed to protect and enhance old-growth conditions. No programmed harvest is scheduled inside the reserves. However, thinning or other silvicultural and non-silvicultural treatments may occur if beneficial to creation, enhancement, and maintenance of late-successional conditions. Management to reduce the risk of large-scale disturbance, such as fire, is recommended. In addition, in younger stands, management should be designed to accelerate the development of late-successional habitat (ROD 1994).

The LSR contains fragmented blocks of NRF habitat that are poorly connected. Large gaps occur between patches of late-successional habitat, which may hinder movement between these patches inside the LSR. Historic harvest practices have also increased the amount of edge habitat present. This may allow predator populations to increase and compete with spotted owls for habitat. There is increased stand structure and increased fire risk and which may result in loss of habitat. White fir is now dominating some sites where Douglas-fir and ponderosa pine once dominated. Future NRF habitat is at risk where this occurs due to the small tree size and loss of stand structure over a long period of time. Future NRF habitat needs to be created by means of stand manipulation and treatments.

There are 26,769 acres (15%) of LSR in the watershed. Trout subwatershed has the most acres within the watershed with 12,371. Thirty percent or 3735 acres are classified as NRF habitat currently. Historically, approximately 75% of the LSR would have been in a NRF condition. Within the two owl home ranges in the Trout subwatershed, NRF also accounts for approximately 30% of the LSR. Historically, NRF may have ranged between 40-60% for these areas.

TREND: Fire suppression has moved much of the LSR from fire climax to climatic climax. Increased stand densities and woody debris accumulations have increased the risk of habitat loss to stand replacement fires. Harvest practices have reduced the amount of late-successional habitat and has fragmented much of the LSR.

Dispersal Habitat for Northern Spotted Owls

Dispersal habitat occurs when forest conditions on the landscape provide suitable habitat for owls to move through in a relatively safe manner from predators and with some chance to obtain food, particularly during juvenile dispersal. Estimating the amount of dispersal habitat is accomplished through use of the 50-11-40 Rule, which is defined as 50% of the landbase supporting trees at least 40 years old. More specifically, 50% of the trees need to be at least 11" dbh, have a canopy closure of at least 40%, and be able to maintain this for the next 100 years.

Habitat with an average of 11" dbh and 40% canopy cover (11-40) was estimated within quarter townships (QT's) on the District. A QT is 9 square miles. Dispersal habitat for this watershed was estimated in 1991-92 and habitat within Habitat Conservation Areas (HCA's) was not calculated in these totals. HCA's have been replaced by LSR's (Late-Successional Reserves) and CHU's (Critical Habitat Units) that do not have the same boundaries. Thus, 11-40 habitat will therefore need to be updated for future projects.

There are 29 QT's in the watershed; 16 are wholly or partially in the wilderness and 13 are completely outside the wilderness. Of the 29 QT's, 9 did not have HCA or wilderness acres within them and 11-40 conditions should be similar if examined today. These QT's had 11-40 habitat that ranged from 7 to 49% with an average of 29% overall; well below the recommended 50%. All of these QT's were primarily mixed conifer dry or ponderosa pine except one QT in the Three Creeks Lake area. It contained lodgepole pine, mixed conifer wet, and mountain hemlock primarily. Most of these areas have been harvested and are marginal for having high canopy closure and maintaining spotted owl habitat.

TREND: Downward over past several years but may be stabilizing with new management practices. Dispersal habitat has declined significantly. Poor dispersal habitat puts the young and the adults at risk of predation and reduces their ability to secure prey. Although one spotted owl pair in the watershed has successfully fledged one juvenile this year. Maintaining and enhancing dispersal habitat is critical to increasing the number of breeding pairs and recovery of the species. The other pair did not respond to surveys conducted in 1998 and has not nested, to our knowledge, since 1990.

Proposed Threatened Species

Canada Lynx The Canada lynx has been proposed for listing as a threatened species. Its presence in this area has been documented historically. In 1916, a trapper brought a lynx into Bend and its pelt was donated to the Smithsonian Institute. A recent article in the Bend Bulletin newspaper reprinted an article published in 1923 of a lynx being caught locally and kept as a pet in Bend. Black Butte lookout, Ed Parks, reported killing a lynx on the butte in 1949. There is one report of a siting outside the watershed near Suttle Lake from 1986. The most recent siting in this watershed was in 1997. Other sitings outside, but adjacent to, the watershed have not been verified. Lynx may not have been common or abundant but were always present. Their main prey, the snowshoe hare, is somewhat common throughout the watershed.

In June 1998, it was proposed for listing as a threatened species throughout it's range in the lower United States. Lynx decline is attributed to loss or modification of habitat, over trapping, inadequate regulatory mechanisms to protect habitat, and increased human induced changes in habitat that have allowed other species (bobcats and coyotes) to move into lynx habitat and compete for prey. Other activities that have adversely impacted lynx include: timber harvest, road construction, development of ski resorts, and urban sprawl. In addition, lynx management standards and guidelines are stated in the NWFP. It is to be managed under Component 3, which requires extensive surveys to identify high-priority areas for species management.

Lynx habitat is generally above 4000 ft. and includes late seral old-growth stands for denning adjacent to areas of young early seral stands of lodgepole pine utilized by snowshoe hare. Potential habitat exists in and near the wilderness areas. Other sites include: Trout Creek Butte area, upper Pole Creek, Three Creeks Lake area, Black Crater, and upper Squaw Creek.

TREND: Downward. Lynx viability is of concern due to low numbers and loss of habitat capability.

Survey and Manage Species

Several species are to be protected under the Northwest Forest Plan (1994) through Survey and Manage guidelines. Great gray owls, cavity excavators, and two mammals, the red tree vole and the Canada lynx. The red tree vole inhabits areas west of the Cascade crest and is not expected to occur in the watershed. Interim guidance for the red tree vole specifies areas west of the Cascade crest and below 3300 ft. should be surveyed. Therefore, the red tree vole will not be surveyed for on the Sisters Ranger District. Surveys are currently being designed for lynx and should be implemented during the summer of 1998.

One terrestrial slug, the blue-grey tail-dropper, and one snail, the Crater Lake tightcoil, are thought to occur on the Deschutes National Forest and need to be surveyed for. Plans for surveys have not yet been completed. These are to be managed under Survey and Manage Components 1 and 2 that require surveys prior to activities and to manage known sites.

The Papillose Tail Dropper, a terrestrial slug and the Oregon Shoulder Band, a terrestrial snail, may also occur but are not expected. Current direction does not require surveys for these species but requires we know them in case they are encountered.

Sensitive Species

Great Gray Owl The great gray owl is designated as a Sensitive species by the Forest Service Regional Forester. Oregon Department of Fish and Wildlife lists it as sensitive and uncommon in Oregon. It is a Management Indicator species on the Deschutes National Forest. The great gray owl is also listed in the ROD as a species requiring habitat protection buffers in and outside the LSR. It is not known if great gray owls were common historically. Historically, habitat would have been more suitable because fires would have kept trees from encroaching into meadows and may have created some meadows. Old-growth stands would have been more common prior to timber harvesting.

Great gray owls occur in mid-high elevation conifer forests. They usually nest in mature or old-growth trees and their nests are usually in old raptor nests, tops of broken trees, or snags. Foraging habitat consists of open areas or meadows usually near water (Hayward and Verner 1994). Potential habitat exists at Pole Creek swamp, Park meadow, Trout Creek Butte swamp, Glaze meadow, Three Creeks Lake area, and Dry Creek meadow. Other potential sites would be in open clearcuts adjacent to stands with old-growth characteristics and water.

There is one siting of a great gray owl in the watershed near Pole Creek Springs from 1992. Glaze meadow was surveyed in 1984, but none were detected. Surveys in 1997 and 1998 did not detect any adjacent to the watershed. Outside the watershed, one unverified siting was reported in June, 1998 and one verified siting was reported in 1997. The ROD designated specific protection measures for nest sites, meadows, and natural openings (ROD, C-21).

TREND: Declining in the Region. No long term, rigorous, or standardized data on regional or local breeding populations is available. It is believed to be declining in Oregon because of loss of nesting and roosting habitat by logging in lodgepole stands for mountain pine beetle control. Other reasons include urban sprawl.

California Wolverine The wolverine is a federal candidate species. Prior to timber harvest activities, the wolverine may have been found throughout the watershed, though probably uncommon, especially at low elevations.

There have been no formal surveys, but there are two recent sightings of wolverine in the watershed (1993 and 1998). In March of 1998, Oregon Department of Fish and Wildlife flew the wilderness areas and believe they may have located a possible den site near Black Crater. Other documented wolverine sightings in the watershed are prior to 1975. It is possible that the watershed supports resident wolverines. This assumption is based on: 1) recent sightings, even though there is high human use in this area and 2) there is unfragmented, primitive, isolated habitat and alpine areas in the wilderness.

Currently, high elevation mixed conifer and mountain hemlock PAGs have the highest potential for wolverine occurrence due to the large unfragmented nature of this area. Wolverine use of the area may include individuals migrating or dispersing through the Cascades from northern Washington or northern

California.

TREND: Unknown. The watershed probably never supported high population numbers. Any wolverines using the watershed are important contributions to species viability. The recent timber harvest activities in the watershed have reduced the amount of suitable wolverine habitat, and probably the numbers of wolverines.

Northern Goshawk The goshawk is listed as a State sensitive species. This species is also listed as a candidate species and is proposed for listing on the Region 6 Regional Forester's Sensitive Species list. It was decided by USFWS (summer 1998) not to propose the northern goshawk for listing at this time. The amount of suitable goshawk habitat in the watershed was probably higher historically than it is today. The large patches of mature and old-growth ponderosa pine habitats that covered most of the watershed were ideal habitat for the goshawks.

In recent decades, timber harvest practices have reduced the amount of suitable habitat, and probably the number of goshawks nesting in the watershed. The conversion of mature and late-successional habitats to younger, even-aged stands has contributed to habitat loss and subsequent population declines.

Goshawk population densities in the watershed are not known. Formal surveys have been conducted in specific project areas but not throughout the watershed. Nine goshawk territories have been identified, and it is likely formal goshawk surveys in suitable habitat would reveal additional nest sites.

Mature and late-successional habitats in the ponderosa pine, riparian, and mixed conifer PAGs are considered potential nesting habitat. Of the 113,466 acres of ponderosa pine, riparian, and mixed conifer in the watershed, approximately 23,322 acres (20%) are dominated by med/large size classes. All other seral stages are considered potential foraging areas. Moist areas on north slopes, often near water are important habitats. Single nest territories may have 2 to 4 nests/stand. Nest areas usually contain stands with the highest density of large trees, high tree canopy cover and high basal areas. The post-fledgling area (450 acres) and foraging areas (5,400 acres) are a mosaic of vegetation structural stages.

TREND: Unknown in the watershed, downward in the Region, but probably downward due to habitat loss/modification. Species viability may be at risk due to habitat fragmentation from timber harvest and reductions in the amount and quality of suitable habitat due to fire suppression. The potential for catastrophic wildfire increases the risk of habitat loss, downward population trends, and loss of species viability.

Fisher The fisher is federal candidate species. Trapping has had a major impact on fisher populations. Fisher population levels were probably higher prior to the 1900's. Fisher trapping in Oregon was closed in 1937.

Large unfragmented mixed conifer and mountain hemlock forests provided suitable habitat. There have been several recent (October 1994) fisher sightings in the Green Lakes area of the Three Sisters Wilderness immediately south and west of the watershed. Population levels have probably always been relatively low and widely distributed. Fishers currently using the watershed are likely to be found in the high elevation mountain hemlock PAG.

Timber harvest practices have probably reduced fisher habitat in parts of the watershed where historically they may have been found. Fragmented forest conditions in the mixed conifer PAG limit potential fisher use.

TREND: Unknown in the watershed, but probably downward from historic levels. The watershed probably never supported high population numbers. Any fishers using the watershed are important contributions to species viability. The recent timber harvest activities in the watershed have reduced the amount of suitable fisher habitat, and probably the numbers of fishers.

Townsend's Big-eared Bat Townsend's big-eared bat is a federal candidate species. Little is known about the historic occurrence of this species in the watershed. It is believed that their numbers were greater than today. Declines are attributed to recreational activities in caves and loss of roosting snags. Bats cannot tolerate people at hibernaculum and nursery sites. Recreational use and vandalism at caves is a problem. The bats occur in numerous PAGs, using caves, buildings, mines and bridge undersides for nursery and hibernation purposes. Their food base is small moths and other insects. Pest control projects which would spray large areas of forests with biocontrol agent BT have been evaluated as a risk to nursing Townsend's bats who cannot fly far for food.

There is one known hibernaculum on the northern boundary of the watershed that receives uncontrolled use. There have been no formal surveys for the big-eared bat. Without habitat surveys, the amount of potential habitat remains a mystery. Many potential sites are unidentified at this time, but are known to occur in the watershed.

TREND: Unknown, because of limited information on potential nursery and hibernaculum sites. Across the Region, population declines are occurring where sites have been disturbed, but where caves have been protected, populations remain stable or have increased.

Black-backed Woodpecker The black-backed woodpecker is considered a sensitive species in the critical category by Oregon Department of Fish and Wildlife. Historic population levels are unknown but were probably higher than today's numbers. This species uses coniferous forests in northern North America from the Pacific to the Atlantic. On the Deschutes, it nests and forages in mature and overmature lodgepole pine and feeds on wood boring insects. It is threatened by the loss of snags and the conversion of mature lodgepole pine stands to younger stands.

Black-backed sightings have been documented primarily in lodgepole pine. However, they also use ponderosa pine, high elevation mountain hemlock, and mixed conifer habitats of the watershed. A black-backed study conducted in the Deschutes National Forest showed habitat selection for mature and over-mature lodgepole pine stands more than younger stands and logged areas (Goggans 1986). Approximately 83% of the lodgepole is classified as potential old growth. The mature lodgepole pine or mixed conifer with lodgepole pine habitats found in the mixed conifer PAG (higher elevations) of this watershed is ideal habitat for this woodpecker.

Nest stands had average tree diameters of 8 inches and nest trees averaged 11" dbh. Black-backs forage in burned forests. The 100 percent population potential for this species is 0.12 conifer snags per acre in forest habitat; these snags must be at least 17 inches dbh or greater and in a hard decay class. Eighty percent of trees used for foraging were infested with mountain pine beetle.

TREND: Unknown in the watershed, but declining in the Region. However, snag requirements will continue to be met via the ROD Standards and Guidelines.

White-headed Woodpecker The white-headed woodpecker is considered a sensitive species in the critical category by Oregon Department of Fish and Wildlife. This species is also identified in the Northwest Forest Plan (Appendix J2) as needing special mitigation provisions. Historically, this species was probably more abundant than it is today because of the loss of snags and the conversion of mature ponderosa pine stands to younger stands.

The white-headed woodpecker has been observed within the mixed conifer and ponderosa pine PAGs of the watershed. Areas with high densities of large diameter ponderosa pine are currently occupied by woodpeckers. White-headed woodpeckers use open (<26% canopy cover) stands with large diameter (> 21" dbh) ponderosa pine snags for nesting (Frenzel 1997). The presence of large diameter ponderosa pine may be essential as foraging areas. On the Deschutes and Winema National Forests, Frenzel (1997) found white-headed woodpeckers used only snags for nesting. The dbh averaged 27.6 inches and canopy closure averaged 6.4%. Diets consist of 60% pine seeds and 40% insects foraged from ponderosa pine trees > 24" dbh. For this species, a snag level of 0.6 conifer snags per acre is required to maintain 100 percent population levels in forested habitats. These snags must be at least 15 inches dbh or greater and in soft decay stages. Actual population densities are not known for the watershed.

TREND: Unknown, but is probably downward from historic levels due to forest fragmentation and loss of medium/large tree ponderosa pine habitats. Stable in the Region. Snag requirements will continue to be met via ROD standards and guidelines.

Pileated Woodpecker The pileated woodpecker is considered a sensitive species in the critical category by Oregon Department of Fish and Wildlife. Pileated woodpecker population densities may have been highest in the wet mixed conifer PAG and the upper elevations of the dry mixed conifer PAG. Timber harvest activities have probably reduced population levels in recent decades due to loss of snags and loss of late-successional habitats. The mixed conifer PAG is heavily fragmented, therefore, the remaining mature and late-successional habitats in this association are critical for pileated nesting and foraging.

There have been numerous sightings of pileated woodpeckers in the mixed conifer PAG of the watershed. Bull and Holthausen (1993) reported that pileated use old growth greater than expected and other forest types less than expected. Nest tree diameter was found to range from 16 to 30 in or greater. Most nest trees (81%) were in large diameter ponderosa pine. Roost trees tended to be in grand fir (62%) and in stands with > 60% canopy cover. This species forages mainly by excavating into wood and scaling or chipping bark. For this species, a snag level of 0.6 snags per acre is required to maintain 100 percent population levels in forested habitats. These snags must be at least 25 in dbh or greater and in hard decay classes.

TREND: Unknown, but declining in the Region. Species viability may be at risk due to habitat fragmentation and reductions in the amount and quality of late-successional mixed conifer habitat. The potential for catastrophic wildfire increases the risk of habitat loss, downward population trends, and loss of species viability. Snag requirements will continue to be met via ROD standards and guidelines.

Williamson's Sapsucker Williamson's Sapsucker is considered a sensitive species in the critical category by Oregon Department of Fish and Wildlife. Sapsucker population densities may have been highest in mixed conifer PAGs. Timber harvest activities have probably reduced population levels in recent decades due to loss of snags and loss of late-successional habitats in both mixed conifer and ponderosa pine habitats. Both PAGs are heavily fragmented, therefore, the remaining mature and late-successional habitats are critical for nesting and foraging.

Williamson's sapsucker habitat is found mainly in the mature and late-successional mixed conifer and ponderosa pine PAGs at 3,500 to 6,500 feet elevation. They also use lodgepole pine/fir areas. This sapsucker is a poor excavator and requires live or recently dead trees with advanced wood decay, such as occurs in mature and late-successional stands of fir. Large diameter trees with heart rot are important habitat components and should be maintained for this species. Snag densities of 0.33 snags per acre is required to maintain 100 percent population levels and should be at least 17 in dbh or greater and in hard decay class.

TREND: Unknown, but stable in the Region. Species viability may be at risk due to habitat fragmentation and reductions in the amount and quality of late-successional mixed conifer habitat. The potential for catastrophic wildfire increases the risk of habitat loss, downward population trends, and loss of species viability. Snag requirements will continue to be met via ROD standards and guidelines.

American Marten The marten is considered a sensitive species in the critical category by Oregon Department of Fish and Wildlife. Geographic distribution of marten in Oregon has been reduced over the past 40-50 years, possibly because of loss and fragmentation of late-successional habitat (Buskirk and Ruggerio 1994). Trapping is still currently legal.

There have been no formal surveys for pine marten in the watershed. Informal surveys utilizing track plates and camera sets have been used and have detected presence. They have been observed in various locations throughout the watershed (especially the wilderness) in mature and late-successional mixed conifer, lodgepole pine and the high elevation mountain hemlock PAGs at elevations ranging from 5,000 ft to timberline. The highest densities of marten are probably found in the upper 1/3 of the watershed, including wilderness areas.

Martens prefer extensive stands of relatively dense forests containing abundant snag and down woody material as habitat for denning, nursery sites, and prey habitat. Moist forests and riparian areas are important to marten, probably due to an abundance of prey species in these sites. Prey species include: squirrels, chipmunks, woodrats, rabbits, voles, birds, and insects. Prey abundance is greater in older forests than in recently logged areas (Thompson and Colgan 1987).

TREND: Declining in the Region. Population densities were probably higher in the past than today, because of less fragmentation. The fragmentation of the mixed conifer PAGs has probably influenced the distribution and densities of martens in these areas.

Other Species of Interest

Osprey There are no known osprey nest sites in the watershed. Occasionally, osprey have been seen foraging in agricultural ponds and at Three Creeks Lake. Potential habitat exists along fish bearing streams, ponds, and lakes. Historically, Squaw Creek may have provided foraging opportunities when salmonids migrated annually.

This species feeds entirely on fish and is moderately associated with mature and late-successional habitats. However, other successional stages that provide large diameter snags and green trees near water will also provide nest sites for this species.

TREND: Stable in the watershed but probably down from historic numbers from loss of historic foraging habitat on spawning anadromous fish in Squaw Creek. However, it is increasing in the Region.

Big Game Historical accounts of deer population numbers vary considerably from many to few. Many factors affect deer populations including: severe winters, forage/cover availability, hunting pressure/road access, competition for forage with livestock, disease, predators, and reproductive success.

In 1826, Peter Skene Ogden reported that deer were scarce in the southern portion of the state (Bailey 1936) and Captain Fremont found similar conditions in 1840 (Fremont 1847). However, miners coming into the area in the 1850-60's reported an abundance of deer (Bailey 1936). At Camp Polk (near Sisters, Ore), military personal reported killing hundreds with ease in 1865-66 (Hatton et al. 1996).

From 1877 to 1907, Judge J. Waldo frequently traveled from the Mt. Hood area south to Davis Lake along the east side of the Cascades, often stopping at the Camp Polk and later Sisters Post Office (Williams 1992). Judge Waldo reported hunting deer and was always successful. In 1901, the first hunting season was established, allowing hunters to take five deer, either sex per year. In 1926, the Deschutes National Forest reported there were 1625 deer on the forest. Details on how they arrived at those numbers were not stated. In 1928, an attempt was made to establish the Three Sisters Game Refuge to prevent the extermination of wildlife (Hatton et al. 1996). This area became the Three Sisters Wilderness Area shortly there after.

After the turn of the century, government regulations and the establishment of the National Forest influenced land and wildlife management. Fire suppression and cattle grazing converted many acres of grasslands to shrublands, which benefited deer winter range. At the same time sheep grazing in the high country reduced forage on summer range. Many predators were killed to protect livestock and farmers killed deer to protect their crops. Timber harvesting opened areas and reduced cover but may have improved forage. Timber harvesting also increased the number of roads into the area. Hunting pressure increased as more people settled the area and as roads and trails into the area increased. Generally, deer populations increased until the severe winter of 1960 when many died. Currently, deer numbers are not as high as they were before the 1960 die-off but they are moderately high, approximately 90% of the desired ODFW management level, and stable.

Mule deer and elk are Management Indicator Species (LRMP 1990) and are important economically for recreation and agriculture. Habitat objectives are to maintain and enhance deer cover and forage. The watershed includes winter, transition, and summer range for deer (black-tails, mule deer and possibly hybrids) and elk (Roosevelt, Rocky Mountain and hybrids). Mule deer are fairly common, but elk are found in relatively small herds in isolated areas of the watersheds.

Forty-nine percent of the watershed (87,758 ac) is classified as deer winter/transition range. Approximately 11% (19,900 ac) of deer habitat is managed under the objectives for Deer Habitat MA-7. Outside MA-7, 38% (67,860 ac) has been classified as deer winter/transition range and is in several different management allocations **(Table W-8)**.

The lower elevations of this watershed are considered transitional and winter range for both species **(Figures W-3)**. Deer and elk migrate elevationally from summer to winter ranges and generally move northeast and east. Deer and elk migrate through the watershed to the Metolius and Tumalo winter ranges. Lower elevations of Green Ridge and the Crooked River National Grassland are all part of the

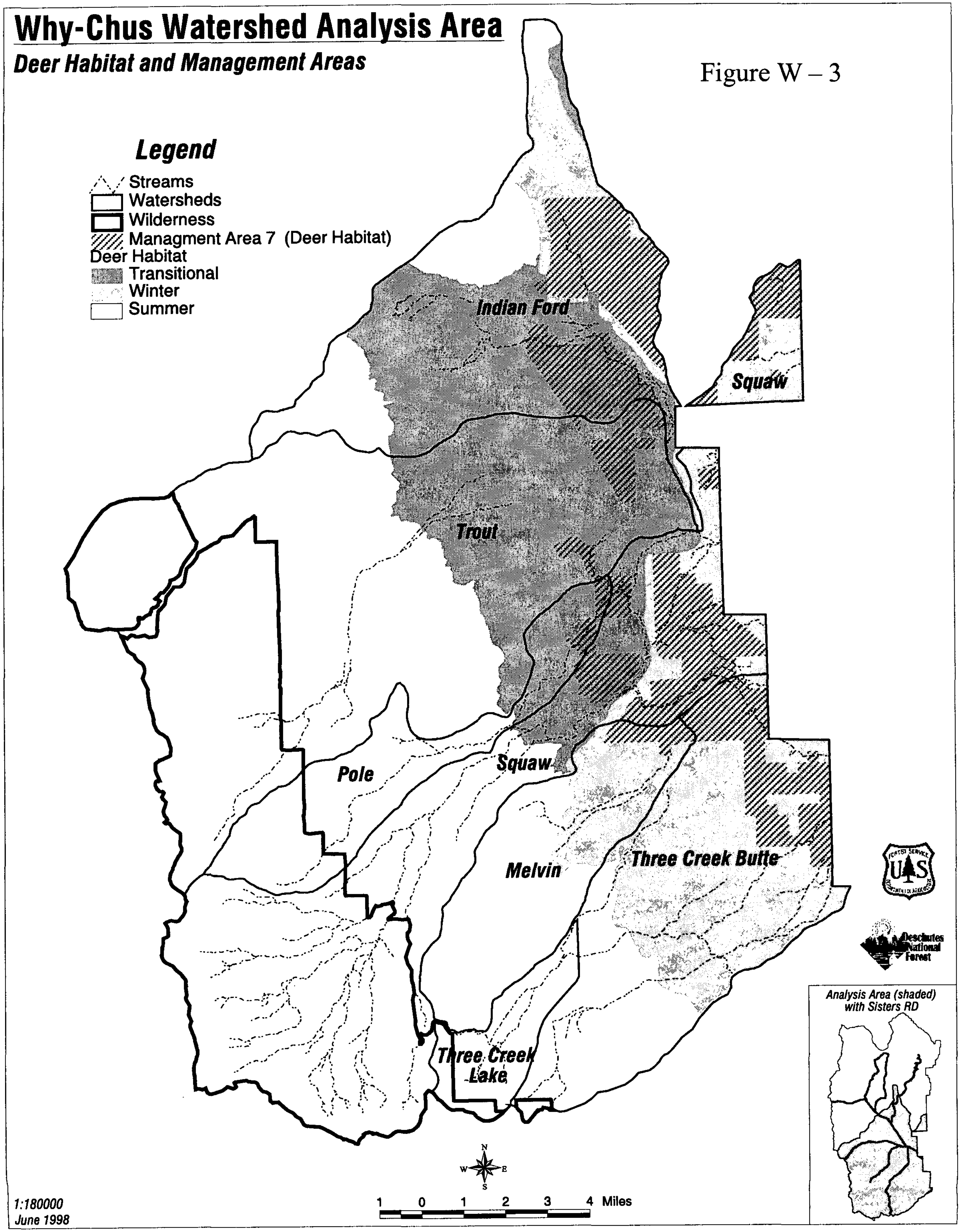
Metolius Winter Range. The Tumalo Winter Range is east of the watershed.

Deer habitat (winter/summer) has generally been managed for a 40:60 cover:forage ratio. Approximately 6% of the analysis area is currently dominated by seedlings and shrubs and 18% by small trees and shrubs. Cover and forage are both adequate throughout the watershed because fire suppression has allowed understories of trees and shrubs to increase. Most issues concerning deer and elk are related to winter range where forage and cover become critical for survival but conflicts with reducing fire risk. Forage quality, availability of cover, high road densities, and harassment from recreationists affect deer survival during winter, spring, and fawning seasons.

TREND: Generally, deer populations vary from year to year and from decade to decade depending on many factors including weather, predation and hunting success. Roosevelt elk populations have increased. Mule deer levels have increased from historic levels and remain relatively stable. Currently deer numbers are not as high as they were before the 1960 die-off but they are moderately high, approximately 90% of the desired management level and relatively stable. The increase in early seral habitats and edge has contributed to these population increases. In the urban interface area, there is a need to reduce deer habitat in order to reduce risk of fire to private land. The impact on deer herds is unknown.

Table W-8. *Deer Habitat in Management Area 7 (LMRP) and outside Management Area 7 by subwatershed for the Why-chus watershed. Sisters Ranger District, Deschutes National Forest, 1998.*

	Subwatersheds							
Deer Habitat	**Indian Ford**	**Melvin**	**Pole**	**Squaw**	**Three Creek Butte**	**Three Creek Lake**	**Trout**	**Total**
Management Area 7 – Deer Habitat								
Transition	2614	0	421	1202	0	0	1519	5756
Winter	4310	630	0	5284	3922	0	0	14,146
Total	6924	630	421	6486	3922	0	1519	19,902
% Sub	25%	5%	4%	16%	16%	0	3%	N/A
% Why-chus	4%	0.3%	0.2%	4%	2%	0	1%	11%
Outside Management Area 7 – Deer Habitat								
Transition	2539	47	2008	3254	0	0	14,889	22,737
Winter	3321	3806	0	4479	13,613	0	0	25,219
Total	5860	3853	2008	7733	13,613	0	14,889	47,956
Grand Total	12,784	4483	2429	14,219	17,535	0	16,408	67,858
% Sub	45%	34%	23%	35%	70%	0	30%	N/A
% Why-chus	7%	3%	1%	8%	10%	0	9%	38%


Why-Chus Watershed Analysis Area
Deer Habitat and Management Areas
Figure W – 3
Legend
Streams
Watersheds
Wilderness
Managment Area 7 (Deer Habitat)
Deer Habitat
Transitional
Winter
Summer
Indian Ford
Squaw
Trout
Pole
Squaw
Melvin
Three Creek Butte
Three Creek Lake
Deschutes National Forest
Analysis Area (shaded) with Sisters RD
N
S
E
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1:180000
June 1998
1 0 1 2 3 4 Miles

Neotropical Migratory Birds Neotropical migratory bird (NTMB) population declines are of growing concern throughout the world. Habitat for some NTMBs may have improved from historic conditions when frequent fires maintained relatively homogenous stands and open understories with less structure. However, snag densities, interior habitats, connectivity, exotic birds, old-growth habitats and habitat changes in other countries are also areas of concern when considering NTMB's.

Some species have been decreasing in abundance throughout their range for prolonged periods. Examples of declining populations include the Olive-sided Flycatcher and Macgillivray's warbler. Since 1966, the USGS Patuxent Wildlife Research Center has been conducting surveys throughout North America. They have analyzed population trends for 134 species in Oregon between 1966 and 1996. They report significant declines for 45 species and significant increases for 12 species. The remainder were stable (**Appendix W-2**).

To help monitor trends in neotropical migratory bird populations on the continent and the region, the USFWS has set-up a network of survey routes; the North American Breeding Bird Survey. The Sisters Breeding Bird Survey Route starts at Three Creeks Lake and goes north along Road 16 to the City of Sisters, then north on the 2058 road to Squaw Back Ridge. This route has been surveyed since 1996. Three years of surveys have been completed and a species list for 1996-1997 has been compiled (**Appendix WA-3**). To date, 57 species have been reported. Populations of 23 of these are declining in Oregon, three are increasing, and the remainder are relatively stable. Many species not seen along the route are listed in **Appendix W-3**.

The changes in NTMB populations within the watershed are unknown. There are a wide range of habitats available in the watershed. Most plant association groups are in a wide range of seral stages. Species composition and structure are diverse. Interior late-successinal old growth forest is limited. To estimate the amount of interior forest available in the watershed, we used spotted owl nesting-roosting-foraging habitat minus the height of 2 site potential trees or approximately 300 feet.

There are 7090 acres of interior forest, or 4%, in the watershed. Interior forest contains microclimatic conditions and stand structure of old forests. Many plant and animal species can survive only under these conditions. Acreage's were estimated from our spotted owl nesting-roosting-foraging habitat (**Figure W-2**). There are approximately 13,655 acres of NRF in the watershed; 52% of which is edge (7090/13,655), and the remainder, interior forest.

There are 650 miles of edge in the watershed. Miles of edge was calculated from the interface between forest and harvest units. Edge habitats are very productive habitats for some neotropical birds because they contain a diversity of plant species and structure.

TREND: Unknown, but is probably upward for early and mid seral species, and downward for many late-successional species. Species requiring early and mid seral conditions have probably increased in number, while species needing mature and late-seral conditions have probably decreased. Edge-related species have probably increased with an increase in habitat. However, small predators that utilize edge habitats for foraging have also increased, especially with the reduction of large predators such as bears, wolves, coyotes, lynx, goshawks, and bobcats.

Non-Native Species *Brown-headed cowbird/natives, especially Neotropical migratory bird conflicts*

Unknown, but probable. The cowbird is found in many habitats throughout the watershed. This species parasitizes many other species. The result is lowered reproductive success for many neotropical birds. The extent of this threat is not known.

Of special concern is the impact of fragmentation on native species that are associated with late-successional habitats. Studies have shown that fragmentation of forested habitats, and the creation of edge habitat has contributed to the expanding range of the cowbird. In addition, fragmented habitats increases cowbird parasitism of bird species associated with late-successional habitats.

Non-Native Species *Barred Owl/spotted owl conflicts*

Probable. There are no known sightings of barred owls in the watershed. One barred owl was observed immediately adjacent to the watershed near Suttle Lake in 1997. There are reported sightings west of the watershed on the Mckenzie Ranger District, 3 sightings south of the watershed on the Bend Ranger District, and a number of sightings in the northwest corner of the Confederated Tribes of the Warm Springs.

Habitat fragmentation throughout the western United States has allowed the barred owl to expand it's range west of the Rockies to the Cascades. The barred owl, a close relative of the spotted owl, appears to be better adapted to fragmented late-successional habitats than the northern spotted owl. Barred owls out-compete spotted owls for suitable habitat (nesting and foraging habitat) where limited habitat exists. The highly fragmented conditions of the mixed conifer PAGs places the spotted owl viability at risk if barred owls move into the watershed.

Non-Native Species *European Starling/Cavity nesting birds conflicts*

Probable. The European starling is common throughout the watershed. It is an aggressive cavity nesting species, which is known to displace native cavity nesting species, especially western bluebirds, a declining species. The extent of starling impacts on native birds is not known. Where snag densities are low, starlings can displace native cavity nesting birds and/or can reduce the population densities of these native species.

Other Human Influences on Wildlife

Other human influences that affect wildlife are stated below. These can have both major and minor effects on either individual species or whole populations.

Trapping

- Still allowed even on sensitive species
- Can reduce localized populations
- May kill non-targeted species
- Enhances genetic fitness by thinning populations

Hunting

- Can reduce localized populations
- May increase disturbance

- Enhances genetic fitness by thinning populations

Recreational Shooting

- Targets non-game species, sensitive, or management indicator species (i.e., hawks)
- Increases disturbance
- May alter reproductive success depending on time of year

Disturbance from recreational activity

- Can alter habitat
- Increases disturbance during critical times (i.e., nesting)
- May alter reproductive success
- May focus predators more readily on species

Recreational Collecting

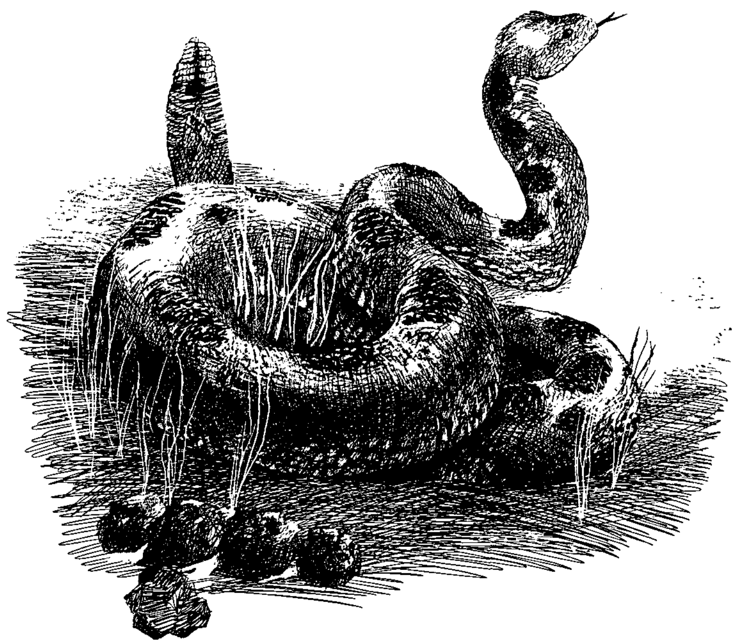
- Reduces population numbers
- Introduces species to new areas
- Can lead to degradation of habitats

Winter Recreation (snowmobiling, trespass into wilderness, heliskiing, etc.)

- Increased disturbance during critical times when energy output is high but energy intake is low
- May limit migration patterns
- May alter reproductive success in rare species such as wolverine

Urban Interface – conversion of agricultural lands to developed lands

- Reduces habitat
- Decreases connectivity
- Introduces new disturbances
- Changes species composition
- Allows exotics and non-natives to out compete natives (increased edge)
- Alters reproductive success
- Increase in non-native predators in the urban interface(i.e., house cats, dogs) which alter population numbers and reproductive success.



Biological Domain-
Aquatic Species of Concern

Characterization

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

Aquatic species of concern for the analysis area have been identified by their status, abundance, habitat risks, and importance to people as a fishery (**Table ASV-1**). Some species may be rare but have a wider distribution in other watersheds in Oregon. Other species may be indicators of specific habitats. Although many other aquatic invertebrates, amphibians, and fish occur in the watershed, only the species of concern are analyzed in this report.

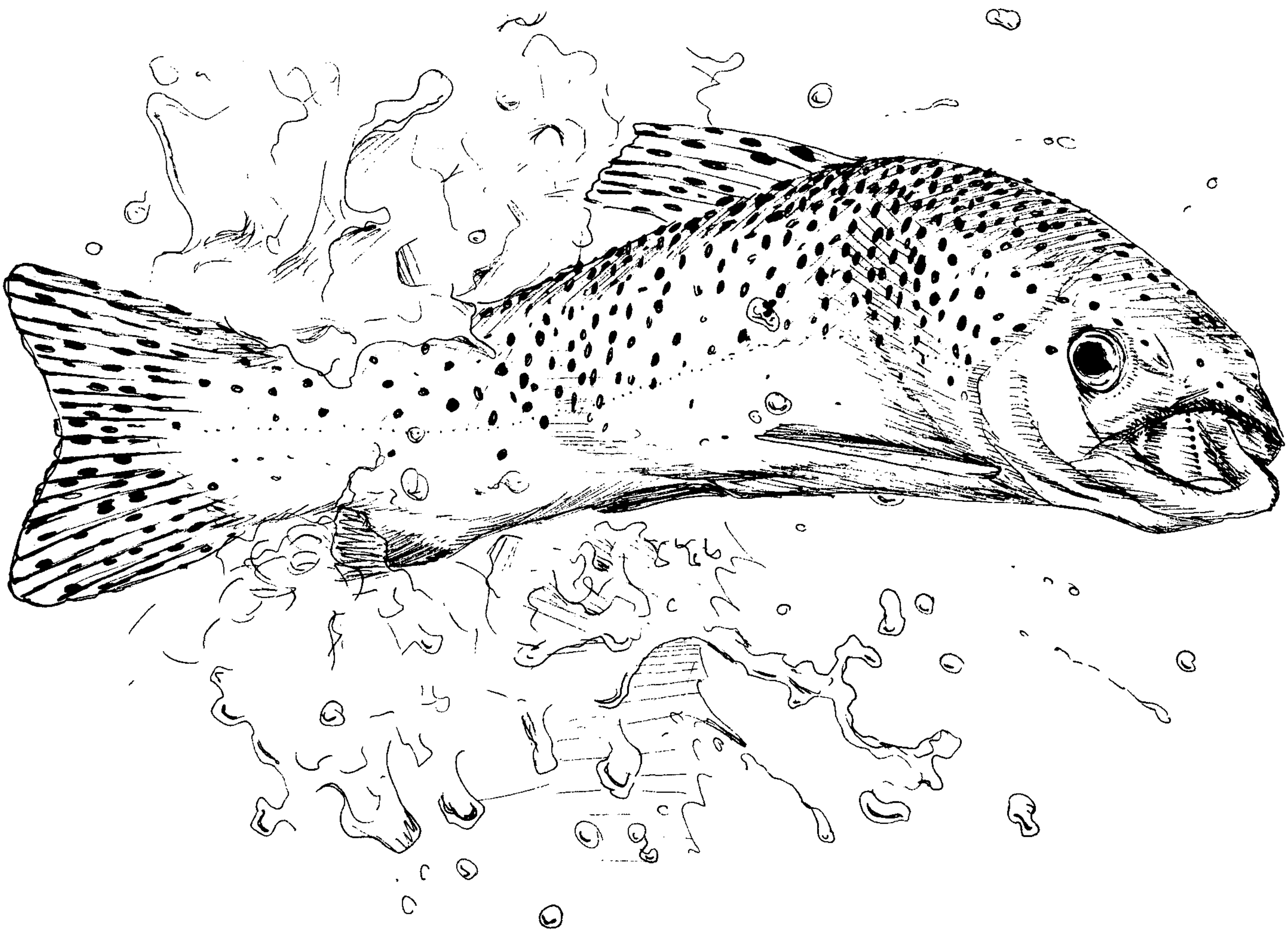


Table ASV-1. *Aquatic species of concern within the Why-chus analysis area. The symbol (X) notes documented sightings, the symbol (H) notes there has been no sighting, but habitat exists in the watershed. U/S= upstream, D/S= downstream, SCID= Squaw Creek Irrigation diversion*

Aquatic Species	**Water Body and Location**									
	Squaw Creek			Indian Ford Creek	Pole Creek	Snow Creek	Park Creek	Trout Creek	Three Creek &Lake	High Lakes
	U/S of SCID	D/S of SCID	D/S of Alder Spr.	U/S of Camp-ground	1514 Road	1514 Road	East and West Fork	D/S of Camp-ground	East and West Fork	Wild-erness
Cascades Apatanian Caddisfly	H			H	H	H				
Deschutes Micro-caddisfly	H	H	H	H						
Redband Trout	X	X	X	X		X		X		
Mountain Whitefish			X							
Suckers		X		X						
Sculpins	X	X	X	X						
Longnose Dace		X		X						
Bull Trout			X							
Kokanee Salmon			X							
Hatchery Rainbow Trout		X		X					X	X
Brook Trout	X	X					X		X	X
Brown Trout		X	X							
Cascades Frog	X				X	X	X	H	X	X
Tailed Frog	H			X		H	H		X	H
Spotted Frog				X				H		
Long-toed salamander RARE Morph/									X	H
Indian Ford Pebble *Snail*				X						
Bull Frog	H	H	H	H						

Reference Conditions

What was the historical relative abundance and distribution of species of concern and the condition and distribution of their habitats in the watershed?

Historically, summer steelhead trout, *Oncorhynchus mykiss*, and spring chinook salmon, *O. tshawytscha*, spawned and reared in Squaw Creek. In 1953, the summer steelhead return in Squaw Creek was estimated at 1000 adults, ranking Squaw Creek the largest run of steelhead in the Deschutes Basin that year (Nehlson 1995). Steelhead were reported to spawn above the town of Sisters (**Figure ASV-1**). Spring chinook were reported to spawn near Alder Springs and in the area around Sisters. Summer chinook may have spawned in the lower reach of Squaw Creek (Lichatowich et al. 1998). Chinook spawning in Squaw Creek numbered less than 100 individuals during the surveys of the 1950's and 1960's. Little information exists of the true potential of Squaw Creek since these inventories were done after the construction of irrigation diversion dams and the major loss of summer flows.

Redband trout, *O. mykiss gairdneri*, appear to have always had slow growth in the upper reaches of Squaw Creek above the town of Sisters. Connection between the Deschutes River and lower Squaw Creek would have given access to fluvial redbands that may have enjoyed faster growth rates in the warm water of lower Squaw Creek and the Deschutes River but moved into upper Squaw Creek to spawn. Historic reports of anglers in lower Squaw Creek are limited, however. Reports of angler's catches in the confluence of Squaw Creek, the Crooked River, and the Metolius River suggested that a fluvial population existed and the connection of these river segments may have been important to the strength of the redband population.

Bull trout, *Salvelinus confluentus*, large and small, have been reported in Squaw Creek near the town of Sisters in the past. A large bull trout was reported at the base of the SCID dam. An angler reported catching bull trout on occasion above the town of Sisters. Although no one has described what would appear to be a significant spawning movement of fish in the fall, bull trout were present in and around Sisters historically. It is possible that the diversion of spring-fed water from Squaw Creek early in the century may have eliminated bull trout from Pole Creek and Snow Creek as early as 1930. Snow Creek was diverted from Squaw Creek and ditched to Three Creek as early as the 1920's or 1930's. Pole Creek and an another unnamed spring were diverted to the town of Sisters in the 1930's. These changes may have eliminated bull trout spawning habitat before much angling was reported in the drainage.

Brook trout, *S. fontinalis*, and brown trout, *Salmo trutta*, were originally absent from the watershed. Brook trout were introduced from the eastern United States into the high lakes and streams. The wilderness lakes have a continued stocking program by ODFW. When brook trout were first stocked, they were reported to grow fast and became large. Today, most populations are slower growing. Brown trout were thought to have moved up from the Deschutes River, where they had first become established.

It is possible that habitat for bridgelip sucker, *Catastomus columbianus*, large scale sucker, *C. macrocheilus*, longnose dace, *Rhinichthys cataractae*, and several sculpin species, *Cottus* spp. may have increased upstream with the increase of water temperatures in Squaw Creek and Indian Ford Creek. These species are not found in the colder waters of the Metolius Basin streams or the upper portions of the Squaw Creek drainage. Historically, these native fish may have been more restricted to the lower portions of Squaw Creek, lower Indian Ford Creek, and the Deschutes River.

There is little historic evidence to help understand trends for the abundance of amphibians and invertebrates. A reasonable assessment of tail frog abundance would follow water temperature changes. Habitat may be restricted for tailed frogs compared to historic conditions, although no confirmed sightings are available. Cascades frogs seem to be well distributed in the higher elevations and were probably present historically. Although *Apatania tavala* has been found in the Metolius River watershed, and not in Squaw Creek, habitat does exist similar to the historic conditions except in Squaw Creek and Indian Ford Creek. Water withdrawls may have restricted their range due to temperature increases associated with low flow.

Current Conditions

What are the current habitat conditions and trends for the species of concern?

Fish distribution

Squaw Creek contains the most diverse fish assemblage in the watershed. However, this fish assemblage is also quite longitudinally stratified (**Table 1; Figures ASV 1 and 2**). Between the confluence with the Deschutes River and Camp Polk, Squaw Creek has brown trout, mountain whitefish, *Prosopium williamsoni*, largescale and bridgelip suckers, bull trout, longnose dace, redband trout, and Piute sculpin, *Cottus beldingi* (Fies et al. 1996, Dachtler and Burke 1997). Between Camp Polk and the Squaw Creek Irrigation District (SCID) diversion, species composition changes to longnose dace, redband trout, brook trout, and sculpin. Above the SCID, fish species become redband trout, brook trout and sculpin (Dachtler 1997, Dachtler and Burke 1997).

Snow Creek, a headwater tributary of Squaw Creek, contains only rainbow trout (**Figure ASV–4**), while Park Creek contains only brook trout. Soap Creek and North Fork of Squaw Creek were surveyed in 1979 and were found to have no fish (Satherwaitte 1979). No information exists on South Fork Squaw Creek.

Indian Ford Creek was sampled and found to contain rainbow trout, longnose dace, and suckers (Mullong 1992). Trout Creek is an intermittent stream that flows into Indian Ford Creek only during high precipitation events. An extant population of redband trout survive in this stream and Trout Creek Swamp.

Of the 13 high lakes in this watershed, six are stocked with fish. Golden, Rim, North Mathieu, and Black Crater lakes are stocked with brook trout while Yapoah Lake is stocked with rainbow trout (Fies et al. 1996). Three Creek Lake and Little Three Creek Lake contain brook trout and rainbow trout. Three Creek Lake continues to be stocked, while Little Three Creek Lake has not been stocked since 1961 (Fies et al.1996).

Fish life histories

Trout life history varies by species. The most abundant form of redband trout is thought to be resident. Fluvial forms of redband trout may migrate into the Deschutes River and move into Squaw Creek to spawn in May. Anadromous steelhead trout were once part of the rainbow complex in Squaw Creek but are now extinct. Brown trout may also exhibit a migratory fluvial life history in lower Squaw Creek, migrating from the Deschutes River into Squaw Creek to spawn in the fall. Bull trout are highly migratory, spawning in September in the Metolius River tributaries, rearing there for 2 to 3 years, moving back down to Lake Billy Chinook and rearing in the lake until sexual maturity. Some of the rearing fish from Lake Billy Chinook move upstream into the Deschutes River and the lower 2-3 miles of Squaw Creek. Brook trout are successful in the high elevation lakes and streams because of their ability to mature at an early age.

Today, migration barriers impede free movement of these migratory life histories (**Figure ASV-3**). Other than Pelton-Round Butte Dams, these barriers are most often irrigation diversion dams. Other barriers to fish migrations are dry channel reaches of Squaw Creek, Indian Ford Creek, and Trout Creek. Irrigation diversions that are unscreened are also barriers to fish dispersal and cause loss of fish each year. The Squaw Creek Irrigation District reported that approximately 5000 fish were recovered from the District ditches in October, 1997 and released into the District and private ponds (SCID, personal communication). One diversion is screened on Indian Ford Creek.

Table ASV-2. *Formal status of aquatic species of concern in the Why-chus analysis area. Symbols are defined as: E-endangered, T-threatened, P-petitioned/proposed for listing, S-sensitive, SC-species of concern, C- Candidate, USFWS - US Fish and Wildlife Service, USFS - USDA Forest Service Region 6, ODFW - Oregon Department of Fish and Wildlife. The confirmed occurrence in the analysis area and the population trend is provided. Also see Riparian Reserves section –aquatic species of concern.*

Species of concern	USFWS	USFS R6	ODFW	Why-chus Occurrence	Why-chus Population Trend
Bull Trout	T	T	S	rearing	recovering
Summer Steelhead Trout	P	P	-	extinct	-
Spring/Summer Chinook Salmon	P	P	-	extinct	-
Redband Trout	C	S	S	resident/ fluvial	unknown
Cascade Apatanian Caddisfly	C	S	S	unknown	unknown
Tailed Frog	-	-	S	unconfirmed	unknown

Fish sampling on Squaw Creek during stream surveys show redband trout dominating the fish community (Dachtler 1997). In the town of Sisters and upstream, fish were inventoried using primarily direct observation while snorkeling. Redband trout comprised 81% of the fish found while brook trout was observed less than 1%. Upstream of Sisters, redbands over 10 inches in length made up 2% of the sample. Longnose dace and sculpin totaled 13% of the fish observed.

Downstream of Sisters, redband trout comprised only 45% of fish sampled by electrofishing. Brown trout were a quarter of the sample and suckers, sculpins, and longnose dace were nearly one third of the fish caught (DEQ unpublished data, 1997).

Threats to the redband population in Squaw Creek and Indian Ford Creek include loss to unscreened diversions, high water temperatures from low flow, introgression from hatchery rainbow stocks, loss of habitat quality due to low flow, loss of wood and pools due to channelization, and migration barriers. Thermal refugia for redband trout exist in the upper ends of the system where springs and snowmelt offer cold water temperatures. Springs along the length of Squaw Creek at Pole Creek, Camp Polk, and Alder Springs offer both summer and winter refugia and additional invertebrate productivity. Channelization has reduced habitat quality in the low gradient reaches around Sisters. This once productive reach has been widened, side channels reduced, and pools lost. Wood was removed below the SCID and cover for redband trout was lost. The removal of willow on Indian Ford Creek and willow and cottonwood on Squaw Creek has led to increased summer temperatures, reduced streambank cover, increased channel width, and reduced pool frequency. Irrigation dams and low flow reaches are barriers to movement in the spring and summer. Hatchery fish introduced to private ponds do escape into the streams, but the extent to which they may interbreed is uncertain. Genetic testing of Squaw Creek redband trout did not show evidence of hatchery influence in the wild fish.

The likelihood of persistence is good due to the number of individuals in the population and the presence of refugia. There is some risk from a large flood or debris torrent, perhaps the scale of a failure in the Carver Lake moraine. Such an event may have the greatest affect on the upper reaches that now function as a refuge for redband trout. The lack of connection to lower Squaw Creek may limit recolonization after such an event. As a fishery, the Squaw Creek population is not near it's potential due to losses from unscreened diversions and migration barriers caused by dams and dewatered reaches.

Bull Trout Status In 1998, bull trout were formally listed as threatened by the USFWS because of loss of habitat, migration barriers, and competition from introduced species. The state of Oregon rates the bull trout population in Lake Billy Chinook and the Metolius River at low risk of extinction (Buchanan et al. 1997). Population numbers have increased since the 1980's as a result of protective angling regulations (Riehle et al. 1997). The Metolius River spawning population uses lower Squaw Creek for rearing before migrating back to the Metolius system to spawn. Because of the migratory habits of these adfluvial bull trout, unscreened irrigation diversions on Squaw Creek may threaten their survival in the watershed. Brook trout, commonly thought as a competitor with bull trout, are found in the Squaw Creek drainage, but in low numbers.

Habitat is in poor condition for bull trout in Squaw Creek. Temperature increases resulting from low flows may have restricted bull trout use of upper Squaw Creek for rearing. Spawning habitat is limited by elevated temperatures in the early summer and anchor ice formation in the winter. Areas where springs occur, such as Alder Springs, provide some refuge from summer high temperatures but do not appear to be cold enough for spawning. Wood removal, reduced side channels, and pool loss associated with channelization has reduced cover for rearing bull trout in the area near Sisters.

Bull trout will continue to use lower Squaw Creek as rearing because their persistence in the watershed is dependent on stable spawning and rearing habitats in the Metolius River system. Losses to unscreened diversions will reduce the numbers of individuals in the system and may reduce the chance of the establishment of a spawning population in the upper reaches of Squaw Creek.

Steelhead Trout Status Steelhead trout have been lost from the watershed above the Pelton/Round Butte Dams. The lower Deschutes River population of summer steelhead has been petitioned for listing under ESA (Endangered Species Act). Runs of wild steelhead have been low compared to the number of stray hatchery steelhead entering the river each year. Interbreeding of the wild and out-of-basin hatchery fish may pose a threat to the genetic integrity and fitness of the wild run.

Should steelhead be reintroduced to Squaw Creek under the new license of Pelton/Round Butte Dam, low flow, high water temperatures, and unscreened irrigation diversions will be limiting factors to the reintroduction effort. Spawning habitat has been reduced due to low springtime flows and high water temperatures during the egg incubation period. Irrigation dams block migration routes upstream and divert juveniles into ditches on their downstream migration. Rearing habitat has been reduced due to channelization, loss of pools and side channels, and loss of wood. The lower reaches have some pocketwater and may be adequate rearing habitat given better instream flow.

The population above the dams would be treated as part of the same population as the lower Deschutes River if a listing under the ESA is issued by National Marine Fisheries Service (NMFS).

Chinook Salmon Status Chinook salmon have been lost from the watershed above the Pelton/Round Butte Dams. In the lower Deschutes River, fall chinook have recently been included by NMFS into a group of populations that have already been listed under the ESA in the Snake River. Therefore, NMFS has proposed the Deschutes River population for listing under the ESA. Returns of fall chinook to the Deschutes River have been relatively high in the past five years (Lichatowich et al. 1998). In contrast, spring chinook returns in the lower Deschutes River have been low in recent years. Summer chinook have been reported in the Deschutes River by researchers, but are not formally recognized by ODFW (Lichatowich et al. 1998). There appears to have been a historical migration of chinook into the lower Deschutes River from April though October. Some of these summer fish were reported spawning in lower Squaw Creek (Lichatowich et al. 1998).

Should chinook be passed above the dams under a new license, the population would be treated as part of the same group as the lower Deschutes River. Prior to the completion of Round Butte Dam, chinook numbers in Squaw Creek were low and probably did not exceed 100 adults (Nehlson 1995). By the time of the spawning surveys and weir trapping, the population of chinook in Squaw Creek may have been suffering from habitat degradation and losses due to unscreened irrigation diversions.

Redband Trout Status Redband trout have been identified as a distinct stock of inland rainbow trout on the eastside of the Cascade Mountains in the Columbia River Basin **(Table ASV-2)**. Threats from the introgression with hatchery stock rainbow trout in many drainages caused some agencies to raise protection for those remaining native populations. Redband trout populations in Indian Ford Creek and Squaw Creek are at risk from hatchery strains of rainbow trout from irrigation ponds and recreation ponds in the system.

Brook Trout and Brown Trout Status Brook trout are an introduced species that have become established in the Why-chus watershed. High elevation lakes and streams have been stocked with brook trout and now have self-sustaining populations that may supply the lower reaches of Squaw Creek. Brook trout are found in Squaw Creek but in very low numbers. Streams with high numbers of brook trout include Three Creek, Park Creek, and the outlet of Golden Lake. These areas of natural brook trout production in the higher elevations may be the core habitats for brook trout in the watershed. Brook trout generally are considered a competitor of bull trout, although in Squaw Creek, they pose little risk of competition due to rearing and spawning habitat segregation.

Brown trout are found in Squaw Creek below the town of Sisters. In some reaches, brown trout may outnumber redband trout. It is likely that habitat for brown trout has increased with the loss of instream flow through irrigation withdrawals. Migratory brown trout from the Deschutes River spawn in the lower reaches of Squaw Creek and may contribute to the Deschutes River population above Lake Billy

Chinook.

In Squaw Creek, habitat use may be partitioned between the bull and brown trout species, where bull trout occupy the colder water below Alder Springs and the brown trout may occupy the warmer water above the springs. Although there may be some overlap in habitat use, no relationship has been made between bull trout and brown trout abundance.

Invertebrate Distribution

Cascade Apatanian Caddisfly Status This insect is sparsely distributed with low densities in several western Oregon river drainage's but may be more common than originally thought. It may be associated with instream wood, swift currents, and clean water habitats. It is found in the Metolius River and its tributary, Roaring Creek. Habitat occurs for this species in the Sisters/Why-chus in springs and streams with swift, cold water at mid elevations. Pole Creek, upper Squaw Creek, Snow Creek and Indian Ford Creek have habitat for this species. Invertebrate sampling on Indian Ford Creek and Squaw Creek have not found this species, although sampling protocols were not designed to prove presence or absence. Surveys of aquatic macroinvertebrates have not found this species, but surveys may not be adequate to prove presence or absence. Although trends in the population or distribution cannot be discerned, protecting instream wood and reducing fine sediment can reduce threats to this caddisfly.

Deschutes Microcaddisfly Status The Deschutes Microcaddisfly builds a small case or purse and feeds on fine organic particles and algae. This species is found in the lower Deschutes River and may be associated with larger river systems or lower elevations. Some individuals have been found in side springs along the river. Although this species has not been found in the Sisters/Why-chus watershed, there may be a chance it occurs there. Habitat may be limited in this watershed but may be found in Squaw Creek or Indian Ford Creek.

Indian Ford pebblesnail has been identified on the draft Sensitive Species List for Region 6. Little is known for this species.

Amphibian Status

Cascades Frog Status This species is an Oregon State Sensitive Species in the critical category because populations appear to be declining at the State and Regional level. Cascades frogs have been found in many lakes and streams within upper Squaw Creek, Three Creek, and Snow Creek watersheds. Generally, this frog can use cool water habitats more than most other amphibian species other than tailed frogs. Brown (1997) mapped distribution and movements of Cascades frogs. The occurrence of Cascades frogs was strongly associated with retention of water during summer but not associated with fish presence. Dispersing Cascades frogs were found to use streams as corridors between habitat patches (Brown 1997). Breeding sites are associated with emergent vegetation, rock substrate, and gradual shorelines. The presence of down woody material, litter, horizontal grass and shrub cover, and high levels of tree canopy in these aquatic habitats are important for maintaining micro-habitats preferred by this species.

Tailed Frog Status This species is an Oregon State Sensitive Species in the critical category because populations appear to be declining. Historic numbers are unknown but it is presumed to have been common. This species has exacting habitat requirements, including the lowest known temperature requirements, and one of the narrowest temperature tolerances of any of the world's frogs. It utilizes fast flowing, cold streams throughout the Pacific Northwest.

Adults spend days under rocks or debris and emerge at night to feed on insects and other invertebrates. This species has been found foraging as far as 75 feet from water. These cold temperature requirements are primarily associated with high levels of canopy cover and cool microclimates found in mature and late-successional habitats.

There have been no formal surveys for this species in this watershed but tailed frogs are recorded on the Oregon Natural History Database for sightings at the springs of Indian Ford Creek and at Three Creek Lake. Threats to their persistence would be increased water temperature, loss of riparian vegetation for shade and an increase in fine sediment in the streambed. Sightings of this species need to be confirmed and protection measures will need to be developed.

Spotted Frog Status This species is a federally listed Candidate species declining at the State level. The changes in population densities and acres of potential habitat from historic conditions to current conditions are not known. The marshy ponds needed by this species were probably never abundant in the watershed.

No formal surveys have been conducted for this species and there are no known sightings within the watershed. This species occupies marshy pond or lake edges or algae-covered overflow pools of streams. However, it is not likely to be found in wet meadows that dry up during the summer, and unlike the tailed frog, it is more likely to be found in slow moving streams. The small ponds and wetlands within the Indian Ford subwatershed are all considered potential habitat for this species. The presence of down woody material, litter, horizontal grass and shrub cover in these aquatic habitats is important to maintain microhabitats preferred by this species.

Other Amphibians Status There is currently worldwide concern that many populations of amphibians are declining. Proposed causes for declines include destruction, pollution, acid precipitation, disease, increases in ultra-violet radiation, and exotic predators and competitors. In addition, man-made disturbances such as road construction, stream channelization, and wetland draining have isolated populations and reduced immigration/migration.

There is potential habitat for many species of amphibians in the area **(Appendix W-1)**. The Forest Service has conducted no formal surveys in this watershed. However, western toads, Cascades frogs, and long-toed salamanders have been studied intensively for many years in the Three Creeks Lake area by researchers (A.Blaustein, C.Brown, and D.Olson) from Oregon State University and the Pacific Northwest Research Lab in Corvallis, Oregon. Important breeding areas have been identified through their efforts (Brown 1997).

Species known or suspected to occur on the Sisters Ranger District are the following:

Northwestern Salamander
Long-toed Salamander
Great Basin Spadefoot
Pacific Tree Frog
Spotted Frog
Rough-skinned Newt
Tailed Frog
Western Toad
Cascades Frog

Some of these species have been previously discussed because they are sensitive and declining. Long-toed salamanders, rough-skinned newts, Pacific tree frogs, and northwestern salamanders are relatively common and well distributed in this watershed and in the larger area where habitat occurs. Generally, these species are associated with shallow warm water with emergent vegetation for breeding and rearing. Northwestern salamanders are more common in the higher elevation lakes while the long-toed salamanders are more common in the mid to lower elevation ponds, wetlands, and lakes.

Researchers believe that the long-toed salamander in the Three Creeks Lake area is a unique species, unlike other long-toed salamanders in the state because it grows a different type of skull and jaw structure under certain conditions and becomes cannibalistic. Researchers have also found that ultraviolet radiation and the fungus, *Saprolegnia* spp. are causing high mortality among amphibians there. A reduction in our protective ozone layer has been blamed for causing damage to amphibians and weakening their immune systems to diseases (e.g., *Saprolegnia* spp.) which occurs naturally but may also have been brought in on hatchery fish. Lastly, recreation in the area has had an impact on amphibian survival and habitat. Trampling of habitat and capture of amphibians has had an impact on amphibian populations.

Bullfrog/Native Amphibian Conflicts There are no known bullfrog sitings in the watershed. They are known to occur at Tule Lakes (adjacent to Deschutes River) on the Confederated Tribes of Warm Springs (CTWS). There is a low probability that the frog could move up the Deschutes River into Lake Billy Chinook and eventually to Squaw Creek or Indian Ford Creek. Expansion into the watershed may be possible into Indian Ford Creek but may be limited by the Weir grade diversion and fast, cold water conditions in Squaw Creek.

Bullfrogs can prey on native amphibians, significantly reducing their population levels. Bullfrogs are very large frogs and can consume large prey. Declines in waterfowl populations, western pond turtles, spotted frogs, and leopard frogs have been partially attributed to increases in bullfrog populations.

Synthesis – Trend Discussion

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?

Chinook salmon and steelhead trout have been lost from the Sisters/Why-chus watershed. Fish passage at Pelton/Round Butte dams was unsuccessful and passage was abandoned for a hatchery program in 1967. Habitat for anadromous fish and resident fish has declined in quality from water diversions without screens, impassible irrigation dams, loss of riparian vegetation, increased water temperatures, and unstable streambank conditions (see Physical Stream Habitat section). These reductions in habitat quality are restricted to Indian Ford Creek and lower Squaw Creek. Fish habitat in the upper reaches of all streams in the watershed are in good condition, similar to historic conditions. Riparian canopy and instream pool habitat is somewhat low, perhaps due to clearcutting riparian areas, wildfire salvage logging, and stream cleaning operations. The diversion of water out of wetlands and stream channels for irrigation is the largest change affecting fish and other aquatic life.

Squaw Creek was important to steelhead production in the Deschutes River and may have been important to the Deschutes River redband population. The link to these populations has been lost because of dams and the loss of instream flow. Although habitat quality has been degraded, Squaw Creek still has good potential if connectivity and flows are restored.

Core habitats for bull trout in the Lower Deschutes metapopulation were probably not dependent on Squaw Creek. The Metolius River, Warm Springs River, and Shitike Creek were most likely more important. If spawning occurred in Squaw Creek, it may have played more of a role as a satellite population that was more dependent on the Metolius subpopulation for its persistence.

Demands for water and land for agriculture and residential development has resulted in habitat degradation in Squaw Creek and Indian Ford Creek. As uses change from agriculture to more residential, there may be more opportunity of habitat restoration as local uses are based on more recreational and aesthetic values.

For more discussion on changes and amphibians see Riparian Reserve Section

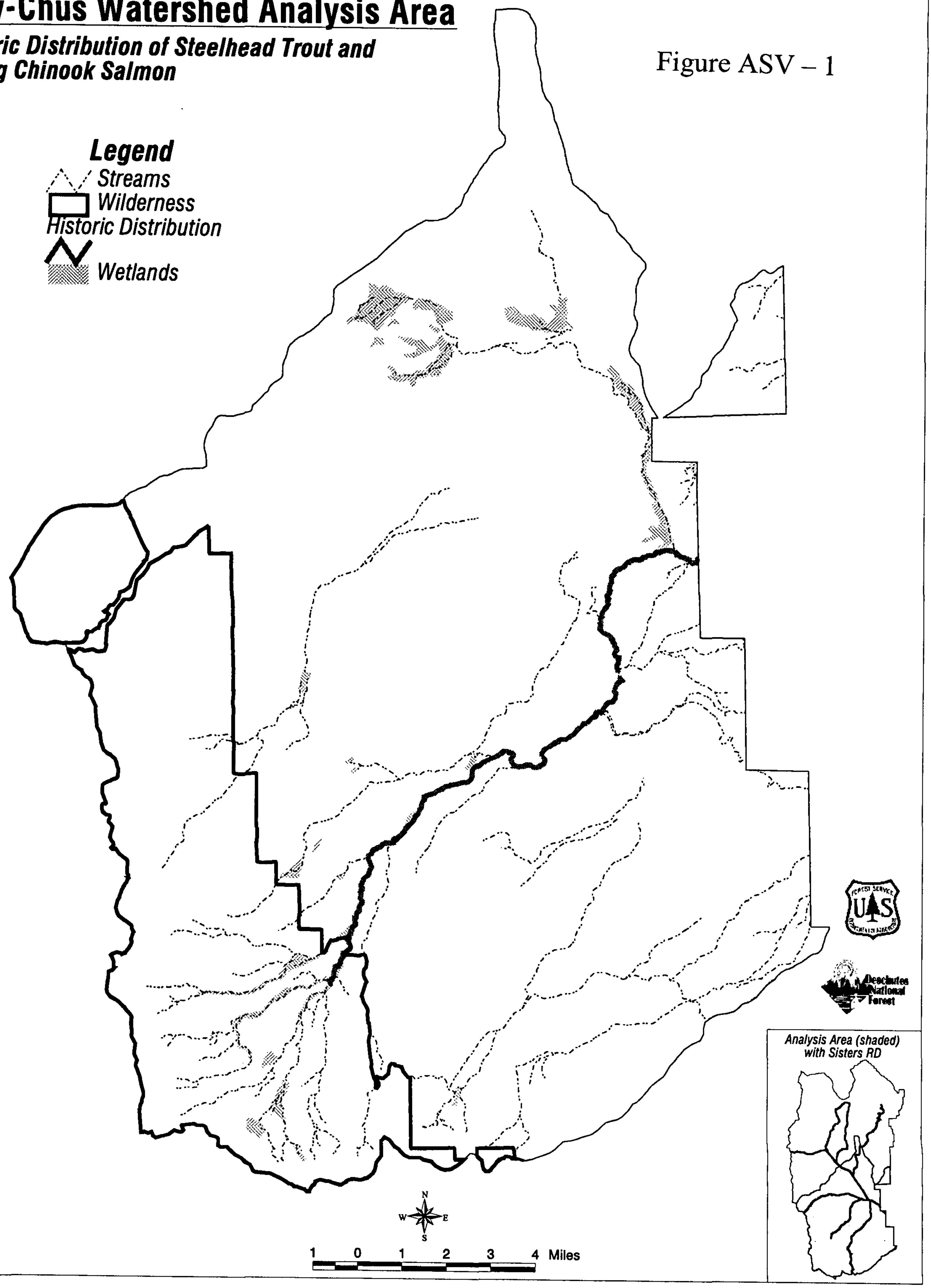
TREND SUMMARY:

- Genetic integrity and fitness of native fish stocks are at risk from introduced and hatchery raised fish. Introduced species alter native species composition and populations of aquatic species.
- Low flows, loss of wood, reduction in pool habitat, and unstable streambanks has decreased habitat quality.
- Removal of willow and cottonwood along riparian reserves has increased stream temperatures.
- Losses of native stock continue to occur via unscreened irrigation diversions.
- Changes in land uses near riparian areas have led to habitat degradation.
- Amphibians are declining world wide, and fluctuations are being seen in this watershed as well.
- Increased recreational activity in sensitive riparian areas has decreased the quality of habitat for aquatic species.

Why-Chus Watershed Analysis Area

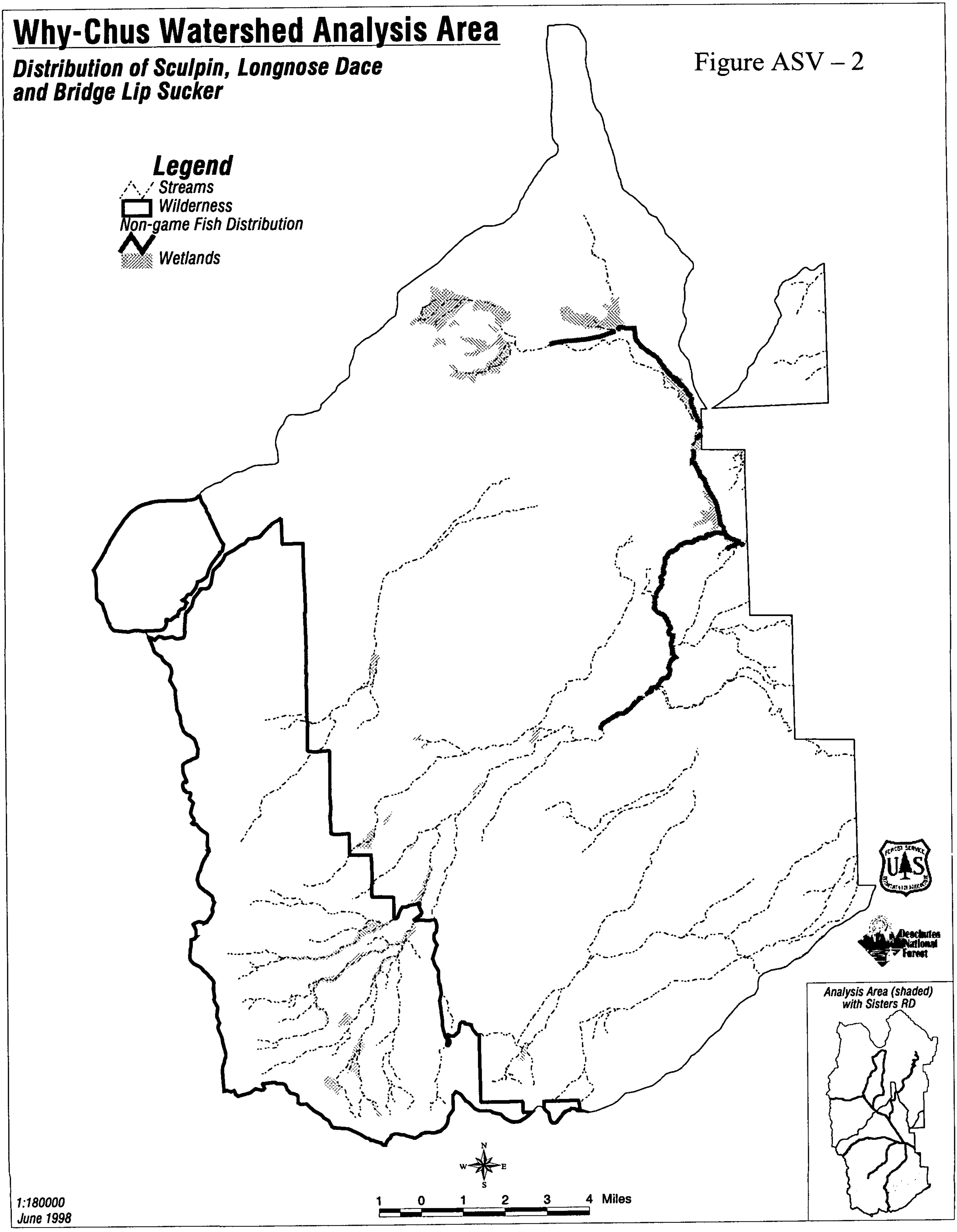
Historic Distribution of Steelhead Trout and Spring Chinook Salmon

Figure ASV – 1



1:180000
June 1998

Figure ASV – 2



Why-Chus Watershed Analysis Area
Distribution of Sculpin, Longnose Dace and Bridge Lip Sucker
Legend
Streams
Wilderness
Non-game Fish Distribution
Wetlands
Analysis Area (shaded) with Sisters RD
Deschutes National Forest
1 0 1 2 3 4 Miles
N
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June 1998

Why-Chus Watershed Analysis Area

Potential Fish Barriers between Sisters and SCID Diversion

Figure ASV-3

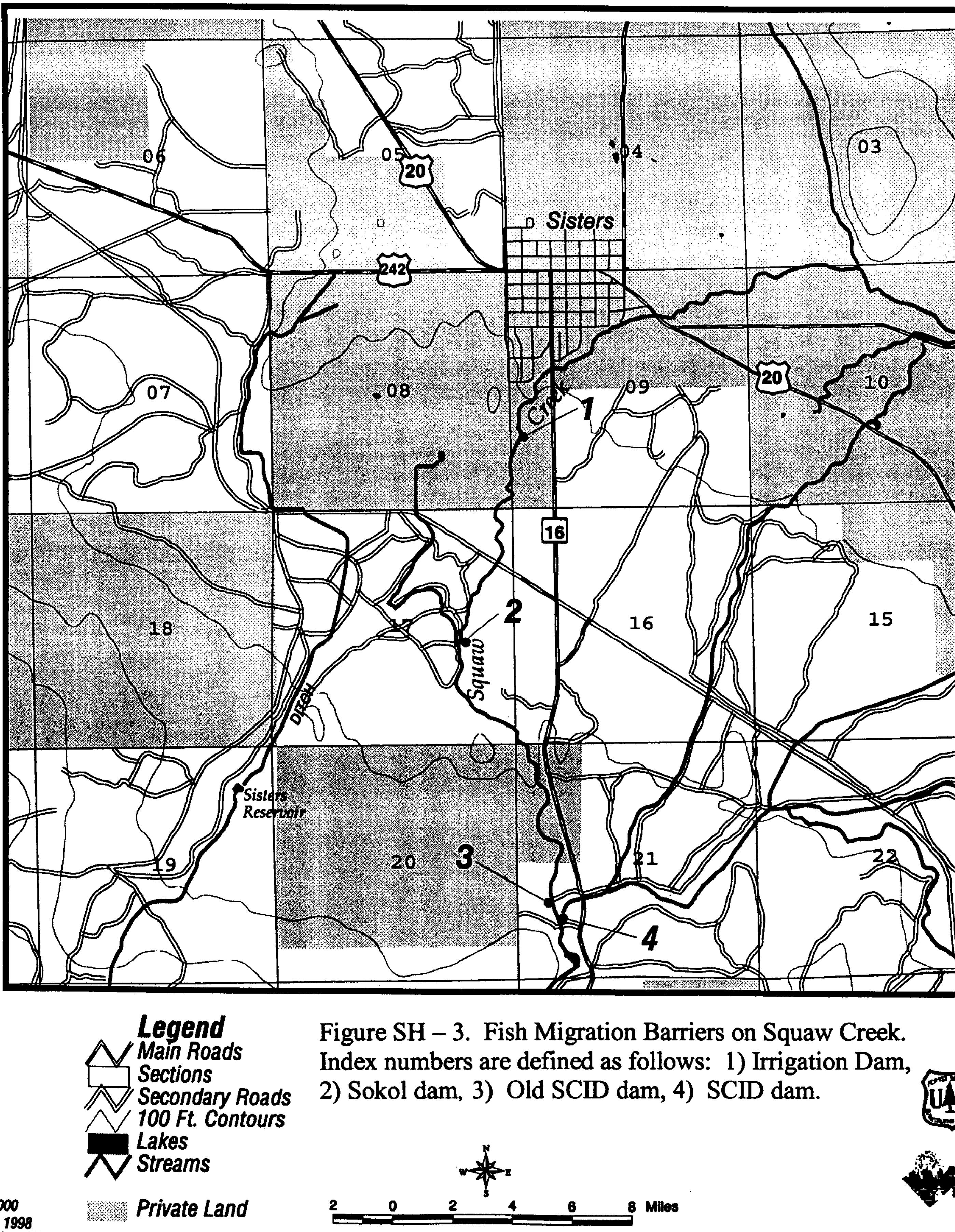
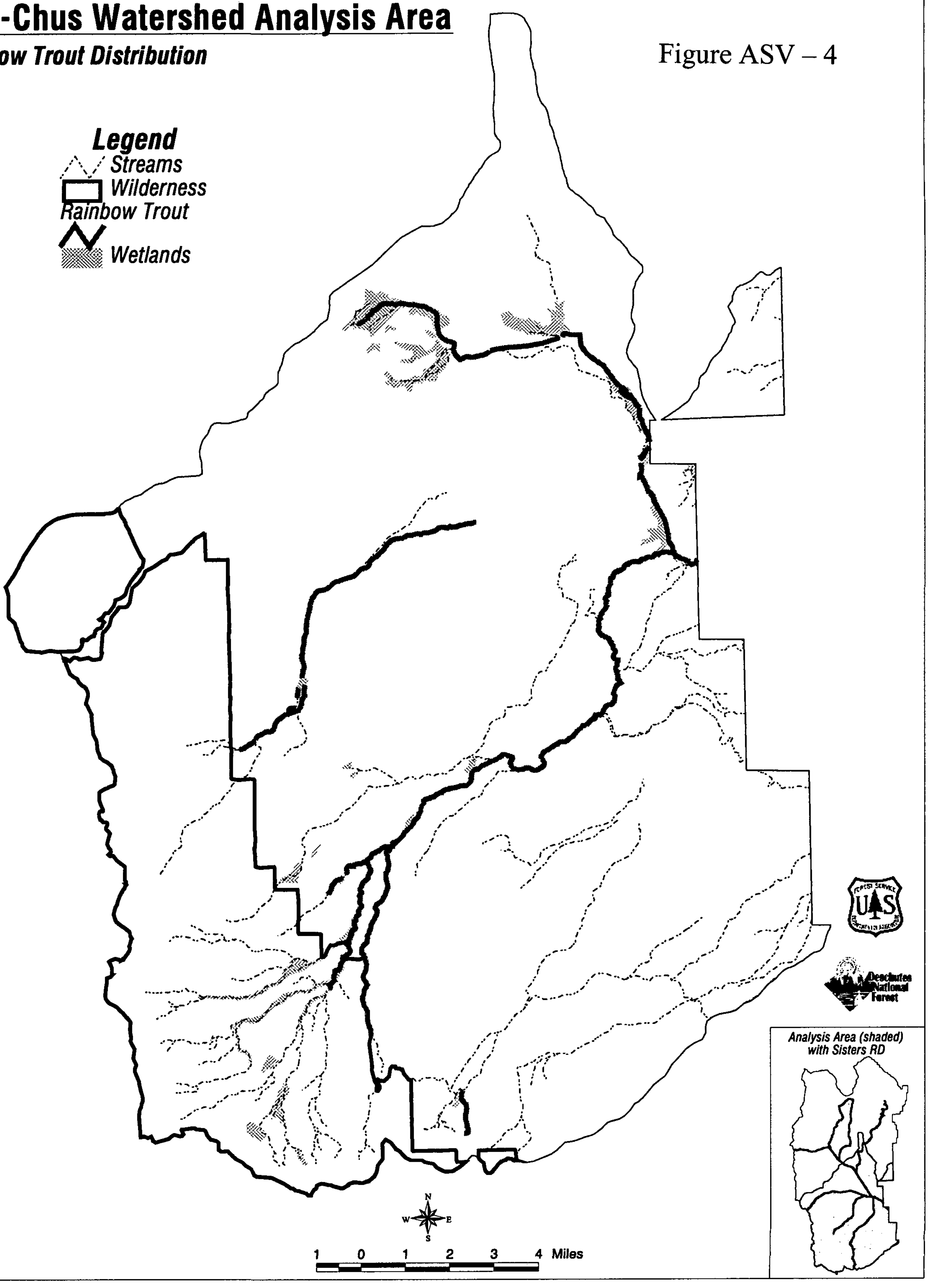


Figure SH – 3. Fish Migration Barriers on Squaw Creek. Index numbers are defined as follows: 1) Irrigation Dam, 2) Sokol dam, 3) Old SCID dam, 4) SCID dam.

Why-Chus Watershed Analysis Area

Rainbow Trout Distribution

Figure ASV – 4



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RIPARIAN RESERVES

Introduction

This section displays the analysis used to adjust Riparian Reserve Boundaries for the Sisters/Why-chus watershed. The Aquatic Conservation Strategy (ACS) in the Northwest Forest Plan (NFP) describes management objectives for Riparian Reserves and Key Watersheds. Generally, the ACS requires management to maintain and enhance all bodies of water and associated riparian areas. Under the ACS, riparian reserves are used to maintain and restore riparian structures and functions of intermittent streams and confer benefits to riparian-dependent and associated species. They also enhance habitat conservation for organisms that are dependent on the transition zone between upslope and riparian areas and improve travel and dispersal corridors for many terrestrial animals and plants. Riparian Reserves also serve as connectivity corridors among the Late-Successional Reserves.

Watershed analysis should take into account all species that were intended to benefit by the prescribed Riparian Reserve widths. Those species include: fish, mollusks, amphibians, lichens, fungi, bryophytes, vascular plants, American marten, red tree voles, bats, marbled murrelets, and the northern spotted owl. The specific issue for spotted owls is retention of adequate habitat conditions for dispersal (ROD 1994).

Riparian reserves are especially important to the Sisters/Why-chus watersheds because they transect a mostly arid landscape.

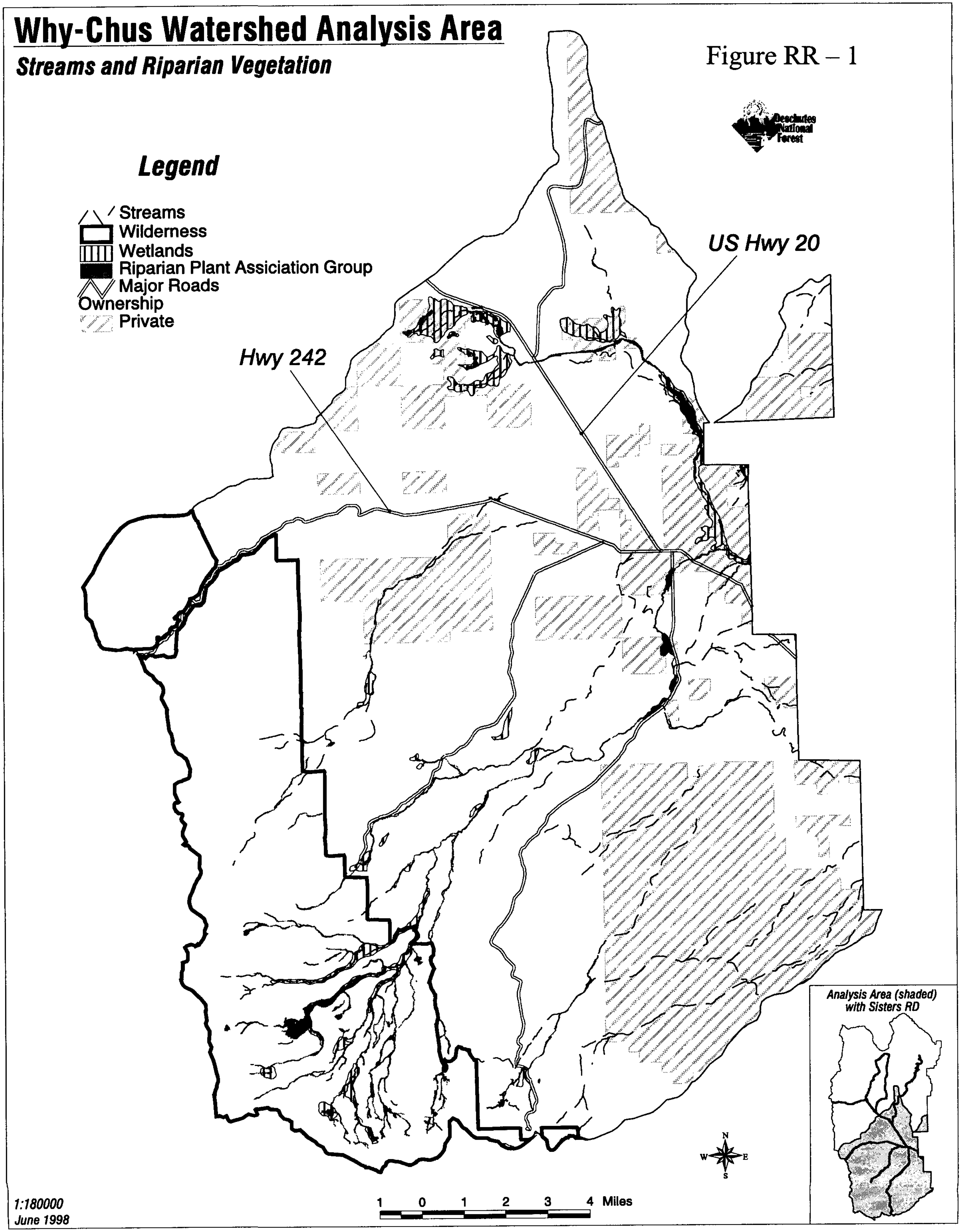
Characteristics of Riparian Reserves

*Characterize the Riparian Reserves in the watershed (e.g., Stream densities, unstable land, vegetation characteristics, floodplains and valley floor widths, presence of fish)***Note also see Erosion Processes, Hydrology and Stream Channels sections

Stream densities are generally low due to highly permeable soils and underlying fractured rock. Surface flow of streams is rare in the Trout, Melvin and Indian Ford subwatersheds **(Table RR-1)**. The Squaw Creek subwatershed has the highest density of streams due to the high elevation, high precipitation, and relatively low occurrence of highly permeable soils **(Figure RR-1)**.

Table RR-1*. Stream density within subwatersheds under analysis.*

Subwatershed	Acres	Miles of stream	Total stream miles /mile ^{2}	Perennial stream miles per mile ^{2}
Indian Ford	28,250	17	0.4	0.2
Melvin	13,132	8	0.4	0.3
Pole	10,662	9	0.5	0.4
Squaw	40,745	94	1.5	1.1
Three Creek Butte	25,219	28	0.7	0.0
Three Creek Lake	4,465	8	1.1	0.6
Trout	55,364	21	0.2	0.2


Why-Chus Watershed Analysis Area
Streams and Riparian Vegetation
Figure RR – 1
Deschutes National Forest
Legend
Streams
Wilderness
Wetlands
Riparian Plant Assiciation Group
Major Roads
Ownership
Private
US Hwy 20
Hwy 242
Analysis Area (shaded) with Sisters RD
N
W
E
S
1 0 1 2 3 4 Miles
1:180000
June 1998

Lakes and wetlands compose some of the riparian reserves in this watershed. Three Creek Lakes has a major component of the lake and pond habitats and Indian Ford Creek has a major component of the wetland meadows and flooded willows stands within the watershed (**Table RR-2**). A total of 1790 acres of riparian and wetland habitats have been identified within the Indian Ford Creek subwatershed alone. These wetlands represent a significant part of the wetlands in the Deschutes Basin north of Bend and represent significant wetlands within lower elevations of the basin. Yet these habitats are rare on the landscape. Wetlands comprises less than 2 % of the total area.

Table RR-2. *Acres of lakes and wetlands in the subwatersheds under analysis.*

Subwatershed	Acres	Acres of lakes	Acres of wetlands
Indian Ford	28,250	44	1790
Melvin	13,132	2	0
Pole	10,662	1	107
Squaw	40,745	84	1119
Three Creek Butte	25,219	1	0
Three Creek Lake	4,465	91	34
Trout	55,364	26	264
Total	**177,837**	**248**	**3313 (1.9% of total acres)**

Riparian reserves in this watershed have been mapped using the classification outlined in the Northwest Forest Plan (NFP). The reserves are dominated by linear stream reserves with a few wetlands, generally along streams. Lakes make up a small portion of the riparian reserve network (**Table RR-3**). Lake and pond reserves are often isolated within the volcanic terrain without inlet or outlet streams. An exception may be Three Creek Lake, which has some connection of streams and wetlands in the upper elevations.

Table RR-3. *Interim riparian reserve acres by reserve type within the subwatersheds under analysis.*

Subwatershed	Interim riparian reserve acres by class				
	Total	**Lake, pond**	**Wetland**	**Perennial stream with fish**	**Perennial stream or intermittent stream without fish**
Indian Ford	2119	228	954	677	260
Melvin	126	23	0	0	103
Pole	707	13	113	482	99
Squaw	5437	597	995	1945	1900
Three Creek Butte	929	29	0	0	900
Three Creek Lake	599	141	32	285	141
Trout	1412	265	157	623	367

Characteristics of perennial streams were assessed to determine factors shaping the design of final riparian reserves (**Table RR-4**). Generally, the presence of fish in streams ranks reserves with full protection under the NFP. Additional protections may be warranted if the floodplain is larger than the standard of twice the maximum tree height for that site. Valley form will play a role if the valley slopes are steep and unstable. Reserve boundaries will need to extend to the top of the inner gorge, whether that is within twice the maximum tree height distance or greater. Meadows and the extent of riparian vegetation will also increase the width of the standard riparian reserve.

Site potential tree heights have been estimated using Volland (1985), Kovalchik (1987) and direction from the Region 6 office on "Determining Site Potential Tree relative to Riparian Widths" dated 2/15/95 (USDA 1995) (**Table RR-4**). These tree heights are summarized by stream and are used to design final riparian reserve widths (**Table RR-5**).

Table RR-4*. Summary of Site Indexes and Potential Tree Heights by PAG for the watershed.*

PAG	Site Index	Potential Tree Heights (ft)
Wet Mixed Conifer	75 – 107	140 – 180 ft (Ponderosa Pine)
Dry Mixed Conifer	53 – 98	100 – 160
Ponderosa Pine	53 – 98	100 – 160
Lodgepole Pine	70 – 96	100
Mountain Hemlock	76 – 97	120 - 160

Unstable land plays a large role in the design of final riparian reserves. Much of the landscape is not prone to landslides or debris flows (see Erosional Processes section). Examples of debris flows and moraine erosion can be found in the wilderness at the bases of the Three Sisters Mountains and Broken Top. These areas have steep terrain, rock slides, and debris slides that can influence stream characteristics downstream. The North Fork of Squaw Creek shows the effects of a debris slide on channel characteristics. The channel is u-shaped with eroded, exposed streambanks that rise 5ft or more above the wetted channel. These debris slides can affect channels downstream by increasing the quantity and quality of sediment transport. Although infrequent, these events themselves may result in unusually high flow events that are several times greater than the normal peak flows in the hydrograph. Widths of final riparian reserves need to be designed with these events in mind.

Table RR-5. General channel characteristics for perennial streams used to determine final riparian reserves.

Determinant	Squaw Creek	Park Creek and upper Squaw Creek Tribs	Indian Ford Creek	Trout Creek	Pole Creek and N. Pole Creek	Snow Creek	Melvin Spring	Three Creek
Fish Presence	Redband Brook Sculpin L. Dace	Brook Trout	Redband / Rainbow Trout	Redband Trout	Brook Trout or none	Redband Trout	none	Brook Trout Rainbow Trout
Valley Form	Short slope in lowlands with >30% slopes upstream of USGS gauge	Narrow v-shaped >60% slopes	Broad <30% slopes	Short steep slopes in narrow valley with moderate slopes along meadow	U-shaped moderate slopes in lowlands with narrow v-shaped >30% slopes in upper reaches	U-shaped moderate slopes in lowlands with narrow v-shaped >30% slopes in upper reaches	Moderate slopes	Narrow v-shaped >30% slopes with broad u-shaped valleys in meadows
Valley floor width (ft)	400-1200	<100	>600	100 steeps 600 meadows	<100	<100 steeps 600 meadows	100	100 steeps 600 meadows
Average Maximum Tree Height (ft)	140	140	140	140	140	140	140	140
Estimated 100-yr Floodplain (ft)	100-600	20-100	50-100	20-100	20-100	50-100	10-20	20->100
Extent of Riparian Vegetation (ft)	25-200	10-200	25-200	10-300	10	10-100	10-20	10-100
Unstable and potentially Unstable Lands	>30% slopes with seeps near Rd 1514 and glacial moraines	Debris flows and glacial moraines		Tuff flow and debris flows and glacial moraines		Cinder slopes near channel		Cinder slopes near channel

Riparian vegetation has been mapped for the watershed and tends to be located in narrow bands along streams with meadow and wetland habitats in the mid-elevations and small patches of riparian vegetation along streams and seeps in the high elevations (**Figure RR-1**). Riparian plant associations have been described by Kovalchik (1987) for the Deschutes National Forest. General patterns of riparian vegetation are a ponderosa pine, aspen, and snowberry dominated association in the lower elevations (**Table RR-6**). Cottonwoods are found from the lower elevations up to 6500ft. Douglas spirea, willow, and birch are found in the open wetlands of Indian Ford Creek. In mid-elevations, among the mixed conifer stands, mountain alder dominates the shrub component and tends to be in a narrow band along the streams. Upper elevations have flooded sedge wetlands and a mix of sedge and grass meadows associated with seeps and snowmelt along the streams. Alpine riparian plant associations are fragile both due to the harsh growing conditions and the poor soil quality. Light, dry, and highly erodible soils are sensitive to disturbance from heavy recreation use.

Table RR-6*. Summary of common riparian vegetation found associated with riparian reserves in the analysis area.*

Waterbody	Riparian Vegetation
Trout Creek Swamp	Lodgepole pine, Engleman spruce, mountain alder, black cottonwood, willow, sedge
Pole Creek Swamp	Lodgepole pine, Engleman spruce, mountain alder, sedge
Twin Meadows	Lodgepole pine, Engleman spruce, mountain alder, sedge
Black Butte Swamp	Aspen, bog birch, willow, bigleaf sedge, bluegrass, Douglas spirea
Squaw Creek	Aspen, black cottonwood, willow, mountain alder, Engleman spruce
Indian Ford Creek	Aspen, snowberry, blue wildrye, small-fruit bulrush, bigleaf sedge, willow, sedge
Cold Springs	Aspen, snow berry, blue wildrye
Trout Creek	Mountain alder
Pole Creek	Mountain alder, Engleman spruce
Three Creek	Mountain alder, willow, high meadows vegetation
High meadows	Black alpine sedge, Holm's sedge, tufted hairgrass, red mountainheath

Historic Reference Conditions

Identify the expected character and distribution of the riparian network, that is, under natural disturbance regimes, what would be the types and relative magnitudes of disturbance in the watershed? What would be the expected composition, distribution, and character of riparian vegetation?

Historically, Squaw Creek had a broad floodplain near the town of Sisters, containing groves of ponderosa pine, aspen and cottonwood, riparian willow, sedges, grasses and forbs. This floodplain functioned to dissipate floods, while holding the streambanks together and resisting erosion. Side channels were used and abandoned as flows declined during the late summer, creating more complex habitats for young salmonids and a variety of other riparian associated species. Without dams or diversions, Squaw Creek was linked to the lower Deschutes River, Indian Ford Creek, Pole Creek, and Snow Creek. Resident and anadromous redband trout and chinook salmon used these habitats. Bull trout ranged throughout Squaw Creek and the Deschutes River to forage and perhaps, spawn in small areas with cold springs.

Indian Ford Creek had steady flows through the summer months as water was slowly released from willow and sedge wetlands. Shade was adequate to maintain water temperatures for rearing redband and steelhead juveniles. Peck's penstemon regenerated regularly from flooding of intermittent channels of Trout Creek and Glaze Meadow. Trout Creek swamp may have released more water later in the summer and maintained flow in Trout Creek lower in the system.

Pole Creek flowed directly into Squaw Creek. Water temperatures would have been very cold water entering Squaw Creek creating a thermal refuge for species like bull trout and tailed frogs. Forest canopy was more complete and maintained extremely cold temperatures in the summer months. Pole Creek Swamp may have been more open as the water regime would have maintained standing water for more of the swamp and later into the summer eliminating many plant species not associated with a wet growing environment.

Three Creek meadows may have provided more productive breeding habitats for amphibians due to more water being released from Little Three Creek Lake. Flows may have been less at the big lake outlet without the diversion of water from the little lake. The size of both lakes was nearly half the full pool of the present lakes. Shoreline vegetation was probably more extensive with a more stable lake level and would have provided more valuable amphibian habitat. Fish were not present in the system historically and would have allowed an abundant habitat for amphibians.

Intact forests adjacent to riparian areas provided shade, more humid microclimates, and large down wood to fall in streams and lay and rot on moist riparian forest floors.

Species Associated with Riparian Reserves

Aquatic Species **(Also see Aquatic Species Section)**

Extirpated Species Summer steelhead trout and chinook salmon have been lost from the watershed and bull trout have reduced distribution. Squaw Creek was a significant habitat for steelhead in the upper Deschutes Basin historically. Contributions to the chinook population may have been sizable as well. These populations of migratory fish may have contributed to the habitat quality of the system for bull trout.

Local Species of Concern Riparian reserves need to be designed to protect these aquatic species of concern that occur in area streams and lakes (**Table RR-7**). Amphibians listed may not be totally dependent on aquatic systems for their entire life cycle buy may require them for at least part of that cycle.

Table RR-7. *Aquatic species associated with riparian reserves.*

Local Aquatic Species Of Concern	Native Of Concern	Region 6 Threatened or Sensitive	Oregon State Sensitive
Redband Trout (known)		X	X
Brook and BrownTrout (known) (non-natives of interest)			
Bull trout(known)		X	X
Sculpin(known)	X		
Suckers(known)	X		
Long-nose dace(known)	X		
Tailed frogs			X
Cascades Frog			X
Long-toed salamanders	X		
Pacific tree frogs	X		
Western toads	X		
Rough-skinned newts	X		
Spotted Frog		X	
Northwestern salamander	X		
Indian Ford Pebblesnail		proposed	

General Habitat elements required by these species include:
Clean cold water, instream flows
Forest canopy to provide stream shade
Instream wood and rocks which create pools and hiding cover
Trees for wood recruitment to stream
Riparian vegetation for shade and invertebrate food
Natural flow and sediment regimes
Shallow water with emergent vegetation

Terrestrial Species Associated with Riparian Reserves

There are approximately 200 species found or suspected to occur on the Sisters Ranger District that utilize riparian reserves primarily for breeding, roosting and foraging. In addition, there are another 71 species that benefit from riparian reserve areas. Assessments of population viability for these species are outlined in **Appendix W-1.** It includes such factors as: dispersal capability, preference for habitat, homogeneity/heterogeneity (generalist or specialist), versatility rating (generalist vs. specialist), abundance, population trends, and status. **Table RR-8** outlines species that have been considered in this analysis for adjusting riparian reserve widths.

Table RR-8. *Wildlife Species of Concern. O= Uses riparian habitat, P= Uses riparian habitat for nesting, denning, or foraging, B= Benefits from riparian reserves by using them to forage, X= shows status.*

Wildlife Species	Habitat Designation (Primary, Benefitting, or Other	Threatened or Endangered	Oregon State Sensitive	Region 6 Sensitive	Management Indicator Species	Survey and Manage	Protection Buffer Species
Northern Spotted Owl	O	X		X			
Bald Eagle	P	X		X			
Black-backed Woodpecker	O		X	X	X		X
White-headed Woodpecker	O		X	X	X		X
Pileated Woodpecker	O		X	X	X		
Williamson's Sapsucker	O		X	X	X		
Flammulated Owl	O		X				X
Northern Pygmy Owl	B				X		
Pygmy Nuthatch	O				X		X
Northern Goshawk	P			X	X		
Great Gray Owl	O			X	X		X
Golden Eagle	O			X	X		
Osprey	P			X	X		
Red-tailed Hawk	P			X	X		
Sharp-shinned Hawk	P			X	X		
Coopers Hawk	P			X	X		
Great Blue Heron	P			X	X		
American Marten	B		X	X	X		
Fisher	P				X		
Wolverine	B			X			
Lynx	P						X
Townsend's Big-eared Bat	B			X	X		
Red Tree Vole	B					X	
Deer	P			X			
Elk	P			X	X		
Prebles Shrew	P			X			
Pgymy Rabbit	O						
Greater Sandhill Crane	P		X	X			
Ferruginous Hawk	P			X			
Blue-grey Tail Dropper	?					X	

Papillose Tail Dropper	?					X	
Crater Lake Tightcoil	?					X	
Oregon Shoulder Band	?					X	

<u>General Habitat Elements required by these species include</u>:
Large trees along streams for nesting, roosting, foraging and denning
Large snags and down woody material along streams for denning/nesting and foraging in an array of decay classes
Deciduous trees and shrubs
Wet, moist and dry meadows
Humid, wet (moist) duff layers
Fairly contiguous canopy cover for dispersal

Wildlife Survey and Manage and Protection buffer Species known or suspected to occur in the watershed.

Surveys for Survey and Manage species have not been completed. Their distribution and habitat use in the watershed is therefore unknown. Both survey and manage mollusk species thought to be in the watershed could be associated with riparian reserves especially on the east-side of the Cascades due to moisture regimes (T. Burke, pers. comm). Distribution and habitat use by species listed as Protection Buffer species have been described in the Wildlife Section except for the pygmy nuthatch and flammulated owl. Surveys have not been conducted for either of these species. However, the pygmy nuthatch is considered to be common and widely distributed and several sitings of flammulated owls have been noted, especially north of this watershed.

Special considerations for Terrestrial species

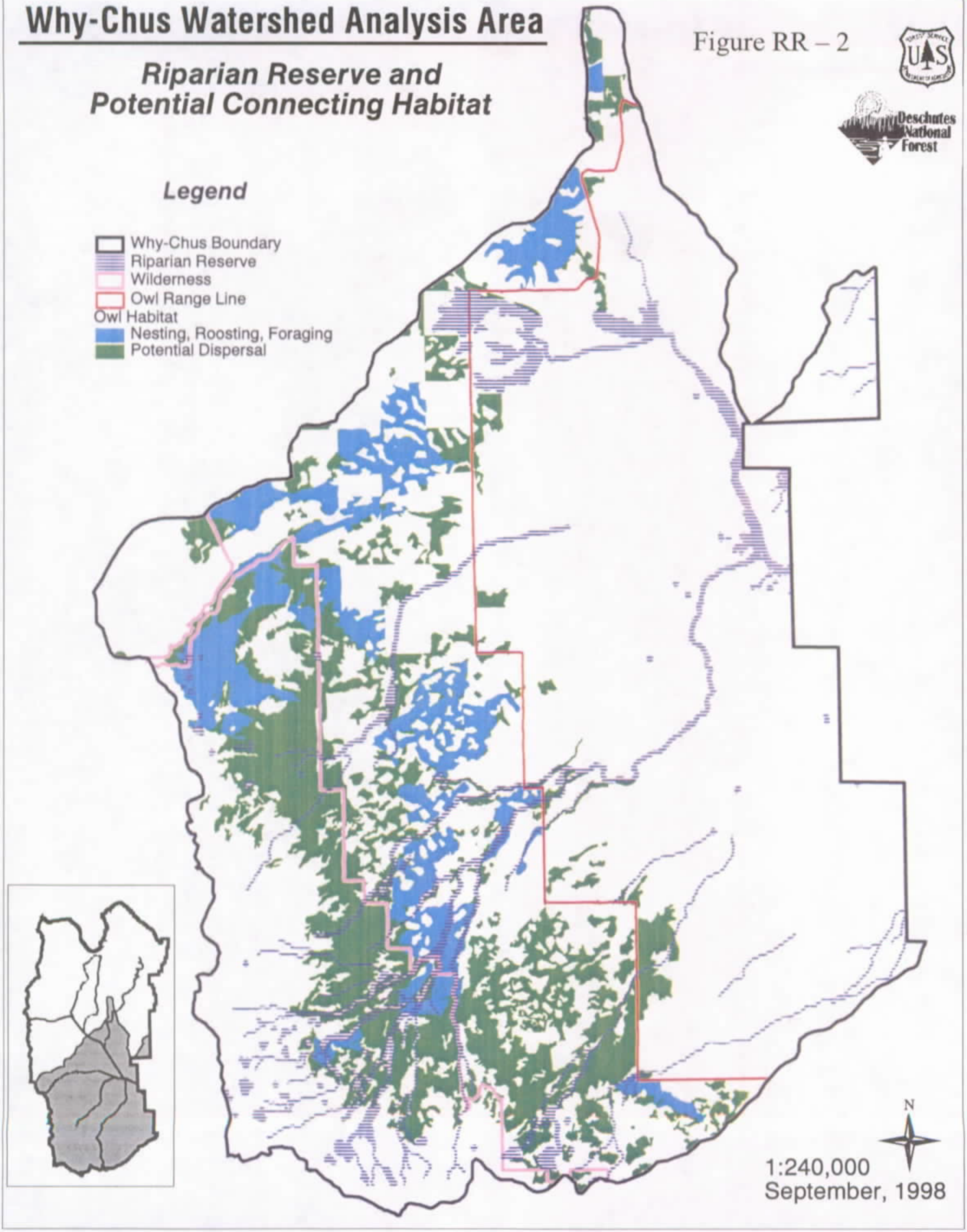
Historically, riparian areas provided greater quality and quantity of habitat for many species. This allowed species to occupy riparian reserves that may no longer be present. Large cottonwood galleries, healthy riparian areas and large trees provided more habitat for everything from nesting neotropical migratory birds to foraging bears to nitrogen fixing lichens. Connectivity of riparian habitats was greater. This allowed for species dispersal, even for those with low mobility or species with small home ranges. Large trees were more prevalent, as were large snags and down woody debris.

Stream temperatures would have been lower because streams had more shade. This provided more habitat for cold water obligates such as tailed frogs. Larger meadows kept open by fires and sustained by water were less likely to be over-utilized. Habitat features, such as emergent vegetation and high water tables, would have provided additional habitat for amphibians and species such as sandhill cranes. Today, these features are absent or reduced. This has led to reduced populations occurring on the landscape or overcrowding into areas that are suitable.

Riparian Reserves in the analysis area provide poor connectivity in a north/south direction because they run parallel to each other and generally in an east/west direction. Connectivity within riparian reserves

Why-Chus Watershed Analysis Area

Figure RR – 2



is limited and narrow. Habitat that could provide connectivity between these parallel riparian areas would be habitat that qualifies as nesting-roosting-foraging (NRF) habitat and possibly dispersal habitat for spotted owls. NRF habitat includes forested areas with >60% canopy closure and trees >21"dbh. Potential dispersal habitat is defined by two layers of vegetation: 1) all plant association groups with >40% canopy cover and trees > 8" dbh; and 2) only mixed conifer wet, mixed conifer dry, and high elevation plant association groups with >60% canopy cover and trees >8"dbh (B.Tandy, pers.comm) **(Figure RR-2)**.

Spotted owl habitat between riparian areas is very fragmented **(Figure RR-2)**. Connectivity between the Squaw and Pole subwatersheds consists of somewhat fragmented NRF habitat. This habitat provides the best connectivity between riparian reserves, compared to habitat between other riparian reserves. This area is classified as NRF habitat, it is the least fragmented, and has the shortest distance between riparian reserves. For these reasons, this area may have the best spotted owl habitat in the watershed.

Connectivity between Pole and Trout is very fragmented and is a mix of dispersal and NRF habitat. Connectivity between Trout and Indian Ford is essentially nonexistent because NRF and dispersal habitats are very fragmented. There are also several square miles of private land that does not provide connecting habitat for riparian reserve species.

Local Plant Species of Concern which benefit from Riparian Reserves

The following plant species of concern (identified as Sensitive by the Regional Forester, on State Watch lists, Survey and Manage, or Protection Buffer species) are (**Table RR-9**):

- known
- reported by a reliable source (but not yet described or mapped)
- or suspected to occur in riparian areas within the analysis.

Table RR-9*. Local Plant Species of Concern.* *No threatened or endangered plants are known to occur.

Local Plant Species Of Concern	Sensitive Region 6	Watch List OHDB	Survey and Manage Species	Protection Buffer Species
Penstemon peckii (known)	X-Endemic			
Gentiana newberryi (known)	X-Edge of range			
*Lobaria dortmanna (*suspect*)*	X			
Agoseris elata (suspect)	X			
Cypripedium montanum(suspect)			X	
Carex capitata (known)		X		
Carex hysterica (known)		X		
Calicium sp. (reported)			X	
Cladonia norvegica (reported)			X	
Lobaria pulmonaria (reported)			X	
Peltigera collina (reported)			X	
Pseudocyphellaria anomala (reported)o			X	
Elaphomyces anthracinus (suspect)			X	
Collema sp. (suspect)			X	
Hydrothyria venosa (suspect)			X	
Nephroma helveticum (suspect)			X	
Nephroma resupinatum (suspect)			X	
Pseudocyphellaria anthrapsis (suspect)			X	
Marsupella emarginata var. *aquatica* (suspect)			X	
Tritomaria exsectiformis (suspect)			X	
Buxbaumia viridis (suspect)				X
Tetraphis geniculata (suspect)				X
Ulota megalospora (suspect)				X

Key Habitat elements required by these species include:

Floodplains and channels with intermittant flooding
Wet and moist meadows, shallow clean water
Old growth trees, live and dead (large snags) near water
Rotten down logs in humid forests
Decidous trees and shrubs (cottonwoods, vine maple)
Rocks near and in water
Humid microclimates
Wood in water
Moist humic soil, moist forests
Clean cold water

Current Conditions and Trends

Identify prevalent conditions of riparian vegetation and the type, magnitude, and age of disturbances, such as floods, ice flows, fires, timber harvest, and road construction that are responsible for these conditions. ***(Also see sections on Hydrology, Stream Channel Habitats, and Erosion Processes)***

Riparian Disturbance Patterns

Floods shape stream channels by scouring pools, forming log jams, and scouring and depositing sediment. The frequency and magnitude of floods will determine the scale of influence on channel morphology. In the Sisters/Why-chus watershed, Squaw Creek is most affected by floods. The highest flow recorded on Squaw Creek was 2000 cfs in 1980. Flows of this magnitude have a large effect on bank erosion and riparian vegetation. The loss of riparian vegetation that helps stabilize Squaw Creek's streambanks may be lost during high flow events that may cause elevated rates of bank erosion. Trout Creek is another stream influenced by floods. Floods connect Trout Creek to Indian Ford Creek and may provide some connectivity for the redband trout populations. Floods in Trout Creek have caused recent problems with residential areas and roads now that development has encroached on the normally dry channel. Road crossings at culverts in the upper Trout Creek subwatershed had also eroded during the 1990 and 1996 floods. Indian Ford Creek increased flow in the late 1990s due to the recovery of the aquifer following the drought of the late 1980's and early 1990's. Wetlands, normally dry in spring, were flooded in 1997 and 1998. Low areas in the Black Butte Ranch have experienced flooding and some homes have been flooded by increased groundwater. Plans to ditch areas to drain problem laden residential areas were made. These projects may effect the hydrology of Indian Ford Creek during low flow periods.

Winter ice dams can cause channel changes. Ice dams can de-water parts of the channel and cause high flows when the dams break up. Pole Creek is particularly known for ice dams and the City of Sisters has removed instream wood from channels to reduce the effect of ice dams on flow. Riparian vegetation that can resist this damage is more successful along this stream. Squaw Creek is known for anchor ice in the upper reaches. Anchor ice can reduce the productivity of the stream for invertebrates and possibly young salmonids, which use the substrate as cover in the winter. Water temperatures have been recorded to be near zero for a significant portion of the winter months.

Wildfire can play a role in shaping the forest along streams and lakes. This landscape has a pattern of frequent wildfire, especially in the ponderosa pine type forests. Riparian vegetation no doubt burned more frequently in this forest type than others, but perhaps less intensely than the uplands. Aspen and willow stands have adapted well to frequent disturbances such as fire. Areas where this would play a role are Indian Ford Creek, Squaw Creek, Trout Creek, and Pole Creek. Mixed conifer areas burned less frequently but more intensely than ponderosa pine type forests. These areas are most at risk due to build up of fuels and the steepness of the canyon terrain mainly due to fire suppression and the reduced fire frequency. High elevation forest types had the lowest fire frequency and are the least out of the natural fire pattern resulting from suppression.

In general, wildfires tend to burn at lower intensities in riparian areas due to high moisture regimes. Some cases in Washington State have been shown as examples of headwater riparian areas that were burned at higher intensities due to the effect of steep canyons funneling winds and radiating heat (Agee, 1992). It is possible this affect would be greatest on streams which supported high densities of riparian vegetation but were dry during the wildfire season. Agee (1988) predicted different effects depending on stream width. Steep canyons do occur in this watershed and may be somewhat vulnerable to this risk. Generally, these canyons have sparse vegetation, due to the dry soils and talus slopes leading down to the stream.

Wind is more of an agent of disturbance in riparian zones in the hemlock and lodgepole pines forests and in areas where wet or loose soils are prevalent. Generally, wet soils will have shallow rooted trees and are often near meadow openings. Engelmann spruce is susceptible to this process in riparian areas. These sites will be more prone to blowdown and may be sources of instream wood. Valleys with narrow, steep slopes may be less susceptible to wind. Some blowdown has occurred in the ponderosa pine flats near Sisters, but these are usually associated with openings.

Tree insects and diseases can be disturbance agents in riparian reserves. Lodgepole stands have a cycle of stand replacement fires or beetle outbreaks on approximately 100-year intervals. Mixed conifer stands with white fir or grand fir are vulnerable to root rots, spruce bud worm, and bark beetles if they become dense and are stressed by drought. Dense stands can develop from the exclusion of wildfire at normal frequencies. This process has occurred in the Metolius River basin to the north of this analysis area and resulted in wide spread mortality in the riparian reserves in the mixed conifer zone. The Sisters/Why-chus watershed is not as advanced as the Metolius River Basin, but the risk still exists. Generally, riparian areas have higher moisture regimes that can support higher densities of trees under less stress and may reduce the risk to some extent.

Beaver probably played a major role in shaping habitat and riparian vegetation along Squaw Creek and Indian Ford Creek. Low gradient reaches with abundant willow and aspen stands were prime habitat for beaver. Many of the beavers were trapped out of Central Oregon and much of the Pacific Northwest by the 1830's and 1840's (from review by Lichatowich et al. 1998). Beaver dams formed pools and side channels and may have allowed retention of water into the late summer low flow periods.

Debris flows and moraine failures occur infrequently on unstable land in this watershed, generally located on the steep slopes of the alpine region of the Three Sisters and Broken Top. These events have long lasting consequences. These disturbances can leave a legacy of instability in the deposits left behind and in the sediment load of the streambed.

Human Disturbances to Riparian Areas

Timber harvest has caused major alterations to riparian zones, especially along Pole Creek and North Pole Creek. Nearly 17% of the riparian reserves have been clearcut or experienced other regeneration harvest. Most accessible areas have experienced removal of large trees through selective cutting. Pole and medium sized trees dominate most forest along the streams in this analysis area. Less than 9% of these subwatersheds have immediate riparian areas dominated by large trees **(Table RR-10)**.

Table RR-10. Riparian reserve acres, percent reforested, acres of riparian vegetation, and size classes within 100ft of streams, lakes, or wetlands. Size classes were summarized from PMR data on GIS.

Sub-watershed	Acres within Analysis Area				Size Classes within 100ft of Channel					
	Acres	Riparian Reserve acres	Percent of reserves clearcut, shelter-wood or wildfire	Riparian vegetation acres mapped	Large tree %	Med tree %	Pole tree %	Grass and Shrub %	Water or Rock %	Ag and developed %
Indian Ford	28250	2885	<1	491	1	23	23	35	1	18
Melvin	13132	508	9	0	1	58	28	9	0	5
Pole	10662	879	17	154	8	33	55	4	1	0
Squaw	40745	7236	2	1722	8	29	41	14	6	2
Three Cr Butte	25219	1475	<1	0	2	49	38	9	0	3
Three Cr. Lake	4465	800	1	90	4	15	41	17	23	0
Trout	55364	1838	2	135	6	28	36	24	3	2

Roads cause a major disturbance to streams at road cuts into steep slopes and at stream crossings. Most effects from roads are from run-off from riparian roads or inadequately sized culverts. These areas can be sources of fine sediment that raise the level of fine sediment above the natural background level. Stream crossings that become blocked or overflow during storm events can cause sudden peak flows that washout. Trout Creek has had culvert overflow problems in the past from debris jams. Snow Creek had overflow problems from an undersized culvert but has been repaired with a larger culvert and a hardened crossing.

Dams Three Creek Lake has been altered by the creation of a dam at the outlet to store water for irrigation. Little Three Creek Lake has had the same type of dam constructed but has since been abandoned. Big Three Creek dam has been judged unsafe for a 100-year flood event. Consequently, it has been restricted from storage until the dam spillway is improved. The lower water level has limited lake productivity for fish by reducing the shallow shoreline area that may have been important for food production. The volume and usable area of the lake may have declined by half. The irrigation ditch that feeds the big lake takes water from the outlet of the little lake. That diversion may reduce the long-term quality of wetland and stream habitat below the little lake downstream to Trapper Meadow.

Grazing and agriculture Indian Ford has a large portion of the immediate riparian zone in grass/shrub because of natural occurring meadows along the stream. A significant portion of the immediate riparian is in agriculture or associated with developments. Riparian vegetation has been grazed or removed on private lands reducing connectivity for riparian species. The USFS grazing allotment on Glaze Meadow has recently been closed but years of intensive grazing removed riparian shrubs and trees and will take years to recover.

One allotment on USFS land is currently active along Indian Ford Creek with approximately 69 AUMs. Private land grazing accounts for most of the grazing along Indian Ford Creek and all of the grazing along Squaw Creek in this analysis area. Grazing occurs on lower Squaw Creek on the Crooked River National Grasslands in the lower 5 miles. Some incidental grazing occurs in the Three Sisters Wilderness area from horse and llama use in Park Meadow and Red Meadow where camps are established. Intensive horse use occurs in the Trapper Meadow Horse Camp along the streams, which flow out of Three Creek Lakes. Streambanks have been trampled and riparian vegetation over grazed in this area around the camp. Grazing was a more significant disturbance agent in the past. Intensive grazing was practiced with sheep and cattle from Sisters and into the high meadows of the Three Sisters Wilderness.

Ditching affects wetland habitats including Pole Creek Swamp, Trout Creek Swamp, Glaze Meadow, and along private lands on Indian Ford Creek including Big Meadow. These wetlands have been ditched in the past and may have a lowered water table and flood regime. Consequently, open meadows are being encroached by lodgepole pine and Engelmann spruce forest. This is obvious at Trout Creek Swamp where a central drainage ditch was dug to drain the meadow.

Flood control measures have altered the Squaw Creek floodplain by channelization after the 1964 flood (see Physical Stream Habitat section). Loss of floodplain function has resulted from dewatering, trenching the channel, loss of riparian vegetation, and the subsequent increase of streambank erosion. This process has taken nearly 100 years to develop and will take many years to reverse. Streambank instability has resulted in bank erosion that may make the restoration of riparian vegetation difficult.

Development in floodplain areas has altered present and future riparian zone function. *See Social Report.*

Recreation effects on riparian reserves are largely concentrated at Three Creek Lakes, lower Squaw Creek, and Indian Ford Creek. Three Creek Lake impacts include trails and developed camping at Driftwood, Three Creek Lake, and Trapper Meadow Campground. Dispersed camping and horse use at one critical amphibian-breeding pond also occurs. Dispersed camping along lower Squaw Creek and Indian Ford Creek may reduce some of the streamside vegetation and may reduce water quality from waste. Wilderness recreation use of Park Meadow and Red Meadow has caused some streambank trampling and some localized vegetation changes.

Riparian Reserve Condition Summary

The habitat was quite different in Squaw Creek historically. Significant reductions in summer flow are a leading cause of these changes, but there have been significant changes to the physical habitat as well. Low summer flow has reduced connectivity, as well as, irrigation dams and hydropower dams. Diversions also reduced connectivity historically in Snow Creek and Pole Creek.

Meadow habitat of Pole Creek, Trout Creek, and Indian Ford Creek has been altered significantly from historic conditions. The quantity of habitat has not been changed as much as the quality of flooded wetland habitats and diversity of the vegetative composition and structure.

Riparian reserves throughout the accessible portions of the analysis area have been significantly affected by timber harvest. Loss of large trees and shade are the most critical changes.

Localized impacts of development affect Federal Lands because of effects to reserve function and connectivity.

Key changes to these Riparian Reserves affect species of concern

Squaw Creek, Pole Creek, Indian Ford Creek , Melvin, and Trout Creek
Reduced connectivity of streams because of ditching, dewatering, and channelization
Removal of large trees and forest canopy, loss of connectivity to adjacent forest

Squaw Creek, Indian Ford Creek, and Trout Creek
Loss of connection to downstream areas because of dams on the Deschutes River

Squaw Creek
Loss of functioning riparian floodplains

Three Creek area, Trout Creek Swamp, Pole Creek Swamp, Cold springs, and Indian Ford Creek area
Wetland alterations including ditching and water diversion

Three Creek area, Indian Ford, Squaw Creek
Localized impacts from recreation, roads, and trails

Risk Assessment

Riparian habitats are considered to be very valuable resources because they are limited in this watershed. Most all species utilize riparian habitat is some way. Potential for loss of riparian habitat is relatively high because natural disturbances such as fire, floods, wind, and erosion are somewhat common. To a lesser extent, landslides, insects, and disease may diminish riparian reserve conditions for dependent species. Fire probably has the most significant impact on vegetation of all risk factors. However, fire is a natural occurrence in this watershed and most species are adapted to it. Unfortunately, fires are more intense than historically due to higher fuel loadings. This situation increases the risk for loss of habitats and reduces the ability of some habitats to recover from these intense fires.

Susceptibility of Squaw Creek to floods has been increased by the loss of floodplain function. Bank erosion has greatly increased from the loss of riparian vegetation and trenching of the channel. Encroachment on the floodplain by development and engineered berms has confined floods and increased the risk of erosion.

Meeting Aquatic Conservation Strategy Objectives

Describe the degree to which the riparian network in the watershed meets ACS objectives. Document the criteria used to determine how the riparian features and conditions address each ACS objective.

Riparian reserves on USFS land generally meet the ACS objectives in the NFP except along the lower reaches of Squaw Creek, Pole Creek, Three Creek, Trout Creek Swamp, and Indian Ford Creek (**Table RR-11**).

Squaw Creek does not meet the ACS objectives because of lack of summer flow, loss of connectivity, loss of riparian vegetation, loss of water quality, and loss of a full complement of native species. Pole Creek has lost its natural connection to Squaw Creek and has a lowered water table in Pole Creek Swamp. Pole Creek does not meet the objective of forest canopy. Trout Creek Swamp also has a lowered water table and altered native species composition. Indian Ford Creek does not meet the objectives based on water temperature, altered summer flow regime, and loss of riparian vegetation from grazing management.

Hydrological alterations and recreational impacts are affecting Three Creek area riparian reserves. Recreational programs and facilities are having localized impacts on ACS objectives and are of concern because of unique amphibian populations and a trend for increasing use. At this time, these impacts are not significant enough to say they are preventing attainment of the ACS objectives, but management is needed.

Table RR-11. *XXX= severe XX= moderate X= low (relative rating)*

Riparian Reserve	Reason for not Meeting the ACS Objectives							
	Lack of Summer Flow	Loss of Connec-tivity	Water Temps	Loss of Riparian Veg	Reduced Water Quality	Altered Native Species Comp.	Forest Canopy	Lowered Water Table
Squaw Creek	XXX	XXX	XXX	XXX	XXX	XX	X	X
Pole Creek		XXX					XXX	X
Three Creek		X		XX		X		XX
Trout Cr Swamp						X		XXX
Indian Ford Cr	XXX	XX	XXX	XX	XX	X		X

Adjusted Riparian Reserve Boundaries and Considerations for Site Specific Project Planning

Adjustment of riparian reserve interim boundaries has been considered for the various species and landforms within this analysis. Site potentials were assessed for the various plant associations along streams and wetlands. Average potential tree heights were used and 140 ft was the average maximum tree height for ponderosa pine in this watershed assessment. Even mixed conifer stands were dominated by ponderosa pine.

****Therefore, this analysis concludes that the standard interim riparian reserve widths as shown below are adequate as adjusted riparian reserves if certain considerations are applied to site-specific situations discovered during project planning.**

Riparian Reserve Widths from the NW Forest Plan ROD C-30	
Categories of waterbodies	Riparian Reserve Widths
Fish bearing streams perennial or intermittent	300 feet on either side (600 feet total) or top of inner gorge or outer edge of riparian vegetation or outer edge of 100 year floodplain *whichever is greatest*
Perennial streams without fish	150 ft on either side (300 feet total) or top of inner gorge or outer edge of riparian vegetation or outer edge of 100 year floodplain *whichever is greatest*
Constructed ponds, reservoirs and wetlands greater than 1 acre	150 ft from the edge of the water or wetland or to the extent of seasonally saturated soil or outer edge of riparian vegetation or extent of unstable areas *whichever is greatest*
Lakes and natural ponds	300 ft from the edge of the water or to the extent of seasonally saturated soil or outer edge of riparian vegetation or extent of unstable areas *whichever is greatest*
Seasonal or intermittant streams without fish	150 feet on either side (300 feet total) include unstable areas channel to the top of inner gorge outer edge of riparian vegetation

Recommendations for Site Specific Project Planning in the Why-chus Watershed Area

This watershed analysis has considered local conditions and species of concerns and recommends the following guidelines for site specific project planning:

1) Delineating reserves:

Site specific assessments should be applied by qualified personnel when delineating riparian reserves on the ground. As a minimum include these factors:

- **Floodplains**- In most cases narrow areas along stream margins and wetlands. However several locations within the watershed have broad floodplains and an intricate network of floodprone channels. Examples include: Low gradient portions of Squaw Creek, Trout Creek, and Indian Ford Creek.
- **Riparian vegetation**- Connect wet meadows to nearby streams where not directly connected. Examples include Three Creek area and Indian Ford meadow. Trout Creek may also have broader extents of riparian vegetation.
- **Stream terraces, benches, and the inner gorge**- Should be included to the outer edge with adequate protection for the slopes leading to the waterbody.
- **Unstable land**- The majority of the area is not prone to slope failures. Highly or moderately erodible soils are present-see Bank Erosion table. Also areas over 30% slope with seeps, example: near Rd 1514 on Squaw Creek, cinder slopes near Snow Creek, Three Creek, and debris flow/moraine areas near Park Creek, Upper Squaw Creek tributaries, Pole Creek and North Pole Creek.
- **Saturated soil and seeps**-
- **Rock outcrops**- included because of their importance for amphibians and other species.
- **Create riparian reserve complexes**- Where riparian reserve boundaries are very close or overlapping consolidate into one large reserve. Consolidate complexes of meadows, intermittent streams, seeps, wetlands, ponds, rock outcrops, and other unique or special habitats.

2) Maintaining Connectivity on the East-side, especially in Matrix Allocations

Riparian reserves are needed to provide connectivity. A combination of 15% reserve areas and riparian reserves were provided in the Northwest Forest Plan matrix allocation to maintain habitat connectivity. This strategy is probably most effective on west-side Cascade systems where stream densities and associated riparian reserves are relatively dense. However, on east-side Cascade systems, stream and riparian reserves may occur in lower densities resulting in poor connectivity if standard riparian reserve widths are implemented. Consider the following:

- To provide for connectivity and interior habitat – *Edge effect has been noted to affect forests up to 800' from edges, rendering that portion unsuitable or degraded for interior species (Noss and Cooperrider 1992).* Where there are openings or plantations directly adjacent to riparian reserves, additional area may be necessary to provide interior habitat. Consider that expanded areas may need be managed under a different scenario than the surrounding matrix stands and may need longer rotations until forest canopy recovers within the riparian reserve. These should be determined on a site-specific basis in the field. Riparian reserve logging restrictions (such as no ground based equipment) do not need to be applied to this expanded area unless other resource concerns exist, i.e., wet soils, soil lichens, etc.

- Plantations or openings on the sides of reserves should be treated by tree culturing, understory thinning, brush removal, etc. to speed the attainment of large tree structure.

3) Enhance Late-Successional Habitat Recovery/Connectivity

- Consider connecting riparian reserves with adjacent north facing slopes to protect the integrity of mesic habitat conditions commonly used by the northern goshawk, marten, and other late-successional species. The reserves and north facing slopes combined can also provide interior habitat suitable for spotted owls.

- Consider connecting riparian reserves to reproductive core areas or activity centers for the northern spotted owl, northern goshawk, or other late-successional species.

4) Big Game Reproduction

- When riparian areas are determined to be important big game calving or fawning areas, consider managing a wider area to provide adequate cover and maintain the integrity of the area. Portions of the corridor may be treated to maintain or develop big game cover conditions.

5) Protecting little known survey and manage species and Scenario 1& 2 species
Species cited in Tables B1 and B2 of the Riparian Reserve Evaluation Techniques and Synthesis manual (1997) will be protected if riparian reserve widths proposed in this watershed analysis are adopted. However, several mitigation measures were listed for each species in Appendix J2 of the ROD. The following should be considered where applicable:

- Protect riparian reserves from grazing for mollusks. Survey Indian Ford Allotment ASAP.
- No new roads should be built in Tier 1 Key Watersheds to protect tailed frogs.
- Apply riparian reserve boundaries around ponds and wetlands less than 1 acre in size for bats. These should be at least 140 feet.
- Clump green tree and snag retention areas in the matrix for bats, fisher, and American marten.
- Place no harvest buffers around cave entrances for bats, fisher, and American marten.
- Provide residual habitat areas around spotted owl activity centers for bats, fisher, American marten, and red tree voles.
- Retain old growth fragments as refugia for lichens and other low mobility species.
- Retain large old trees with large lateral branches and emergent crowns in clumps as habitat for lichens; select the oldest, the largest, along with some asymmetrical trees, and leaning live and dead trees.
- Encourage growth and reproduction of cottonwoods and other deciduous species as well as Pacific yew for lichens.

Riparian Restoration Projects

1) Riparian Reserve Treatments
Vegetation manipulation within the reserves may be necessary to sustain and recover late-successional habitat conditions. The primary objective of treating riparian reserves is to establish large tree structure and improve rapid recruitment of large wood to streams at a faster rate than would occur naturally. The effects of the treatment need to be off set by the benefit to the function of the riparian reserve. Treatments in the uplands beyond the inner gorge may be most effective at reducing the risk of wildfire and loss of large wood over time.

- If vegetation manipulation is needed, only treat a portion of the reserve in each entry so that untreated refugia is maintained.
- Large tree stands are rare in local riparian reserves and those remaining need to be protected. Timber harvest within riparian reserves should not remove any live trees or snags larger than 21" dbh or down logs with an average diameter of 16" dbh or greater. Some exceptions may exist.
- Emphasis should be small tree understory thinning by hand or full suspension logging.
- Do not drive equipment in reserves during harvest or post harvest to protect soils, survey and manage soil lichens, and mollusks.
- Fuel treatments of riparian reserves need to be limited to light intensity underburns (primarily in mixed conifer dry and ponderosa pine types).

2) Flow acquistion. The potential for restoration of flow of Squaw Creek is good because community interest and trends of many agricultural lands being sold for residential uses. This change in use may make surface water rights available for trade for groundwater rights. Pole Creek may be important for flow acquisition because of the high water quality.

3) Squaw Creek Floodplain Restoration is possible but needs to be approached with caution. Squaw Creek has high flow potential and has highly erodible bank material. Poorly designed instream restoration work may reduce the stability of the streambanks. The elevation difference resulting from the trenching needs to be addressed to restore floodplain function. Riparian protection should be done for dispersed camping areas also.

4) The Three Creek Area needs restoration because of high recreational use and the potential for loss of amphibian habitat. The risk of no management is high due to the slow recovery periods at high elevations and the value of the area to unique amphibian populations. Risk of management may be to simply displace the uses rather than eliminate the riparian trampling. Any restoration of the riparian corridor needs to provide for use, but manage for protection at the same time. The dam restoration has been stalled due to a dispute with an irrigator over the right to manage the dam. Water storage is not allowed until the dam is improved. Further work is needed to negotiate a solution. The dam should be removed or restored but the interim is not preferred for fish, recreation, irrigation, or amphibians.

5) Trout Creek Swamp has potential for restoration by blocking the central ditch and allowing for a higher water table. The result would reduce the encroachment of lodgepole pine into the meadow. This will change the vegetative community back to a more flooded wetland and help restore habitat suitability for many species.

6) Indian Ford Creek needs riparian protection from dispersed camping. The risk is to displace campers to new locations rather than reduce the impacts. Indian Ford flows and water quality are threatened. Restoration of willow as shade is needed in the private land where clearing has been done for grazing. A narrow band of willow would increase shade greatly for the low flow sections of the stream. Alternatives to the wastewater releases by Black Butte Ranch need to be explored.

Social Domain

"We have to remember we're not pioneers anymore"

Bill Edwards

"We need to just try to keep the community together. Grange halls and other organizations did it in the past. We need to keep communication open between people, so we can understand each other."

Larry Huettl

"How are we going to be able to regulate the number of people that are there at any given time? That's so far removed from peoples thinking about 'This land is your land , this land is my land and by George I can use it any way I want to'".

"Sam saw the big picture. He kept saying to me "We've got to stop just cutting trees, and just cutting these beautiful boards out of these beautiful trees. We got to, just like a wooden pig, use everything but the squeal and have better use for every bit of it. And keep planting and planting and doing- so that there are going to be big forests. Because if Oregon loses its forests and its streams, then what have you got. You've got another Los Angeles."

Becky Johnson (Mrs. Sam)

Social Domain
Human Uses/Characterization

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

The Why-chus watershed extends from the glaciated peaks of the Three Sisters Wilderness through the town of Sisters and beyond into rangelands and irrigated fields. Human uses are varied and reflect the diversity of the area. The area has a long history of use by Native Americans and is within the ceded lands of the Confederated Tribes of Warm Springs Reservation of Oregon. The Confederated Tribes include Wasco, Warm Springs (Tenino), and Northern Paiute. These tribes comprise 3 linguistically distinct peoples: the Wascos, speaking Kiksht, a dialect group within Upper Chinook; the Warm Springs or Tenino, speaking Sahaptin; and the Paiutes of the Hunipuitoka subgroup, speaking Northern Paiute. Treaty rights reserved by the Tribes include the right to graze, fish, gather, and hunt.

The initial European settlement and development of this area was closely tied to commerce at the crossroads of transportation routes from the Willamette Valley to the grasslands of Central Oregon. Natural resources drew early settlers to the area. Vast forests of old growth pine provided building materials for homesteads and towns. Timber harvest and sawmills were a major part of the early economy of Sisters. Timber harvest still occurs in the watershed on both public and private land. Miscellaneous forest products such as mushrooms, Christmas trees, and firewood are gathered and sought after within the watershed.

Water is a significant resource for people in the watershed. In an arid landscape with limited surface water streams, such as Squaw Creek, made settlement, ranching, and farming possible. Diversion of water to support agriculture began in the late 1800's. This resulted in total diversion of some stream flows for human use. Natural conditions along these streams have been altered over time as the streams were ditched to aid in irrigation efforts, or channeled to prevent flooding.

Besides their importance to agriculture, ranching, and municipal water supplies, streams in the area are also appreciated for their beauty and recreational opportunities. The upper portions of Squaw Creek are designated by the Wild and Scenic Rivers Act to be protected because of outstanding remarkable natural and scenic value for the benefit of present and future generations. The Wild and Scenic River designation applies to the 15.4 mile segment of Squaw Creek, from its source to the hydrologic gaging station 800 feet upstream from the intake of McAllister Ditch. The upper portion of the river, including the 6.6 mile segment and its tributaries from the source to the Three Sisters Wilderness boundary, are classified as a "Wild River". The 8.8 mile segment from the wilderness boundary to the gaging station are classified as a "Scenic River".

The city of Sisters is the economic hub of the area. Today the general character of the economy in this area is commercial, light industrial, recreational, and agricultural. Commercial and retail services are concentrated primarily within the Sisters city limits and along Highway 20. Sisters has a growing residential population and lies within a county that has Oregon's fastest growth rate. The population of the city is only about 800, however between 6,000-10,000 people live in associated subdivisions. Local and tourism–related demands for recreation, housing, and consumer goods continue to rise. As part of the Deschutes National Forest, the Sisters area is a popular recreational destination for people throughout the Northwest and beyond. Recreational activities occur throughout the year. Camping, hiking, horseback riding, mountain biking, riding off road vehicles, hunting, fishing, driving for pleasure, nature study, and winter sports (snowmobiling, nordic skiing, and snow play) are among the more popular activities. The analysis area receives less recreational use than other parts of the Sisters Ranger District such as the Suttle Lake area or Metolius Basin. However, because of its proximity to the growing Sisters area, day use is rapidly increasing. The most heavily used area is Three Creek Lake.

Highway 20 is Oregon's busiest route over the Cascade Mountains. There are over 815 miles of other roads providing easy access, even to higher elevations. Many of the roads are located in areas that have been logged over the past century. A paved road provides access to the 6400 foot level of the Three Creek drainage, and other gravel roads provide access to the Three Sisters Wilderness boundary. Roads within the watershed range from two-lane State highways with wide, paved shoulders and passing lanes to simple wheel tracks. The typical road is a native surfaced, single lane road in a 14 foot-wide clearing.

Human Uses /Changes and Trends

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

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

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

Tribal Cultural Resources

Early Use Native Americans lived and traveled through the watershed for thousands of years before the arrival of the first Europeans. Little is known about this early occupation or when it began but people were using similar environments as early as 12,000 years ago. Travel routes often followed waterways. Several rock sources in the upper Squaw Creek watershed were utilized for making stone tools. Other cultural materials were probably used in the upper watershed in the summer and in the lower watershed during winter months. The use of fire by Native Americans to manage important gathering or hunting areas has been documented in other areas and may have occurred in this area as well.

Treaty Rights and Ceded Lands On June 25, 1855, the Tribes of Middle Oregon signed a Treaty with the United States that established the Warm Springs Reservation and reserved rights for fishing, hunting, gathering, and grazing on lands ceded by the Tribes to the United States. These ceded lands cover 1/6th of the State of Oregon with boundaries at the middle of the Columbia River, the summit of the Cascade Mountains, the 44th parallel, the summit of the Blue Mountains, and the headwaters of Willow Creek. The entire Sisters Ranger District and the watershed analysis area are ceded lands with protected treaty rights, managed in trust for the Tribes.

Current Tribal Uses and Cultural Resources Trust responsibilities for tribal interests on ceded lands include protection of archeological materials and sites and the protection of cultural materials and sites for present and future generations. The Tribes have provided us the following definitions regarding cultural resources:

- *"Cultural Materials" means materials or objects designated by the Tribal Council as having cultural significance that are obtained from (a) protected lands or (b) outside the Reservation if associated with treaty rights or other tribal rights. Cultural materials may included such things as eagle feathers, fish, game, roots, berries, cedar bark, Indian medicines, and water having special significance." (Tribal Ordinance 490.010- 1)*

A partial list of tribal cultural materials is included in the Tribal Ordinance 490.510. The Tribes may expand this list by amendment. They have also provided us with confidential lists of cultural plant materials to be used in project planning and analysis.

- *"Cultural site" means an area designated as such by the Tribal Council which has particular cultural, religious, or traditional value to the Confederated Tribes and which requires the protection of this chapter to prevent damage, abuse, or deterioration." (Tribal Ordinance 490.010-5)*

Information regarding cultural sites is sensitive and is shared with the Forest Service and others as needed.

Cultural Resource Issues

The following issues have emerged from Tribal input to project level analysis, cooperative planning efforts between the Forest Service and the Tribes, and discussions with the Culture and Heritage Committee and other tribal members during this analysis.

The name "Squaw Creek" The origins of the name "Squaw Creek" are unknown. Native Americans across the country, including members of the Confederated Tribes of Warm Springs, consider the term "Squaw" offensive and have shared with us that it is a derogatory reference to a female body part.

The Forest Service has discussed this issue with the Culture and Heritage Committee and Cultural Resource Department of the Confederated Tribes to determine their preferred name for Squaw Creek. These discussions have clarified that early explorers encountered Native Americans from different tribes and recorded several names for the creek. In 1855, railroad surveyors Abbott and Williamson recorded the name "Why-chus", from the Sahaptin language meaning "a place to wade across water". Soldiers at Camp Polk in 1865, recorded the name "Sesequa" which may be a Paiute term for "tall rye grass".

During preliminary discussions with the Culture and Heritage Committee they recommended "Why-chus" as a good name because it was the most prominent name in oral and written history. Tribal Council has not formally ruled on the matter. Further discussions are needed before the process for a name change is initiated. Out of respect for the Tribe's concerns and as a way to start building public understanding of the issue, the Forest Service Analysis Team chose to use the word "Why-chus" rather than "Squaw" for the title of this analysis.

Restoration of Anadromous Fish to the Deschutes River Basin The Tribes are interested in restoring steelhead and salmon runs and recognize Squaw Creek as critical to that objective because it historically provided over ½ of the available spawning habitat in the middle Deschutes system.

This issue is being addressed as part of the Pelton/Round Butte Hydro Relicencing process. Restoration of flows and water quality on Squaw Creek will be critical.

Forest Service Management of Ceded Lands The Forest Service has a trust responsibility in managing ceded lands. This means that resources valued by the tribes need to be protected and enhanced, especially during management activities. The Tribes closely monitor and comment on Forest Service management.

Sharing information about Cultural Plants The Tribes rely on the Forest Service to survey, inventory and protect desirable cultural plants. They have asked to be notified when we find potential gathering areas for certain plants. The Forest Service provides courtesy permits to Tribal Members to help us monitor use and protect the gathering rights of enrolled Tribal members.

Project-level plant surveys have identified many species of plants that have cultural significance. Most of these are common species of shrubs, trees, lichens, and forbs that can be found in many places on the Sisters Ranger District. Good stewardship of the forest will enhance these plants. One of the most important cultural food plants found within the watershed is huckleberries. The exclusion of fire and closing of forest canopies has reduced huckleberry habitat. Potential habitat for another important plant, Blue Camas, may have existed in seasonally wet meadows in the Indian Ford/Glaze Meadow/Black Butte swamp area. Camas may have been extirpated through long and intensive grazing. If oral histories reveal it was once present there may be an opportunity to work with the Tribes to reintroduce this important cultural plant.

Protection of Known and Undiscovered Archeological and Cultural Sites
The Tribes rely on the Forest Service to survey, inventory and protect prehistoric and cultural materials and sites. This is further discussed under Heritage Resources.

TRENDS relevant to Tribal Cultural Resource Issues:

- **Communication and information sharing between the Forest Service and the Tribes has improved in the last decade. Continuing efforts to understand and address Tribal concerns is needed.** Several projects have brought Tribal elders and resource specialists together with Forest Service specialists. Information sharing and cooperation is at unprecedented levels, but still needs improvement. Frank discussions are occurring regarding the offensive nature of "Squaw" place names. Confidential lists of important cultural plants are helping us understand which plants are most important to protect and enhance. The Culture and Heritage Committee has toured the District twice this year to discuss cultural plants and assess opportunities for gathering. The common goal of restoration of anadromous fish is bringing agencies and the Tribes together. Much more needs to be done to address the issues discussed above.
- **Increased human use and disturbance have increased the probability that undiscovered and known sites of cultural importance are being impacted.** Inventory and protection of culturally significant sites needs to continue at a more rapid pace to match growth pressures.

Heritage Resources

Prehistoric Resources Most known resources are on public lands with little information from private lands. Known prehistoric resources are of moderate density consisting mostly of areas where tools were made from obsidian (lithic scatters or lithic reduction sites). Some rock shelters show signs of prehistoric use. One shelter is reported to contain human remains and needs further study and coordination with the Confederated Tribes of Warm Springs.

Management emphasis is on the identification and evaluation of prehistoric resources during the planning stage of upcoming projects. Projects can usually be modified to avoid impacts. Impacts to resources occur through uncontrolled activities and dispersed use. People remove flakes and arrowheads. Many existing campgrounds and roads impact known and unrecorded sites in their operations and maintenance.

Historic Sites Historic sites on public lands may include remnants of early transportation routes such as historic wagon roads, portable sawmills, early irrigation structures, remains of homesteads, trapper cabins, fire lookouts, guard stations and historic trash dumps. Significant historic sites on private lands include the site of Camp Polk, the Camp Polk Cemetery, and registered historic buildings in the city of Sisters such as the Sisters Hotel, the Hardy Allen House, and the Sisters Bakery.

TREND: Important information from Heritage Resources is being lost through removal of artifacts, development on private lands, and decomposition of wood and metal.

European Settlement and Uses

An abbreviated history of Sisters is displayed in the "Sisters History in a Nutshell". A more complete timeline can be viewed in **Appendix S-1**. Early European explorers traveled through the area beginning in the 1820's. The Sisters area is the site of the earliest European settlement in Central Oregon. The town of Sisters was started from soldiers building nearby Camp Polk in 1865. By the 1870's, the area was more settled and the first water diversions were being built for irrigation. In the early 20th century, the town of Sisters grew and the nearby area saw an increase in farming, timber cutting, grazing of sheep and cattle, and water diversion for irrigation. By the 1920's, roads, trails, and irrigation ditches crossed most of the watershed and both communities and scattered houses dotted the landscape. More people came into the area with the completion of Santiam Pass in 1938. By the 1940's, railroad logging had pushed north from Bend into this area and beyond.

Sisters History in a Nutshell

*Sheep*Cattle*Logging*Sawmills*Tourists*

- 1825 Early trappers and US Army representatives begin exploring east side of the Cascade Mountains
- 1843 John Fremont with Kit Carson and Billy Chinook pass through present town site of Sisters while developing map of Oregon
- 1855 Williamson and Abbot survey the area for a railroad route and record early descriptions of Squaw Creek and Indian Ford Creek
- 1865 Camp Polk briefly established
- 1870 Samuel Hindman establishes first homestead near site of Camp Polk
- 1871 First water rights filed
- 1880 Tourist economy gets its start as merchants supply sheepmen passing through each summer on their way to pastures in the high Cascades
- 1890 First sawmill is built on Squaw Creek, it is water powered
- 1895 Squaw Creek Irrigation Company formed with 1892 water rights
- 1900 Cattle become important part of economy centering on the vast holdings of the Black Butte Land and Livestock Company
- 1901 Brothers Alex and Robert Smith plat the town of Sisters
- 1923 Fire destroys town buildings between Elm & Fir, south of Cascade, Hotel Sisters is scorched but saved
- 1924 Fire destroys town buildings on both sides of Cascade from Fir to Spruce Hotel Sisters is scorched but saved again
- 1930's First electricity available
- 1937 Timber economy booms, census shows town triples in size from 1935 (to 441)
- 1946 Town is incorporated (Vote 115 for, 61 against)
- 1953 Timber economy busts, Dant and Russell sawmill closes, $300,000 in payroll lost
- 1963 Round Butte Dam completed on Deschutes, steelhead can't return to the sea
- 1965 Last sawmill closes
- 1967 Last steelhead in seen in Squaw Creek
- 1970 Black Butte Ranch home sites go on the market
- 1975 First Sisters Quilt Show
- 1983 Village Green City Park is constructed
- 1998 Pine Meadow Ranch development starts construction
  Vote for a sewer for Sisters passes

A few human uses have decreased over time. Grazing was much more common in this watershed in the 1920's and 30's. Now it occurs in small amounts on private lands. Logging was once a major part of the Sisters economy supporting many small portable mills scattered throughout the forests and larger mills near town. Old growth pine became scarce and most small mills closed after private timber lands were logged off. Public timber became harder and more expensive to access and the last sawmill in Sisters closed in 1965. In the 1920's and 30's Forest Service administrative sites were located along Trout Creek, Cold Springs and other remote areas and have since been abandoned. This includes at least three ranger stations and three fire lookouts.

Irrigation and Agriculture

"Irrigation is the golden key which may unlock the doors of civilization to wide districts in Oregon, particularly east of the Cascade Mountains..." W.E. Smythe 1902.

Historic use The presence of streams such as Squaw Creek and Indian Ford Creek drew early settlers to the Sisters area and made ranching and farming possible. Early settlers struggled with short growing seasons and poor soils but in good years raised a variety of crops and vegetables. Federal policies such as the 1877 Desert Land Act and the 1894 Carey Desert Land Act encouraged settlement by providing free land to settlers if they could irrigate, settle and cultivate the land. The 1902 Reclamation Act began a progressive program emphasizing engineering and technology to transform arid lands into productive farmlands by helping finance dams and water diversion structures. It was only two decades between the first diversions of Squaw Creek water by individual farmers in the 1870's to a cooperative venture to form the Squaw Creek Irrigation Company in 1895. By 1917 this became the Squaw Creek Irrigation District, the second district to file and be recognized by the State of Oregon. For more on irrigation history in the area see the Sisters History Fest Timeline, **Appendix S-1** or Irrigation Development in Oregon's Upper Deschutes River Basin 1871-1957, M.H. Hall 1994.

Current Irrigation and Agriculture, Changes, and Trends

"1912 water rights were not worth a hoot. 1902's no good. We used to run 1902, and 1903 and 1904 out to Plainview when the creek was high, you could run some then, but after July you don't get that, its not there anymore. So the only people getting their water were from the 1880-1900 dates. (And people with rights after 1900 often didn't get their water rights) *That's why you saw those were vacant spots all out through Plainview and anyplace you want to look around the country here where people tried to make a living and couldn't and had to give it up." Jess Edgington 1998*

Squaw Creek Irrigation District still holds the primary water rights in the analysis area and draws approximately 140 cfs to irrigate croplands in the Cloverdale and Lower Bridge area. The water diversion is located near the gaging station at river mile 26.8. Before 1965 the District was able to divert approximately 200-235 cfs because of higher stream flows. As stream flow drops in the summer months the resulting flow does not support 100% of the agricultural need, water is rationed and the stream is often dewatered. The severity of irrigation water shortage and stream dewatering varies by year with available snowpack and weather. Crop needs are supplemented by private wells where possible.

According to the 1994 Squaw Creek Watershed Assessment (Deschutes Soil and Water Conservation District), approximately 8000 acres are irrigated by Squaw Creek in Townships 13-15 South and Range 10-12 East. Major crops include pasture, hay/alfalfa, potatoes, grains, and mint. Sprinkler irrigation occurs on 90% of the area and 10% utilizes the gravity surface irrigation method. Conservation efforts continue among irrigators using Squaw Creek water. Several irrigators have recently sold their water rights to Oregon Water Trust who will return the water to instream use.

Indian Ford Creek was once a major tributary to Squaw Creek and water is diverted for pasture irrigation. The largest water rights holder on Indian Ford Creek is Black Butte Ranch for 7.27 cfs. Black Butte Ranch has drilled wells to reduce its surface water needs. The oldest water rights holder is the Willows Ranch with rights for 1.37 cfs. Water demand often exceeds available water in the creek which varies depending on weather and snowpack.

Pole Creek also was a tributary of Squaw Creek. Pasture irrigation of Patterson's Ranch and diversion for Sisters water supply often dewater Pole Creek. Other diversions of surface water for irrigation occur on Trout Creek and Cold Springs.

Former ranches in the Squaw Creek, Black Butte and Indian Ford area were subdivided in the 1960's-1970's and developed for home sites. In 1998 at least two large agricultural parcels adjacent to Sisters are changing use to high density business and home developments. Land use laws currently protect many irrigated lands from high density developments but some may be further parcelized.

Attitudes have changed regarding the value of instream water and a living creek. Irrigators and other concerned citizens are working together to help provide solutions.

"The town people never used to care much about what went on with extra things around here. Their interest was in logging and their jobs. They liked to fish and hunt, I know that. But as far as taking any care of Squaw Creek or anything like that, that's was just somebody else's concern. I think there's a vast amount of caring now. People that are here and see the potential of a stream going through town, a steady stream, not an off and on one." Jess Edgington 1998

TREND: In the past 100 years a shift has occurred from ranching and agriculture towards light industry, tourism, and residential uses of former farm and ranch lands. Surface waters were over-allocated and there has not been enough surface water to fill existing water rights since the early part of the century. The number of farms has decreased but agriculture remains an important part of the area economy and character. Attitudes have changed regarding the values of instream water. Opportunities for purchase or lease of additional water rights will occur as farm and ranch lands change use.

Grazing

Historic Use

"Sisters was a sheepman's town; that is, the economy was sheep. They were coming this way before the turn of the century, before there was a Forest service, when it was Public Domain." Alvin Cyrus 1992.

"There were lots of sheepherders up there in that country that kept the grasses down inside the woods. The woods were very open. And there wasn't a lot of undergrowth. ." Becky Johnson (Mrs Sam) 1998.

In the late 1800's thousands of sheep and cattle grazed the meadows and openings on both sides of the Cascade crest. The understory shrubs and grasses in many areas were consumed. Establishment of the National Forest in 1906 initiated the move toward reduction of livestock numbers and establishment of grazing seasons more consistent with the resource capability. From 1880 until the late 1960's thousands of sheep grazed forest areas near the city of Sisters from July until October.

Current Grazing

1946 "After the war, I went into business with Dad, after a fashion. We kind of had to start over again with cattle. We had what was called the Bull Springs Cattle Association, under lease from Brooks Scanlon... the township area from Sisters to Tumalo. But that petered out. This is not a cow country here. We'd be fine if there was only 2-3 people trying to operate.. But the Forest Service has never been pleased with our cattle operation in this country. Good reason for it. I can understand it better now than I could then." Jess Edgington, 1998.

Grazing continued through much of the Sisters high country under permit by the Forest Service from the 1900's to the 1980's. In recent years requests for use have dropped as the local livestock industry has changed from large ranches to smaller more specialized operations with more exotic livestock. The following allotments are established. Four of five are open, currently inactive allotments. Closure of allotments requires an environmental assessment (EA), under the National Environmental Policy Act (NEPA) with public notice and review.

The Squaw Creek Cattle and Horse Allotment (25,050 acres, open, inactive) runs in an area of wilderness from the foot of Broken Top to McKenzie Highway . It had 1250 head of cattle in 1932 and 123 by 1982. It was closed due to cattle damage to developing tree plantations, including eating pine trees. This allotment developed Spruce Spring as a water source with pipes and tanks. Approximately 35 miles of barbed wire fence still is found on the boundaries, including fence near Squaw Creek Falls which is a hazard to hikers and firefighters. Portions of area are protected by Wilderness and Wild and Scenic River designations. Scheduled for EA/NEPA in 1999, but was not funded.

The Cache Mountain Sheep Allotment (32,822 acres, open, inactive) covers a large area around Cache Mountain south to the McKenzie Highway and Cold Springs area. Records indicate the area had a history of continuous grazing since the early 1900's. Heavy grazing occurred before 1918 by sheep and a few cattle. From 1918-23 there was heavy use by cattle. In 1924, 2400 head of sheep grazed the allotment. It was closed between 1959 and 1978 for poor economics, then reopened. Sheep used the allotment until a few years ago. In its last few years of operation in the early 1990's, complaints were common, often concerns from hunters regarding interference with deer and elk forage, or complaints about odors and grazing of vegetation and wildflowers. Portions of area protected by Research Natural Area designation, and Late Successional Reserve. Scheduled for EA/NEPA in 2001.

Garrison Butte Cattle Allotment (13,817 acres, open, inactive) centers around the Garrison Butte/Indian Ford area, east of Black Butte. Portions of the allotment are within this analysis area. Historic information was unavailable. Scheduled for EA/NEPA in 2000.

The Glaze Cattle and Horse Allotment (1,127 acres, EA completed, closed 1998) is adjacent to Black Butte Ranch and contains a portion of Indian Ford Creek, wetlands, meadows, a designated Old Growth area, and a large population of the rare wildflower Peck's penstemon. The area was grazed for over 100 years as one of the earliest settled areas near Sisters. Meadows were ditched to dry them for earlier grazing and Kentucky bluegrass was planted on what may have been a tufted hairgrass meadow. The area was also logged before exchange to the Forest Service in the late 1940's. In the 1970's the adjacent private ranch was developed into Black Butte Ranch, and now contains over 1000 homes.

Cattle tended to overgraze certain riparian and meadow portions of the allotment leading to little stream cover, lack of willow and aspen regeneration, species composition changes in the meadows, and low flowering success for Peck's penstemon. An Allotment Management Plan revision led to closure, largely due to the difficulty of financing required monitoring to ensure protection of sensitive resources.

Willows were reintroduced into some stream and pond areas. Riparian areas, meadows, and rare plants are recovering but may need the reintroduction of fire. Many years of grazing and alteration in meadow hydrology by ditching have created shifts in plant species composition that may not be reversible. The area is still fenced and has three exclosures. One large exclosure installed to protect Glaze Meadow ponds from cattle also restricts some wildlife movements. Some perimeter fences may need to be maintained to help protect the area from vehicle damage; some problems occur with off road vehicles from the Black Butte Ranch urban interface. Dumping and trespass also occur. A fuels reduction project is thinning trees and using prescribed fire on some portions. Many old and current horse trails from Black Butte Stables cross the allotment area and some are highly eroded. Urban interface impacts have increased.

The Indian Ford Allotment (85 acres, open, active) is downstream of the Glaze Allotment and situated between two private properties. It contains a portion of Indian Ford Creek, meadows, wetlands, pine forests, and a large population of Peck's penstemon. The area has been grazed since the late 1880's. Scheduled for EA/NEPA in 1996, was not funded.

The Allotment Management Plan for the allotment needs to be updated. It was reissued in 1996 without analysis as part of the provisions of the Congressional Salvage Rider. Indian Ford Creek is proposed for listing under the Clean Water Act 303-D process for poor water quality related to low flows. The creek is often completely diverted for irrigation and this affects riparian and meadow vegetation. Point and non-point pollution from sewage and grazing areas contribute to enrichment of the creek and algal growth. The grazing on the area is light, however it may be reducing flowering of Peck's penstemon.

TRENDS:

- **Grazing use has declined dramatically since the early 1900's and especially in the last 30 years.** This has been due to both economic factors and environmental concerns. Social concerns and lack of tolerance for grazing effects have increased. The long term effects of the intensive grazing that occurred in the area in the early 1900's are unknown. The legacy of grazing improvements on closed and inactive allotments (water developments, fencing, introduction of non-native grasses, and hydrological alterations such as ditching wetlands and meadows to allow easier grazing) have altered areas and continue to affect habitat.

- **Funding to administer grazing allotments has declined while concern and legal requirements regarding environmental effects has increased.** One active and 3 inactive allotments need updated management plans or environmental assessments which will close them. Another allotment was recently closed because inadequate funding was available to manage grazing with required monitoring.

Commodities-Timber/ Forest Products

Historic Use

1903 or 1904 "Sam's father came up into Oregon. It was very difficult to get to Central Oregon because the only travel was by rail or stagecoach in those days. When he saw the pine timber out in the Sisters country he said " This has to be the finest pine timber in the whole wide world and this is where we should establish a sawmill if we're ever going to have one, but mostly buy and sell this timber".

Later... "There were lots of saw mills in Sisters(about 11). But they didn't have any railroad and it was hard to get those great big logs to a railhead. They built the sawmills nearer to the timber so you didn't have to haul those logs so far. They were logging with horses, maybe with oxen in those early days. ." Becky Johnson (Mrs. Sam) 1998.

The pine forests in the Sisters area were quickly recognized as a vast source of lumber to supply homesteaders and growing towns. Timber harvest began in the Sisters area in the 1890's with a water-powered mill along Squaw Creek, but very little timber harvest had occurred in the area by 1893 when the Cascade Forest Reserve was established. A 1915 map shows 1760 acres as logged (S.J. Johnson Foundation Archives). By the 1920's timber harvest on private lands in the eastern portion of the watershed speeded up.

"They were cutting all the big straight trees with good logs in them and leaving the ones that weren't going to yield that much. And they believed in leaving trees for seed, but they didn't really worry about the reproduction. It was hard for me coming from the east where I was fetched up that if you cut a tree down you planted another tree and trees were precious. I think in those days, they were hard pressed, especially during the depression. They let land go back for taxes. They were only interested in the trees. Once they cut the trees and they cut the most marketable and the most valuable of them first. So the only trees that were left were the disfigured ones or the ones that were hard to get. Later the stumps were right down to the ground so they got every inch of merchantable stuff out of it. But I think mostly it was sort of "cut out and get out". Becky Johnson (Mrs. Sam) 1998.

The timber economy boomed between 1935 and 1937 with all the mills running double shifts, the population of Sisters tripled in size (to 441). Railroads extended into the forests in the 1940's but railroad logging ended around 1950. Most private land was harvested by the 1950's.

"After the war was over there weren't too many of those 11 sawmills left. They either had cut out of timber or didn't have any more. There was so much competitive bidding on Forest Service properties. They were always bidding against Brooks Scanlon and Shevlin Hickson and Dant and Russell, another big mill here in town." Becky Johnson (Mrs. Sam) 1998.

Timber harvest on public lands began in earnest after World II (1947) but many mills were in trouble and shutting their doors by the 1950's. The Forest Service was blamed for its policies and not making enough timber available. Timber harvest intensified in the 1970's and 1980's with a change in management philosophies from selective cutting to clearcutting.

Current Use

"Well, I don't like to see clear-cuts. I'm very definitely against clear-cuts. Selective logging didn't seem to me to be too detrimental. Most of these forests around here have been logged at one time or another, you see stumps out there, but the forests have grown up again. Lets say I have no objection to logging conservatively, and leave some of the old growth." Georgia Gallagher, 1998.

Public concerns regarding clear-cutting and its visual effects in the scenic front country of the Cascade

Mountains escalated. This resulted in a lawsuit against the Sisters Ranger District that brought logging to a near stand still in the early 1990's. The resolution of the lawsuit required improved District process, more monitoring, and careful consideration of visual effects. Scientist's concerns about declines in species dependent on Northwest Old Growth forests, such as the Spotted Owl, resulted in new management philosophies such as the Northwest Forest Plan.

The Sisters Ranger District predicts a continued role for timber harvest as part of forest management with estimates of a sustained program of 10 million board feet a year. This is approximately 20% of the yearly amount produced in the 1980's.

Demand for special forest products such as firewood, posts and poles, Christmas trees, boughs, cones, mushrooms, and commercial transplants continues to increase. More of these products could be sold with more funding for management of the program. As use grows there is a need for more information to understand the effects of removal of these products on the forest ecosystem.

TRENDS:

- **Sisters has changed from a logging town to a city with a more diversified economy. There is still an important role for forest products in the watershed area but emphasis has shifted to consider ecosystem management strategies.** The vast old growth pine forests of the past have largely been cut and people place great value on remaining large trees.

- **The demand for special forest products continues to grow and needs monitoring.**

Commodities- Geothermal Energy

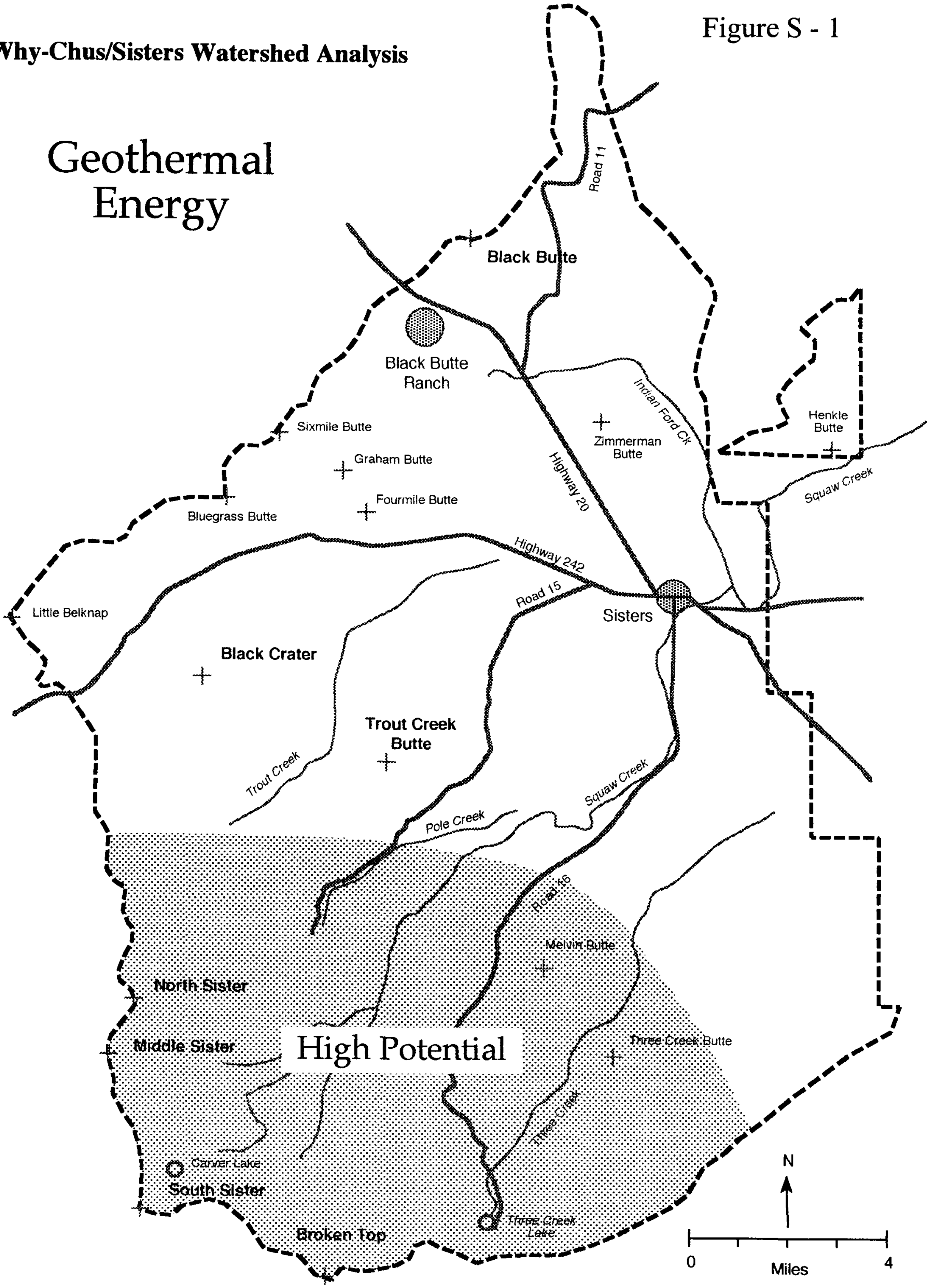
Geothermal Energy Potential Areas above 4000 feet elevation south of Sisters have high potential for producing eletricity from geothermal energy ***(Figure S-1).*** Rhyolite domes, such as Melvin Butte and Three Creek Butte, and known explosive eruptions in the Tumalo Highlands are powerful geologic indicators that a great deal of heat lies underground. Exploration in the 1980's, including drilling, was not discouraging; over 60 geothermal leases were filed for the Sisters area. Most of these leases have expired. There has never been a commercial geothermal plant in Oregon. The closest was in Newberry Crater, which was not developed because of cost.

Current Conditions Geothermal leases may be reopened by new application at any time. Geothermal power plants, such as the 30 megawatt plant proposed at Newberry Crater two years ago (1996), require several well pads, pipelines, and a generating facility. Because of the Newberry Geothermal Proposal many of the effects of a geothermal plant are understood. Exploration techniques can be relatively non-invasive, with small diameter 3 inch cores which drill to 4000 feet deep. If a plant is constructed the major impact is visual. The cooling towers often produce a condensation plume which would be visible in the scenic front country. The well pads are 4 acres in size and power plants about 30 acres in size. Powerlines, roads and pipeline corridors are associated developments. Half of the royalties from the steam supplying these plants is returned to the County. This can be a substantial sum: 1 million/ year was projected for the County from the Newberry Plant.

TREND*:* The current trend for geothermal development is flat, but could resurge in the future if the price of electricity or natural gas goes up.

Why-Chus/Sisters Watershed Analysis

Figure S - 1



Commodities- Mineral Sources- Gravel and Cinder

Historic Use Red cinder roads made Central Oregon famous in the 1930's through the 1970's. Cinders absorbed more asphalt than gravel and were less durable. Most road builders switched to gravel in the mid 1970's.

Existing Pits and Quarries Nineteen pits and quarries have supplied cinders, sand and gravel, hard rock, and clay since at least the 1960's. Volcanic cinders have been used as low quality aggregate for roads (e.g., Fourmile Butte Cinder Pit) and for winter sanding cinders along Highway 20 (Zimmerman Butte Cinder Pit). Gravel pits have provided high quality base and surfacing aggregate for roads (e.g., McKenzie Gravel Pit). Squaw Creek Rock Quarry, the only rock quarry, has supplied aggregate for roads. The Edgar Lake Clay Pit has provided clay for lining irrigation ditches and stock ponds. Of the nineteen pits and quarries listed in the 1990 Deschutes National Forest Plan Appendix 8, only about seven are currently active.

Mineral Resources Potential The mineral resource of this watershed is large. Sand and gravel lie under more than 40 square miles of land. Volcanic cinders make up more than 50 cinder cones and ridges, however, some of these are within wildernesses. Large areas of lava could be sources of hard rock. Known sources of clay are currently being mined.

Conflicts Mineral pits on private and public lands, especially in the urban interface tend to be controversial for the following reasons:

- Noise
- Dust
- Safety issues associated with truck traffic
- Asphalt plants
- Attractive nuisance for off road vehicle play, shooting, dumping

TREND: Cinder use is down. Gravel use is steady. Pits continue to be controversial. One new pit expansion is currently proposed in the Black Butte area.

Land ownership, Land Use, Growth, and Development

"Those were the days when it was advertised that settlers should come out to Oregon and make a claim for land. So all these lumber mills were doing the same thing. They were locating people from the Midwest to come out here and stake claims and then the lumber companies bought them out because they weren't going to succeed with ranching. Nobody told them they couldn't raise anything in this dry desert country. That's how the lumber companies accumulated land." Becky Johnson (Mrs. Sam) 1998.

Historic land ownership In 1893 President Grover Cleveland withdrew large forest areas from eligibility for homestead claims and the Cascade Forest Reserve was established. It was a precursor to the Deschutes National Forest which was established in 1908. A 1930 Timber holdings map (S. J. Johnson Foundation Archives) shows most forest lands east of the Forest Reserve owned by "Hill, Johnson-Gilchrist, or Brooks Scanlon). These lands were largely acquired by road/rail land grants or buying out homesteaders. Many private timber lands including the large holdings of the Johnson – Gilchrist Company in the Black Butte, Indian Ford and Sisters area were exchanged to the Forest

Service after they were logged. In the past 105 years there has been an increase of National Forest lands and reduction in private lands through land exchanges in the analysis area.

1893--- Cascade Forest Reserve = 67%	**1998--- National Forest =75%**
--Private land = 33%	**-Private = 25%**

Growth and Increased Use

What are your hopes for the future of Sisters? *"That growth will slow up... its not slowing, its gaining speed. And I'm afraid with the sewer every green spot in town will fill up with buildings, all those drainfields will be built on. Preserve the atmosphere... You know that's what has made Sisters successful is the kind of openness and the atmosphere. Georgia Gallagher, 1998.*

Deschutes County is Oregon's most rapidly growing county. Population has increased by 35% from 1990-1997. Double digit growth is projected to continue into the next century. Since the early 1960's, 6,000-10,000 people have built permanent and vacation homes around Sisters. Current land use laws will limit additional new subdivisions, but at least 4 are currently planned or under construction in the analysis area which will add 300 or more new homes (Pine Meadow Ranch, Forbes, Buck Run expansion and Aspen Lakes). These subdivisions are in areas that were farms or private forest lands. This growth will continue to increase recreational day use, intensify urban/interface problems, and affect landscape character.

Although accurate use figures are not available for the Why-chus watershed, the Bend Chamber of Commerce reports between 1993 and 1997 indicate that use in the Central Oregon area doubled from 2 1/2 million visitors to over 5 million visitors.

Forest/Urban Interface Resort and residential sub-divisions (including Black Butte, Tollgate, Crossroads, Buck Run, and Indian Ford) have inserted hundreds of acres of development into areas surrounded by public forest lands, creating large areas of forest/urban interface. This has had a tremendous impact on the forest. Problems associated with urban interface areas include new user trails and roads, off road vehicle damage and noise, illegal tree cutting, noxious weed introduction and spread, firearm use threatening wildlife and recreationists, and less obvious pressures from yard and construction debris dumping, encroachment, and the visual impacts of homes and properties bordering the Forest.

Current land ownership/land exchanges Most of the land in the analysis area is National Forest which limits growth in the area. There is continued interest in land exchanges to block up private and public lands and provide growing space to the City of Sisters. Three land exchanges have occurred since 1991, two to the Sisters School District and another to Crown Pacific Timber Company. Land exchanges are increasingly controversial because people pay premium land prices to live next to National Forest and are often fearful of changed ownership and use. Concerns regarding one of these exchanges was reduced by the establishment of a conservation easement held by a private land trust which prohibited development or excavation. An additional exchange may be proposed to accommodate the City of Sisters sewer. Future opportunities to acquire private lands are becoming diminished because of the division and housing developments on large parcels.

Growth, Water, and Wastewater As discussed in the Hydrology section, the Sisters area has abundant ground water and could easily support more ground water use without significant drops in the water reaching the Deschutes River. However, new large wells or periods of drought could have localized effects on shallow wells.

Wastewater may be contributing to the water quality problems in localized areas near Indian Ford, McKinney Butte, and Squaw Creek. No evidence as yet ties drainfields in Sisters to pollution of ground water. Low water flows and high temperatures in Squaw Creek and Indian Ford Creek may accelerate bacterial and algal growth and make these streams particularly vulnerable to point and non-point pollution.

Floodplain development

*"I haven't seen a flood (*on Squaw Creek*) since 1964. Somebody around here might have seen something that seemed high to them but it wasn't high as they get. After we moved from the ranch, around 1960, the bridge we crossed on was 12 feet above the creek and 4-5 feet above the bank. That year the ice jammed someplace and it came down the creek, picking it up as it came. It piled up against that bridge till it was clear up over the top of a car on top of that bridge." Jess Edgington 1998.*

Houses have been built in mapped and unmapped floodplains in the past several decades. In 1995 winter flooding occurred after 7-10 years of drought and many people found themselves living in a floodplain and experiencing water damage. Inactive springs at Black Butte Ranch resumed flows and flooded basements of houses. The Trapper Point subdivision was particularly hard hit when Trout Creek resumed flow for the first time in 15 years. The Forest Service received many requests to "do something" but there was no simple way to reroute water without flooding other developed areas.

The responsibility for controlling development in mapped and unmapped floodplains rests with Deschutes County and the City of Sisters. Both have flood zone restrictions, but current County and City zoning allows development within the 100 year floodplain under some conditions. County and City definitions of the floodplain zone differ. The City of Sisters has allowed creation of new lots in areas which have historically been flooded. Within the past 10 years new houses have been built in areas which show evidence of flooding in the past (Buck Run). Floodplain developments are at risk during large flood events and will limit and complicate restoration of natural stream function.

Growth/ Utilities and Infrastructure The Forest Service must allow access to inholdings of private land surrounded by National Forest. Utility lines including phone and powerlines cumulatively affect forest habitats with localized disturbance from installation and maintenance. Many of these utility corridors become vectors for introductions of noxious weeds. The number of requests for new utilities to private inholdings has dropped because most have been subdivided to current zoning lot size minimums. This may change if land use laws become more lenient.

GROWTH TRENDS:

- In the past 100 years there has been an increase in public lands due to land exchanges
- Land exchanges are continuing but becoming more controversial
- Potential for acquisition of private lands in the future is dropping because they are developed
- More people and more homes are coming to the area and using nearby National Forest lands
- Homes are being built on lands which were formerly farm or forest lands
- Forest/urban interface areas have increased and have special problems
- Homes are being built in areas which have flooded historically
- The trend for new utilities construction through public lands is leveling

Recreation

Wilderness Recreation

The Three Sisters Wilderness occupies portions of five sub-watersheds within the analysis area.

Early Wilderness Management and Use Recreation use in the Three Sisters Wilderness dates back to before the turn of the century. From the time the area was included in the National Forest System until the termination of World War II, administration was largely custodial in nature. Trails and administrative facilities suitable for fire prevention and suppression activities were constructed and maintained during this time.

The Three Sisters Primitive Area was established by the Chief of the Forest Service in 1937 under the authority of Regulation L-20. It consisted of about 191,000 acres of rough, primitive country along the backbone of the Central Oregon Cascades. The Three Sisters Wilderness was established on February 6, 1957. With the passage of the Wilderness Act on September 3, 1964, the area became a part of the National Wilderness Preservation System. The Oregon Wilderness Bill of 1984 expanded the Sisters Ranger District portion of the Three Sisters Wilderness Area to include some roadless areas in the vicinity of Snow Creek and Black Crater Lake.

Current Wilderness Use and Management The need to educate users in good Wilderness practices resulted in assignment of the first Wilderness Ranger to the northern portion in 1964. Additional rangers were added over time. Their duties were to furnish information, collect data, clean up campsites and maintain trails. The first of several Forest discussions on coordination and management between the Deschutes and Willamette National Forests occurred during the 1970's. This was also the time when research began to address solutions to management problems. One of the outcomes was the development of the Limits of Acceptable Change (LAC) Process. This gave managers a way to measure and monitor the physical and social impacts of recreation use. Current management direction is provided primarily by the Wilderness Strategies Project EA which was completed and signed in 1990 by a team from the Willamette and Deschutes National Forests.

The Three Sisters Wilderness is now managed jointly with the Willamette National Forest as one contiguous area. Wilderness regulations require that all users carry a self issue permit. Other regulatory management activities being used include a campfire ban in the Chambers Lake area and designated campsites at North and South Matthieu Lakes. In general, human uses of the Wilderness include hiking, horseback riding, hunting, fishing, mountain climbing, and photography.

In the Three Sisters Wilderness overnight use has declined, while day use is up considerably (Hall and Shelby, 1992). Day use rose from 42% of total use in 1982 to 76% in 1995. The average group size for day use is 2.6 people per party, and the average for overnight use is 3.0 per party. In the Wilderness as a whole, use has doubled from 1982-1991, and has continued to increase at a rate of 4% per year. Growing use threatens forest plan standards for physical impacts and social encounters. A quota system may be needed to avoid further impacts within the wilderness. The priority area in which this system could be implemented would be the Matthieu Lakes area. The Obsidian Limited Entry (LEA) on the Willamette National Forest could be expanded encompassing a larger area and help attain this objective.

Surveys show that visitor destinations in Wilderness are closely associated with bodies of water.

Camping and day use in and around lakes and streams has had a significant impact on natural processes. Lake shorelines and streamsides have lost considerable vegetation due to past camping practices where camping to close too the water's edge was a normal activity.

Fire has been one of the natural processes that created and maintained ecosystems of the Cascade Crest Wildernesses. In 1996, a team from the Deschutes and Willamette National Forests wrote a Prescribed Natural Fire Program Plan for the Mt. Jefferson, Mt Washington, and Three Sisters Wildernesses. This plan paves the way for the re-introduction of natural fire in the Wilderness. However, a "risk assessment" and "management ignited supplement" must be done before the plan can be implemented.

The Squaw Creek grazing allotment extends into the Three Sisters Wilderness. It has been inactive since 1984 but fences are still in place. Most of the grazing occurred in the high meadows, such as Red Meadow and Park Meadow.

Other resource concerns in Wilderness are: trails that go through (instead of around) wet meadow areas; trail short cutting resulting in erosion; camping too close to lakes or streams; proliferation of user-created trails on certain routes including peak climbing; depletion of the dead and down woody material resulting from use in campfires; and camping in or on the edge of meadows. Most water bodies within Wilderness are known or suspected of being contaminated with giardia. Wilderness trespass by snowmobiles has become a law enforcement challenge in recent years in the boundary areas near Three Creek Lake and McKenzie Pass.

Early Wilderness Trails Most of the current trail system evolved from earlier sheep drives, firemen's way trails, packers' routes, and fishermen trails. The trail system was refined over time. The trailheads evolved with the road systems. As the roads pushed further into the woods and towards the Wilderness, so too did the trailheads. Some of the early trail building and maintenance was done by the Civilian Conservation Corps (CCC's).

Current Wilderness Trails and Trailheads There is a network of trails accessing the Three Sisters Wilderness Area (see **Figure S-1**). This system provides adequate access to all parts of the Wilderness while leaving vast pristine areas. Ten trailheads provide wilderness access and for the most part, are adequate to meet the demand. The Tam-McArthur, Little Three Creek Lake, and Pole Creek trailheads are inadequate, and poorly defined. Improvements to these facilities are scheduled for 1999. However, improvements to Pole Creek trailhead are scheduled for 1998. This includes the installation of a new accessible toilet. The road to Squaw Creek Falls trailhead is deteriorating making clearance difficult for some passenger cars.

Generally speaking, wilderness trailheads should be low standard and primitive, but adequate for travel by passenger car. The one exception to this standard is the Park Meadow Trailhead. This access road is little more than a jeep trail. At the present time, users have the option of parking along Road 16 or driving 1.5 miles along the jeep road to the actual beginning of the trail. The long term proposal is to move the trailhead to Road 16 and convert the existing road to a trail.

The trail maintenance budget has gone down in recent years making it difficult to accomplish trail maintenance objectives. The Fee Demo (Trail Park Passes) has provided some relief, although the future of that program remains uncertain. Money for improvements has been provided through the Capital Investment Process which allows all Forests to compete for a pot of money managed at the regional level. Current regional policy is to avoid building new trails. Changes in the system can be made, but there should be no net gain in the miles of trail within Wilderness.

Recreation- Non-Wilderness Trails, Trailheads, and Sno-Parks

Within the watershed there are two sno-parks, one informal sno-park, three non-wilderness trailheads. Winter sports use increases each year.

Sno-parks The Upper Three Creek sno-park located on Road 16 has received extensive work in the past five years. It is now paved and contains a warming cabin and toilet. It is in excellent condition and has been "discovered" by the public. Use increases each year and the snowmobile portion of the lot is often at capacity. Fortunately, the Lower Three Creek sno-park is lightly used and capable of handling the overflow. The informal sno-park on Highway 242 is also busy and congested at times. This indicates there may be a future need to evaluate and provide for additional parking and snow plowing in that general area.

Non-wilderness summer trails include the Metolius-Windigo Trail, The Sisters Mt. Bike Trail system, a portion of the Roads to Trails system, and the Little Three Creek Lake Trails (see **Figure S-1**). Of these, the Metolius-Windigo Trail is the longest and most significant. It spans across the entire watershed at a fairly low elevation, making it accessible for approximately nine months of the year. It receives a moderate amount of use primarily by equestrians, but is becoming increasingly popular as a mountain biking opportunity. Maintenance is done primarily by user groups. However, this may be contributing to the spread of weeds. The ford and crossing at Squaw Creek is often a challenge due to the swift current. There have been requests for a hiker/biker bridge. The Sisters Mt. Bike and Roads to Trails systems receive moderate use and are popular because they are easily accessed directly from the town of Sisters or Black Butter Ranch.

Non-wilderness winter trails include the Cross-District Snowmobile Trail, the Three Creek Lake Nordic Trail System, and the McKenzie Pass Tour. The Cross-District trail spans the entire watershed. Its situated at high elevations where good snow conditions are more likely, especially in low snow years. The trail maintenance budget has gone down in recent years, making it difficult to accomplish trail maintenance objectives. The fee demo (Trail Park Pass) has provided some relief; although, the future of that program remains uncertain.

Campgrounds

Historic development of Campgrounds Locations for early campgrounds were generally chosen as a result of a demand for improvements in traditional dispersed camp sites. Some of the campgrounds in this watershed may have been worked on by crews from Sisters Camp, the large CCC camp in the Metolius Basin, which was in full operation during the mid 1930's and early 1940's. There is, however, no physical evidence remaining to support this, with the possible exception of a shelter at Lava Camp Lake Campground. However, it is not known if the shelter was constructed by the CCC's or if it was of earlier origin. Two campgrounds in the watershed, Graham Corral and Sisters Cow Camp, have historic values related to the livestock industry.

Developed Recreation - Campgrounds *(A detailed assessment of facilities is in* **Appendix S-2***)*
There are ten campgrounds and horsecamps within the watershed with a camping capacity of 580 people at one time. These are Three Creek Lake, Driftwood, Three Creek Meadow and Horse Camp, Black Pine Springs, Cold Springs, Graham Corral, Indian Ford, Whispering Pines, Sisters Cow Camp, and Lava Camp Lake. All campgrounds, with the exception of Lava Camp Lake, are operated by concessionaires. Development levels of the campgrounds vary to some degree. They offer basic

facilities consisting of tables, fireplaces, parking spurs, toilets, corrals or stalls in horse camps, garbage containers, and potable water. Indian Ford, Cold Springs, and Graham Corral offer the highest level of service having both potable water and garbage service.

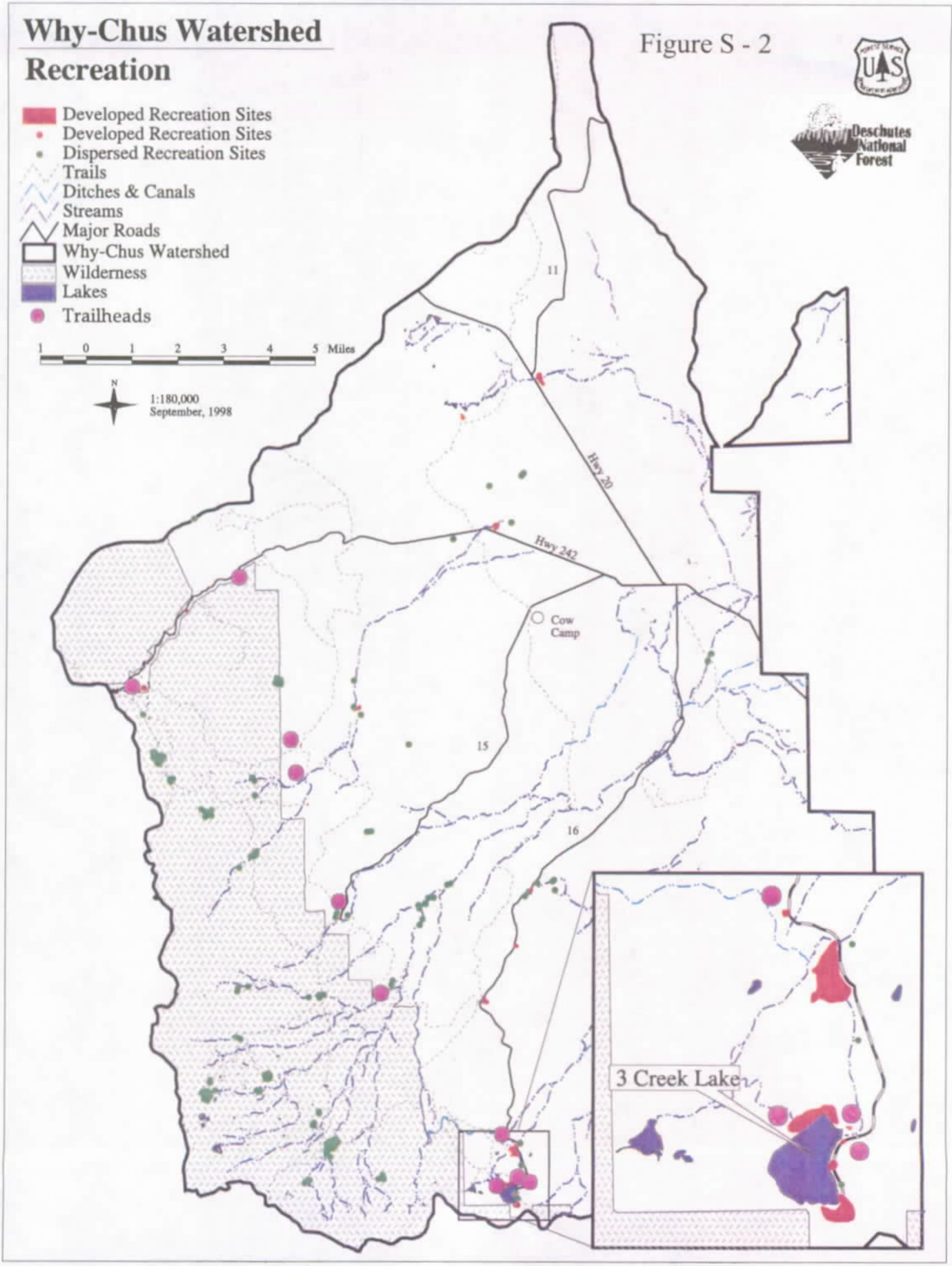
The general condition of site facilities, such as picnic tables, fireplaces, toilet buildings, parking spurs, and the like, is fair to poor. The average "as built" date for most the campgrounds occurred in the mid 1960's, and ordinary wear and tear has taken its toll. Within campgrounds, there has been a change in the type of camping occurring in the campgrounds, with a significant move to more frequent use of motor homes and trailers as opposed to tent camping. The length of stay by campers seems shorter than historically occurred.

Currently, very few of the facilities within the watershed meet American Disabilities Act (ADA) requirements. Any facilities that are upgraded or replaced must meet these standards. The majority of the campgrounds, as well as the facilities within, continue to fulfill the basic need of the user, although some will require minor improvements or upgrades in the near future. It should be noted, however, that the average user of the campgrounds in this watershed is seeking a more primitive camping experience, and does not desire higher levels of development.

Four of the ten campgrounds are designated horse camps. Each of the camps offer a variety of riding opportunities, settings, and services. The use of these camps seems to be gaining in popularity and the user groups, such as Oregon Equestrian Trails (OET). These groups are very active in the maintenance and improvements of the facilities in and around the camps. There is a need to provide more trail opportunities in these areas and to construct more horse watering troughs in camps that are ill-equipped. There is concern that horses may considerably contribute to the spread of noxious weeds. There is a move in many National Forests to reduce the risk of weed introduction by requiring certified weed-free feed.

Use levels throughout the campgrounds range from low to high, with the majority falling into the moderate category. The Three Creek Meadow and Lake area receives the highest level of use, especially on weekends and holidays. The high use of this complex, which includes three campgrounds, three trailheads, a permit operated store and boat rental facility, and a horse camp, has resulted in adverse impacts to riparian areas around the lake and to streams entering the lake. Erosion along trails and the steep banks around the lake are also problems. Some mitigating measures have been implemented in the area, including designation of campsites, enforcement of regulations, construction of a trail around the lake, and installation of water troughs and fences to keep horses out of streams and meadows. Plans to relocate trailheads and trails are underway to reduce parking and congestion problems in the area. Road improvements have allowed more motor homes into the area. It is now common to drive up to the Three Creek Lake campgrounds and see large motor homes parked in the campsites, where a few years ago the condition of the road would have prevented this type of vehicle even making it up to the lake. Development and implementation of a site restoration and vegetation management plan is needed for Three Creek.

Black Pine Springs campground is the lowest use site in the watershed. It is currently in a state of serious disrepair and requires attention. Given the condition of this site and the low use it receives, removal of the existing facilities, rehabilitating the hill climbing area, and converting the site to a dispersed camping area should be considered.


Why-Chus Watershed
Recreation
Figure S - 2
Deschutes National Forest
Developed Recreation Sites
Developed Recreation Sites
Dispersed Recreation Sites
Trails
Ditches & Canals
Streams
Major Roads
Why-Chus Watershed
Wilderness
Lakes
Trailheads
1 0 1 2 3 4 5 Miles
N
1:180,000
September, 1998
11
Hwy 20
Hwy 242
Cow Camp
15
16
3 Creek Lake

Non-Wilderness Day Use Day use is growing in the watershed, however, facilities are limited and poorly dispersed. There is a great demand for improved day use opportunities and facilities. The only facilities presently available specifically for day use only on Forest Service lands are located at Indian Ford and Cold Springs Campgrounds along Highway 20 and Highway 242. Generally, use is low in these areas with the most common activity occurring at these sites being bird watching. Indian Ford receives heavy use from highway travelers, but the use is not, by definition, recreation oriented. It is used more commonly as a "rest area". Two city parks in Sisters offer other options for day use close to the town of Sisters.

The Three Creek area is inundated with day users, and except for trailheads, there are no formal facilities developed to accommodate day use. Some attractions offered in this area include driving for pleasure, viewing scenery and wildlife, boating, fishing, the store and boat rental facility, trailheads, and an unofficial beach/swim area. Traffic congestion at the turnoff to Driftwood Campground to Three Creek Lake campground is a particular problem, especially on busy weekends and holidays.
Day use activities outside of developed areas occur throughout the watershed but kinds of use and numbers of occurrences are not well known.

Dispersed Recreation

Dispersed Camping Dispersed camping in non-wilderness areas is not generally considered to be of great concern. There are areas of concentrated use, but levels are not such that they should warrant immediate mitigation measures. There is a need, however, to develop a monitoring system that will allow management to recognize potential areas of concern.

Generally, the most popular sites are associated with riparian areas. The areas of greatest concern are along Squaw Creek near Sisters and a short section of Indian Ford Creek south of the campground. The concerns generally stem from the type of use that is occurring. These areas have been traditionally used as long-term "homesteads". The extended duration of these occupants result in increased compaction to camp areas and increased accumulation of human waste and other debris associated with this type of use.

Some dispersed camping occurs that is not associated with riparian areas. Generally, these sites are associated with big game hunting that occurs in the fall. Duration time in these areas in generally short, and evidence of damage is minimal.

Other Dispersed Recreation This category addresses recreation activities, other than day use and camping, that occur outside of developed recreation sites. These activities generally include OHV use, hiking, bicycling, driving for pleasure, swimming, viewing wildlife and scenery, picnicking, hunting and fishing, gathering forest products, and other similar activities. Many of these activities occur near, or are the result of, the urban interface. There is currently a need to gather more information on the types of use that are occurring, the negative impacts they may present to the resources, and/or quality of life.

Recreation Experience

Growth , Increased Use and Changes in the Recreational Experience Increasing use has resulted in people's experiences changing. Where just a few years ago, a Wilderness camping experience, or even a campground camping experience, could feel like an "escape". The crowds of today make it more and more difficult to find this experience. Even getting there is harder. Within the town of Sisters, traffic congestion is becoming frequent through the town on weekends, and becomes especially bad on holidays or special event days, resulting in traffic backing up on either side of town.

RECREATION TRENDS:

- Wilderness overnight use has declined while day use has increased.
- Wilderness camping and day use has impacted areas near streams and lakes.
- Most water in the wilderness is infected with giardia.
- Recreation budgets have decreased.
- Trailheads, trails, and facilities need improvements.
- Winter sports use is increasing, the informal sno-park on McKenzie Hwy (242) is congested.
- Mountain biking and horse use has increased.
- The Three Creek area receives high use and resource damage is occurring, some improvements have been made.
- Campground facilities are in fair to poor condition and do not meet American Disabilities Act standards. Camping use has changed from tents to more motor homes.
- More horse trail opportunities are needed.
- There is an increase in non-recreational forest camping/living which is causing resource damage.
- Forest/urban interface activities are increasing and need monitoring.
- The recreational experience is becoming more crowded.

Transportation and Access

1905-" J.L. Nye had an interesting experience, when he looked up and saw a "strange contraption" of iron and tin approaching, which came swiftly and had an ugly snort to it. What was it? The gatekeeper (of the Willamette Valley and Cascade Wagon Road) had never been called on before to let an animal like this through the gate. Then the thing came to a stop and the driver approached and offered to pay toll. The keeper looked the thing over and then consulted his toll sheet. He also noted that horses and all other animals had given this rig all the road. After pondering for a few minutes, he told the driver that he would have to classify his outfit as a "Road Hog" and pass him through the same as other hogs at the 3 cent rate. This automobile belonging to Dwight B. Huss and called "Old Scout" was the first car to cross the Santiam Pass." Tillie Wilson and Alice Scott, 1976

Historic Use The first road was built into the watershed in 1865, the Santiam Wagon Road or Willamette Valley Cascade Mountain Military Wagon Road. A second road was built into the watershed through McKenzie Pass (McKenzie Wagon road) in the 1870's. In the 1920's, this road was the first across the Cascades developed for automobiles. In 1938, Highway 20 through Santiam Pass was completed and brought even more people into the area from the Willamette Valley.

Much of the current forest road system was put into place to facilitate hauling logs off private and National Forest lands. This process started late in the last century and was well in place by the 1940's. From 1945 until the 1990's, roads were being developed into most timbered areas except designated wildernesses. Many started out as railroads, but were quickly converted to roads with the development of logging trucks. The logging roads were then heavily used by recreationists shortly after their completion. The road to the Three Creek Lake area was completed in 1923 and was intended to serve two purposes, fire protection and making the Three Creek area more accessible for those seeking recreational opportunities. This indicates that there was already an existing need for increased recreation opportunities in the area.

Current use The watershed analysis area contains 774 miles of road which equates to 41% of the total road miles on the Sisters Ranger District. This translates to a road density of 3.7 mi/mi^2 of road within the watershed which is equal to the District's overall average. This is above the recommended 2.5 mi/mi^2 cited in the Deschutes National Forest LMRP. The 774 miles of roads equates to 1783 acres of land in use as roads.

This density calculation is for the entire watershed analysis area and includes wilderness and closed roads that have not been obliterated. The Biological Domain Wildlife Section discusses localized density calculations, which are more relevant to wildlife issues and <u>does not</u> include wilderness acres.

Only 7-10% of the road miles receive routine maintenance each year. These are primarily maintenance level 3-5 roads. The remaining road miles receive only what is necessary when environmental damage is detected or they are being used for timber hauling. The area does not appear to have widespread road runoff problems. Some localized trouble spots have been identified. Most road sedimentation problems stem from the result of failed waterbars or the absence of drainage. The lack of widespread problems is primarily due to the rocky soils within the area. They tend to have good infiltration characteristics lessening the erosional effects of roads. See **Appendix S-3** for more information.

Unmaintained and low use roads close themselves over time. Many roads are now undriveable due to manzanita and other vegetation encroaching into the roadway. This indicator would suggest the lack of need for that particular road. However, prior to this event occurring, assurance is needed that these roads are hydrologically sound, have all culverts removed, and adequate drainage restored.

Eight known physical deficiencies have been identified from past transportation studies and field reconnaissance. These include public safety projects such as adding or improving shoulders along Roads 11 and 16. These roads are Highway Safety Act roads and require a certain level of maintenance. Other projects include repairing areas where sedimentation and erosion are occurring due to water being diverted along the road. Further field reconnaissance is needed to identify roads with environmental problems before they brush in. (See Recommendations Section)

Forest roads are a popular driving experience for many people. More than 95% of forest road traffic is now passenger vehicles. Road closures have become increasingly controversial because they close off automobile access to areas people enjoy for driving and hunting. Around Sisters and other urban interface areas, new roads and trails are being created by off road vehicles and high clearance vehicles for off-road recreation. Driving off-road is not by itself illegal, unless specifically prohibited (e.g., area closure) or if it causes resource damage.

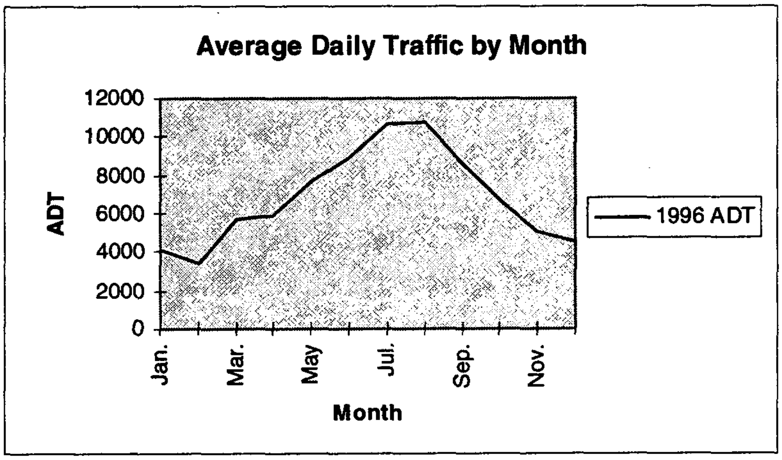
Commercial timber sale traffic has decreased, however, recreation traffic has increased keeping overall traffic counts similar. Vegetation management projects, mineral extraction, and the removal of other forest products will continue to require an adequate transportation system.

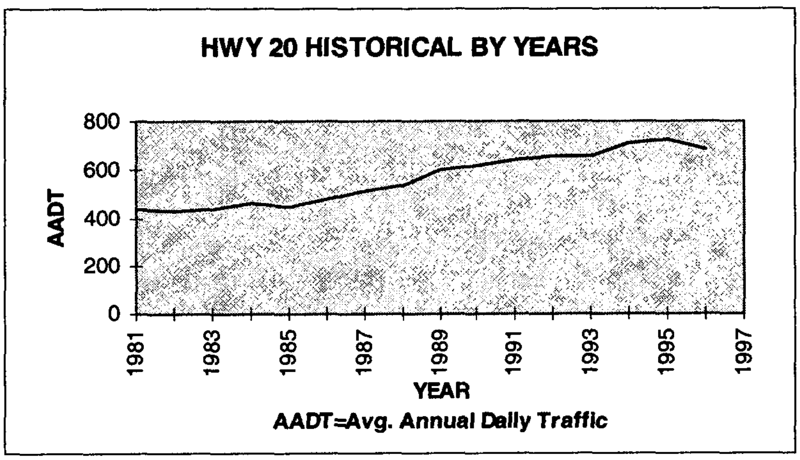
The ability to finance road construction and reconstruction through timber sales is largely gone. Today's timber sales tend to be smaller in scale than in the past and produce less funding for road maintenance. Some funds are produced by firewood sales that contribute to upkeep of popular woodcutting roads. Some new road construction may be needed in the future to replace poorly located existing roads or to access new areas. In key watersheds, such as Squaw/Pole and Three Creek there can be no net increase in road miles.

Traffic Volumes and Trends

State Highway 20, Santiam Highway Oregon Department of Transportation Volume tables show a 58% increase in 15 years (1982 to 1996), from 4300 to 6800 vehicles per day. These are year round daily averages. There is a significant change within seasonal traffic on the highway, from a February low of about 3400 vehicles per day to a high of over 10,000 per day in July and August. This is a yearly cycle (See attached Monthly Volume Comparison).

Of the 6800 vehicles per day on the highway in 1996, 89% were classified as passenger or light vehicles.





State Highway 242, McKenzie Highway Volume tables show 1200 vehicles per day at the Sisters City Limits on this highway , a 40% increase in just 6 years (1990 to 1996). Much of this is local city traffic towards Trout Creek, 3 miles west of Sisters. While there is also a large increase (38%) in traffic at the Pass, summit traffic on that portion of the highway within forest boundaries is showing a short term decrease. There is no traffic classification data available for this highway.

Road 11, Green Ridge Road From 1977 through 1997, the yearlong Average Daily Traffic (ADT) on this road has varied from a low of 82 (1996) to a high of 159 (1986). Fluctuations have historically been due to changes in logging related traffic. Overall, even with a seemingly significant fluctuation from year to year, the overall ADT has remained fairly constant, 100-150 (See attached Traffic Count Table). Although there hasn't been a traffic classification done recently, it can be assumed that the commercial traffic has dropped significantly and the recreation traffic is increasing. Recreation traffic is estimated to comprise about 90% of the use. During the spring and summer months, an estimated 30% to 40% of this traffic is traveling through to the Lake Billy Chinook area. The classification work done in the past showed typically 8-10% of the traffic to occur at night and during the hunting season. This has been as high as 23%. Shorter days at that time of year and travel to and from favorite hunting areas in the pre-dawn and post-sunset hours could account for that increase. Counts on this road and many others on the forest used to show the hunting season as the single largest traffic event of the year. This road typically showed a 300% increase for the first two weeks of October.

Road 16, Three Creeks Lake Road Counts from 1980 through 1990 on this road seem to correlate with what has been shown on Rd 11; 1994's count was elevated. This may be a long-term increase and if so, it is assumed to be recreation based. Much of what was discussed earlier applies to this road also. The overall ADTs range from 85 to 200 with a long-term average of approximately 150.

Road 15 Some counts were conducted on this road in the early to mid 1980s, showing an ADT of 50 - 60. The average has probably not changed greatly.

Other Traffic Count No other significant traffic counts are available for other roads in this area.

TRANSPORTATION TRENDS:

- Current road densities exceed recommended densities.
- Erosion problems are not widespread, but some localized problems exist that need repair.
- Most roads were built to facilitate logging. Logging use and funding for maintenance has declined.
- Road use has shifted from logging use to recreational use.
- Road inventories are not current and need updating.
- Traffic counts are not current for many forest roads and need updating.
- Unmaintained roads that are closing themselves are a priority to inventory to detect drainage problems and pull culverts.
- Driving forest roads is a popular activity, 95% are passenger carrying vehicles.
- Road closures are increasingly controversial.
- New roads are being created in the urban interface , especially by off road vehicles.
- Traffic volume on Hwy 20 has increased by 58% in 15 years (1982-1996).
- Local traffic on McKenzie Highway (242) has increased by 40% in 6 years (1990-1996)

Scenic Quality and Perceptions of What is "Natural"

Landscape character

"We stuck through the woods and soon saw the white tents in an open prairie covered with grass and bordered by fine timber. This little opening, amid forest-clad mountains and grand snow peaks, furnished a camping place, the wild beauty of which I have seldom seen equaled." (Near Indian Ford Creek) R.S. Williamson and H.L. Abbott., 1855.

"Sisters was always beautiful, you could see those mountains." Becky Johnson (Mrs. Sam) 1998.

The scenery and forests of the Sisters area impressed explorers Williamson and Abbot in 1855 as they continue to impress people today. This is the "sense of place" and the reason people come here and the reason people live here. The high desert sunny climate rounds it out to make this area a perfect habitat for people. Driving for pleasure to view this scenery is the number one recreational use. People want to build their homes as close to the mountains as they can afford and each with the design criteria to have a view of the Three Sisters peaks.

Sense of Place Sense of place is "*what begins as undifferentiated space becomes place when we endow it with value*" (Tuan 1977) or the collection of meanings, beliefs, symbols, values, and feelings that individuals or groups associate with a locality. "*One of the great and largely unmet challenges associated with ecosystem management is treating people as a rightful part of ecosystems. In many ecosystem models, despite occasional rhetoric to the contrary, there is still a tendency to treat people as autonomous individual agents outside the ecosystem, at best a source of values to be incorporated into decisions, at worst, agents of catastrophic disturbance of an otherwise smoothly running system*" (Williams and Stewart 1998).

Historic Landscape Character

1920's *"The woods were very open. All you could see were the stems of those great big pines, they called them "yellow bellies". And there wasn't a lot of undergrowth. So those forests were open and wonderful and you could see through them." Becky Johnson (Mrs. Sam) 1998.*

Forests dominated the historic character of the landscape as they do today. In the past, ponderosa pine plant associations appeared predominantly open and park-like with grassy forest floors. Small, sunny openings typically contained clusters of young pines. The orange trunks of the large pines formed the dominant visual component. From a distance, the forest canopy appeared coarse-grained and somewhat uniform. Small openings resulting from fires, disease, or insect damage were typical. The effects of low intensity fires were often visible in the form of fire scars, blackened boles and red needles on lower tree branches.

Mixed conifer plant associations were more visually diverse than the ponderosa pine forest areas. Different species of trees formed a variety of textures and shades of green in the forested canopy. Up close, these forests appeared to have multiple heights and ages of vegetation. Large, orange-trunked ponderosa were still a common visual component in these areas joined by the large gray trunks of other species. From a distance, the canopy appeared dense with a variety of textural and color diversity. Natural disturbance agents such as fires, insects, and disease caused some openings in the canopy.

The higher elevation plant associations such as hemlock and subalpine fir, appeared shorter and stouter than the lower elevation species. Vegetation at the higher elevations bends and conforms to the wind. Grassy meadows and high alpine lakes combine to formed pristine settings with expansive views across the forested land below. Rugged, rocky peaks, usually covered in white, form the uppermost edges of the watershed.

Bands of brighter colored, dense riparian vegetation flowed throughout the watershed. Riparian vegetation followed creek corridors and dominated large wetlands.

Current Conditions

"The view is more important now than it ever used to be. Nobody cared much about a view. We just went outdoors if we wanted to look at the mountains. Now you've got to have a clear shot so you can see them. So views are important." Jess Edgington 1998.

'They (the Forest Service) talked about logging Black Butte from time to time. And Phil Dahl (timber industry) said, 'Hell we're idiots if we do that, because no matter what you do you're going to get blamed and on top of that Black Butte will look like a striped ape's behind. And there's nothing that says we have to bid on it.' And nobody did. And that was something they decided ahead of time. They just didn't want Black Butte disfigured." Becky Johnson (Mrs. Sam) 1998.

People who come here to recreate or live want to see and enjoy a natural environment. For the most part their expectations are met. However, fire exclusion, logging, recreational pressures, and development have changed scenic conditions and degraded the integrity of people's expected experience. People's expectation's of what is "natural" often does not include very natural disturbance factors, which play an important role in forest ecosystems such as fire, floods, insects and disease. Many hold an idealized view of nature where forests are mature, tidy, smoke-free, and unchanging and streams are gentle.

Fire exclusion has contributed to pine forests that are less open and more dense with brush. The effects of periodic low intensity fires such as blackened tree boles, red needles, and smoke which clouds mountain views have become less common and people often react to these visual results of prescribed fires as "unnatural" and "ugly". With an increased effort to help people understand the long term benefits of prescribed fire, tolerance is slowly increasing with residents, but visitors and newcomers often do not understand or accept the role of fire as beneficial or natural.

Efforts to reduce fuels around homes in the forest/urban interface will bring people face to face with more open, forest stands with fewer trees and less brush in their backyard. Awareness of the risk of wildfires is making people more tolerant of these changes for the sake of defensible space and home protection.

Past timber harvest has affected scenic condition by removing large trees and creating openings with clearcuts or shelterwoods. Many old timber units are highly visible close up and far away. Winter snows accentuate the unnatural shape and hard edges of old timber units. Many people hate clearcuts. Up close these units appear green and vigorous with young even-aged ponderosa pine plantations. But because of regular spacing and lack of structure and diversity, plantations often look more like tree farms rather than people's vision of a "natural" forest. Roads, soil disturbance, and areas of non-native weedy plants are also often associated with plantations.

Large trees hold tremendous value with the public. People expect to see big trees in a forest. Early selective logging and later more intensive harvests have concentrated on the removal of valuable old growth pine. People now often react strongly to suggestions of cutting larger trees for any reason. There is a lack of trust that sound biological reasons exist for cutting trees and a fear that the timber targets may drive forest management. This District has been in court and in the newspapers because of people's concerns about the visual effects of clearcuts and cutting big trees. Big trees are now relatively rare on the landscape compared to historic levels and often are the first to die in overstocked stands where they compete for light and moisture.

Visual changes in higher elevation mixed conifer forests and lodgepole forests are more subtle, but similar to those in lower elevation forests. The disturbing visual effects of large- scale mortality such as is seen on Santiam Pass is found in a very small part of this watershed area. Mortality and high intensity fires are due in lodgepole forests because of natural cycles and may occur in the near future.

People have altered streams in the area for many years. The behavior of free flowing natural streams which flood, deposit log jams and debris, and meander across the landscape is not considered desirable by many living near floodprone areas. Because of the long legacy of ranching and agriculture in this area, many people are used to the look of managed pastures and enjoy seeing grazing cattle and horses as a part of our western heritage. Some people find ungrazed, healthy riparian areas "messy looking" or believe riparian vegetation "steals water from the creek". Others living next to streams remove riparian vegetation to enhance views of the water. Riparian areas are popular places to recreate. Concentrated use along some streams and lakes has trampled vegetation, compacted soils and degraded scenic quality.

By helping people understand the role of disturbance agents in the ecosystem we can realize the long term benefits of managing landscapes for an "ecological aethestic". This means looking beyond just what is pretty from the road, to include management which preserves the integrity, stability, and function of the ecosystem. Ecological beauty may sometimes look messy, but it will be more sustainable.

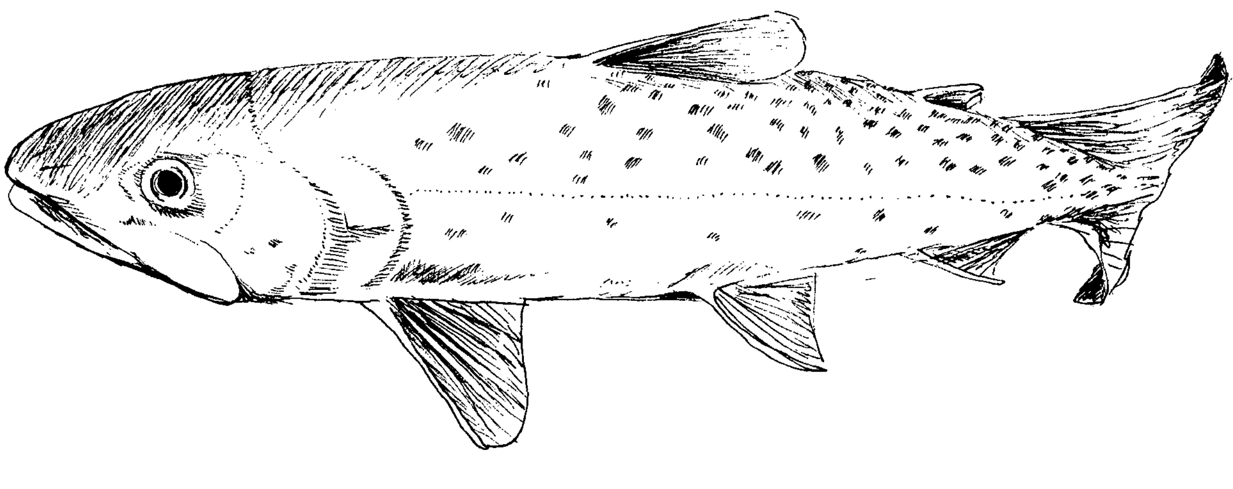
TRENDS:

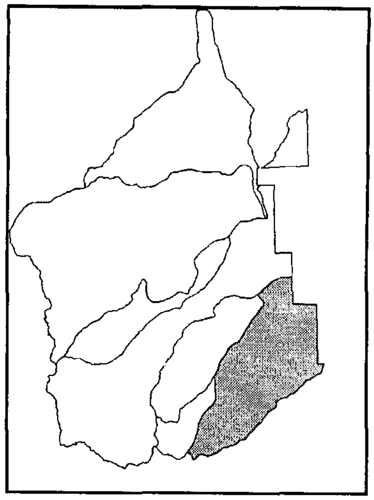
- Scenery has grown in importance as part of the "Sense of Place" of Sisters.
- Driving for pleasure to view scenery is the number one recreational use.
- People expect to see a "natural" looking environment, their expectations are mostly met.
- Scenic quality has been degraded by fire exclusion, logging, increased use, and development.
- Many timber sale units are highly visible and look unnatural.
- People expect to see big trees.
- Natural riparian areas and streams may look "messy" to some people because of a legacy of managed pastures and alterations of streams.
- Many people do not understand or accept the visual effects of disturbance agents such as fire or floods.
- There is a trend in scenery management to manage for an "ecological aesthetic" that includes the role of natural processes, instead of just making things look pretty from the road.

Synthesis

***Why-chus Subwatersheds at a Glance

**Trends





THREE CREEK BUTTE SUBWATERSHED

Total Acres: 25,219
% DNF: 30%
% Private: 70%

PHYSICAL:

Road Density: 2.2 mi/mi^2 (All 2^0)   Riparian Road Density: 6.2 mi/mi^2

Streambank Erosion: None known

Hydrology: Three Creek Butte Creek - Intermittent stream. Three Creek Ditch - diverted into subwatershed. Other information is not available at this time.

AQUATIC: No information available on streams within this subwatershed.

VEGETATION:

DISTRIBUTION OF VEGETATION		
Forested = 92%	Non-Forest = 7%	Not-Classified = 1%

SIZE DISTRIBUTION OF CLASSIFIED FORESTED VEGETATION			
DOMINANT SIZE CLASS	TREE SIZES	SIZE CLASS DISTRIBUTION	POTENTIAL OLD GROWTH
Seedling/Sapling	<5"	10%	---
Pole	5"-9"	17%	1%
Small	9"-21"	68%	13%
Medium/Large	21"+	5%	2%
TOTALS		100%	16%

Interior Forest	Late Successional Reserve
<390 Acres	24 Acres

LUMPED PLANT ASSOCIATION	
LPAG	% Acres
Ponderosa Pine	70%
Mixed Conifer Dry	11%
Lodgepole	10%
Juniper Woodland	4%
Mixed Conifer Wet	3%
High Elevation	1%
Meadow	<1%
Aquatic	---
Riparian	---
Special (Non-Forest)	---
TOTAL	100%

FISH/WILDLIFE/PLANT STATUS:

Threatened, Endangered, & Sensitive Fish & WL
- No T&E wildlife species known
- No T&E fish species known
- American Marten (S)
- Wolverine (S)

Survey and Manage Wildlife Species
- Lynx (S&M 3)
- Mollusks (S&M 1,2)

Management Indicator Species
- Deer
- Elk
- Primary and secondary cavity nesters

Threatened, Endangered, & Sensitive (TES) Plants
- No TES plant species known

Survey and Manage Plant Species
- No Survey or Manage plant species known

Special Habitats
- Deer/Elk summer range
- Deer (MA-7) 3922 ac
- Winter Range 17,534 ac
- Summer Range 7684 ac

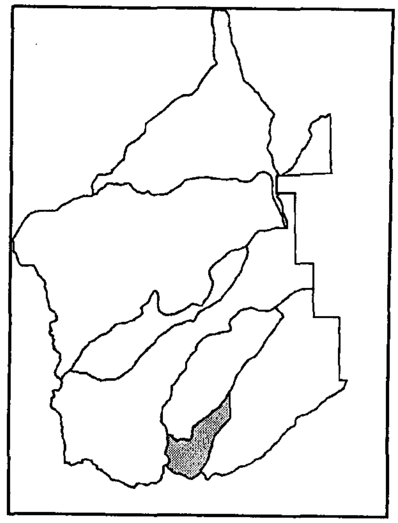
THREE CREEK BUTTE SUBWATERSHED

Subwatershed Unique Attributes:

- Most private land - 70% (9000 acres in proposed Crown Land Exchange)
- Bear Wallow Roadless Area
- Lowest road densities in the watershed (2.2 mi/mi^2)
- Least amount of Late-Successional Reserve (LSR) in the watershed
- Most deer winter range of any watershed
- No documented weed sites
- Scenic Front Country
- Least recreational use of any watershed (most may be snowmobiles)
- Road 370 is popular snowmobile route

Limiting Factors:

- No Stand Exam data, no mortality data - Private land may limit landscape level management
- Least amount of large tree habitat
- Large fires in past (both logging and lightning started)
- Private land on east side has many subdivisions (Harrington Loop, Plainview, etc.)
- Significant amount of urban interface within watershed- needs better monitoring
- Highest mortality in lodgepole pine occurring at high elevations
- NRF (Nesting, roosting foraging) habitat for the northern spotted owl is 13% of the potential acres (3001 ac of potential, 391 ac = NRF)
- Highest amount of NRF in matrix
- Concerns regarding wilderness trespass by snowmobiles
- Wilderness boundary is largely unsurveyed and unposted



THREE CREEK LAKE SUBWATERSHED

Total Acres: 4,466 Ac
% DNF: 100%
% Private: 0%

PHYSICAL:

Road Density: 2.31 mi/mi^2 (0.97 mi/mi^2 = 1^0, 1.35 mi/mi^2 = 2^0)   Riparian Road Density: 2.2 mi/mi^2

Streambank Erosion: Low for both Three and Snow Creeks

Hydrology: Three Creek - major surface flow. Originates as snow melt and spring fed system in wilderness. At wilderness boundary, flow is controlled by lake release. Area below meadow has been slightly modified by ditching. Snow Creek - minor surface flow, snow melt and spring fed system.

AQUATIC:

Stream Name	H2O Temp	Barriers	Substrate	Large Wood	Pool Area	Pool Quality	Off-Channel	Channel Condition
Lower Three Creek	R	N	R	PF	PF	PF	PF	R
Below Three Creek	PF	Dam	PF	PF	PF	PF	PF	PF
Three Creek	PF	R	PF	PF	PF	PF	PF	PF

Aquatic Habitat Ratings: Properly Functioning (PF) At Risk ® Not Properly Functioning (N) Unknown (?)

VEGETATION:

DISTRIBUTION OF VEGETATION		
Forested = 91%	Non-Forest = 9%	Not-Classified = <1%

SIZE DISTRIBUTION OF CLASSIFIED FORESTED VEGETATION			
DOMINANT SIZE CLASS	TREE SIZES	SIZE CLASS DISTRIBUTION	POTENTIAL OLD GROWTH
Seedling/Sapling	<5"	2%	---
Pole	5"-9"	9%	2%
Small	9"-21"	86%	50%
Medium/Large	21"+	4%	2%
TOTALS		100%	54%

Interior Forest	Late Successional Reserve
0 Acres	2,742 Acres

LUMPED PLANT ASSOCIATION GROUPS	
LPAG	% Acres
Lodgepole Pine	42%
High Elevation	24%
Mixed Conifer Wet	17%
Mixed Conifer Dry	6%
Special (Non-Forest)	6%
Aquatic	2%
Riparian	2%
Meadow	<1%
Juniper Woodland	---
Ponderosa Pine	---
TOTAL	100%

FISH/WILDLIFE/PLANT STATUS:

Threatened, Endangered & Sensitive Fish and WL
- ◆No T&E wildlife species known
- ◆No T&E fish species known
- ◆Northern Goshawk (S)
- ◆Tailed Frog (S)
- ◆American Marten (S)
- ◆Wolverine (S)

Survey and Manage Wildlife Species
- ◆Lynx (S&M 3)
- ◆Mollusks (S&M 1,2)

Management Indicator Species
- ◆Mule/Black-tailed Deer
- ◆Elk

Threatened, Endangered, & Sensitive (TES) Plants
- ◆*Carex capitata* (ONHDB Watchlist)
- ◆*Gentiana newberryi* (S)

Survey and Manage Plant Species
- ◆*Elaphomyces subviscidus* (S&M 1,3)
- ◆*Nivagastrium nubigenum* (S&M 1,3
- ◆*Rhizopogon flavofibrillosus* (S&M 1,3)
- ◆*Tritomeria exsectiformis* (S&M 1,2) Potential

Special Habitats
- ◆Springs
- ◆Meadows
- ◆Vegetated, shallow lakes and ponds
- ◆Summer Range for Deer/Elk

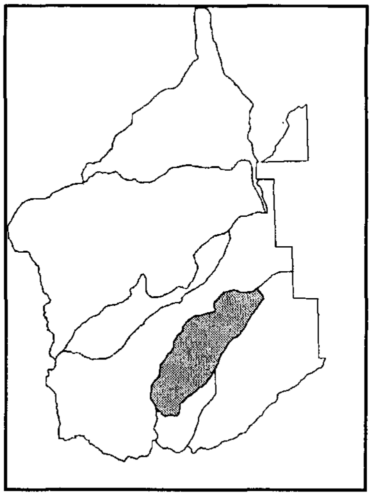
THREE CREEK LAKE SUBWATERSHED

Subwatershed Unique Attributes:

- 100% Forest Service lands
- Scenic Lakes and landscape features(Three Creek Lake, Little Three Creek Lake, Trapper Meadow., Tam McArthur Rim)
- Highest recreational use- increasing day use
- Three campgrounds, one horse camp, four trailheads, small store and boat rentals
- Easy access to subalpine meadows
- Most popular fishing area
- Important winter sports area
- Only entry to Bend Ranger District- access to Cascade Lakes Highway over primitive road
- Important amphibian area, may have new species, rare morphs
- Hot spot for amphibian research. Longest running amphibian monitoring site in the US and probably the world
- Rare fungi
- Highest percentage of high elevation and lodgepole plant association groups - (67%)
- Isolated aquatically
- No documented weed sites
- Least amount of Deer Habitat (MA-7) in watershed

Limiting Factors:

- No stand exams, no mortality data
- Highly visually sensitive
- Short growing season, fragile high elevation ecosystem
- Damage to riparian reserves from trails, horses, hikers, campers
- No nesting , roosting, and foraging (NRF) habitat for the northern spotted owl
- Ditching results in dewatering of meadow
- Meadows have been damaged by off road vehicles, reoccurring
- Dam limits allowable storage due to condition, results in a large draw down which limits riparian vegetation around lake- water rights and ownership issues
- Stands reaching physiological limits - may crash
- Wilderness trespass by snowmobilers
- Wilderness boundaries need surveying and posting



MELVIN SUBWATERSHED

Total Acres: 13,131
% DNF: 74%
% Private: 26%

PHYSICAL:

Road Density: 5.0 mi/ ($4.5\ mi/mi^2 = 2^0$, $0.5\ mi/mi^2 = 1^0$) Riparian Road Density: $9.2\ mi/mi^2$

Streambank Erosion: Not Available

Hydrology: Melvin Spring - spring fed system in ponderosa pine vegetation zone. Stream has been diverted into ditch near head of spring.

AQUATIC:

Stream Name	H2O Temp	Barriers	Substrate	Large Wood	Pool Area	Pool Quality	Off-Channel	Channel Condition
Melvin Spring	PF	PF	N	N	N	N	N	N

Aquatic Habitat Ratings: Properly Functioning (PF) At Risk ® Not Properly Functioning (N) Unknown (?)

VEGETATION:

DISTRIBUTION OF VEGETATION		
Forested = 98%	Non-Forest = 1%	Not-Classified = 1%

SIZE DISTRIBUTION OF CLASSIFIED FORESTED VEGETATION			
DOMINANT SIZE CLASS	TREE SIZES	SIZE CLASS DISTRIBUTION	POTENTIAL OLD GROWTH
Seedling/Sapling	<5"	9%	---
Pole	5"-9"	25%	2%
Small	9"-21"	57%	24%
Medium/Large	21"+	9%	8%
TOTALS		100%	34%

Interior Forest	Late Successional Reserve
0 Acres	244 Acres

LUMPED PLANT ASSOCIATION GROUPS	
LPAG	% Acres
Ponderosa Pine	50%
Mixed Conifer Dry	20%
Lodgepole Pine	17%
Mixed Conifer Wet	12%
High Elevation	1%
Special (Non-Forest)	<1%
Aquatic	---
Juniper Woodland	---
Meadow	---
Riparian	---
TOTAL	100%

FISH/WILDLIFE/PLANT STATUS:

Threatened, Endangered, & Sensitive Fish and WL
- No T&E wildlife species
- No T&E fish species
- American Marten (S)
- Wolverine (S)
- Flammulated Owl (S)

Survey and Manage Wildlife Species
- Lynx (S&M 3)
- Mollusks (S&M 1,2)

Threatened, Endangered, & Sensitive (TES) Plants
- Potential CACH habitat - old population, hasn't been relocated

Survey and Manage Plant Species
- No Survey and Manage Plant Species

Weeds
- *Centaurea diffusa*- Diffuse Knapweed

Management Indicator Species
◆Northern Goshawk

Special Habitats
◆Springs
◆Deer Habitat (MA-7) 630 ac
◆Winter 4436 ac
◆Transition 47 ac
◆Summer 8649 ac

MELVIN SUBWATERSHED

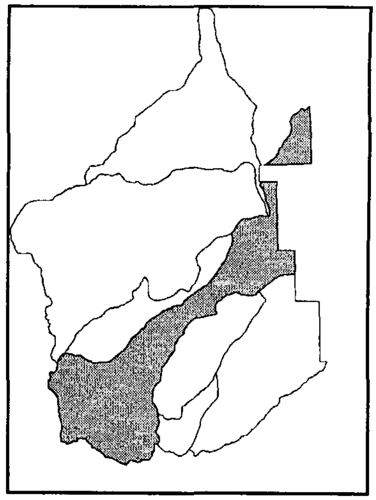
Subwatershed Unique Attributes:

- Road 16 - Easy access and paved - Provides most popular "Driving for pleasure" experience
- Scenic background but not widely visible
- Three Springs - cold water refuges in Ponderosa Pine plant association
- Two popular sno-parks
- Contains the most matrix allocation within the watershed
- No nesting, roosting and foraging (NRF) habitat for the northern spotted owl
- Least percentage of NRF relative to potential (0 acres of NRF : 3184 acres of potential)
- Popular trails- Metolius Windigo, Cross District Snowmobile, nordic and other snowmobile trails
- Mineral Resouces- pits and quarries
- Popular hunting area
- Woodcutting area in lodgepole, Christmas tree gathering of white fir

Limiting Factors:

- Private lands constitute 1/3 of watershed
- Visually disruptive clearcuts
- Diffuse knapweed spreading along Road 16
- High levels of dwarf mistletoe in pines
- Most surface water ditched shortly after emergence into irrigation ditches
- Deer winter range
- Stream/road interactions (streams in some areas are leaving ditches and running on roads)
- Restoration of stream to old channel may cause new road/stream interactions (i.e. running on roads and road culverts not able to handle flows)
- Increasing winter recreation use, little USFS presence due to lack of funding

SQUAW SUBWATERSHED



Total Acres: 40,743
% DNF: 88%
% Private: 12%

PHYSICAL:

Road Density: 4.4 mi/mi^2 Riparian Road Density: 2.6 mi/mi^2
(4.2 mi/mi^2 = 2^0, 0.2 mi/mi^2 = 1^0)

Streambank Erosion: High due to alterations caused by upstream water diversions

Hydrology: Squaw Creek - major surface flow. Largest surface flow in watershed. Snow melt fed system with rapid snow melt meaning high, temporary discharges. Discharge varies between 105 cfs to 2000 cfs.

AQUATIC:

Stream Name	H2O Temp	Barriers	Substrate	Large Wood	Pool Area	Pool Quality	Off-Channel	Channel Condition
Source to SCID	PF	PF	PF	PF	PF	PF	PF	PF
Below SCID	N	N	PF	R	R	R	R	R

Aquatic Habitat Ratings: Properly Functioning (PF) At Risk ® Not Properly Functioning (N) Unknown (?)

VEGETATION:

DISTRIBUTION OF VEGETATION		
Forested = 75%	Non-Forest = 19%	Not-Classified = 6%

SIZE DISTRIBUTION OF CLASSIFIED FORESTED VEGETATION			
DOMINANT SIZE CLASS	TREE SIZES	SIZE CLASS DISTRIBUTION	POTENTIAL OLD GROWTH
Seedling/Sapling	<5"	3%	---
Pole	5"-9"	18%	1%
Small	9"-21"	73%	16%
Medium/Large	21"+	7%	5%
TOTALS		100%	22%

Interior Forest	Late Successional Reserve
2,390 Acres	3,118 Acres

LUMPED PLANT ASSOCIATION GROUPS	
LPAG	% Acres
Ponderosa Pine	36%
High Elevation	16%
Special (Non-Forest)	14%
Mixed Conifer Dry	12%
Mixed Conifer Wet	9%
Lodgepole Pine	7%
Riparian	4%
Juniper Woodland	1%
Meadow	<1%
Aquatic	<1%
TOTAL	100%

FISH/WILDLIFE/PLANT STATUS:

Threatened, Endangered, & Sensitive Fish and WL
- Bald Eagle BECA (T)
- Northern Spotted Owl (T)
- Bull Trout (T)
- Steelhead (Extirpated)
- Chinook Salmon (Extirpated)
- Redband Trout (S)
- Marten (S)
- Fisher (S)
- Wolverine (S)
- Cascades Frog (S)

Threatened, Endangered, & Sensitive (TES) Plants
- *Gentiana newberryi (S)*
- *Penstemon peckii (S)*

Survey and Manage Plant Species
- *Lobaria pulmonaria* (S&M 4)
- *Rhizopogon evadens* v. subalpinus (S&M 1,3)
- *Cladonia norvegica* (S&M 3)
- *Psudocyphellaria anomala* (S&M 4)
- *Peltigera collina* (S&M 4)

- Northern Goshawk (S)

Survey and Manage Wildlife Species
- Lynx (S&M 3)
- Mollusks (S&M 1,2)

Management Indicator Species
- Great Gray Owl
- Golden Eagle
- All Woopeckers
- Mule/Black-tailed Deer
- Elk
- Primary and Secondary Cavity Nesters

Weeds
- *Centaurea diffusa*- Diffuse knapweed

Special Habitats
- Springs
- Large Subalpine Meadows
- Bull Trout Habitat
- Deer Habitat (MA-7) 6486 ac
- Winter 9763 ac
- Transition 4454 ac
- Summer 26,527 ac
- Owl NRF 2390 ac
- Potential Suitable Habitat (Northern Spotted Owls) 11,483 ac

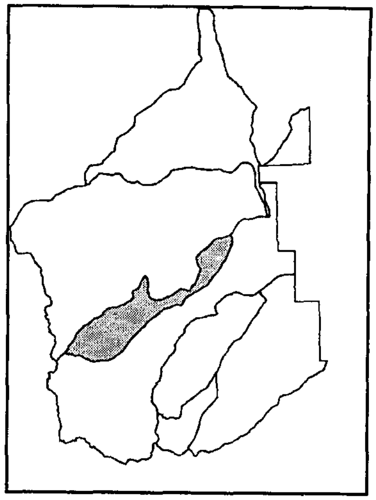
SQUAW SUBWATERSHED

Subwatershed Unique Attributes:

- Flashiest system for peak flows - Influenced by snow melt and run-off where other subwatersheds are more influenced by lake release, meadow release or spring fed systems
- Historic anadromous fish habitat
- Potential reintroduction of anadromous fish
- Unique waterfalls – Squaw Creek Falls
- Wild and Scenic River from the source to the Three Sisters Wilderness boundary, 6.6 miles (WILD); from the Three Sisters Wilderness boundary to the hydrologic gauging station 800 ft. upstream of the intake of the McAllister Ditch, 8.8 miles (SCENIC)
- Most wilderness lakes
- West-side lichens at the edge of their range
- Most dispersed camping both recreational and non-recreational (transients)
- Northern most Newberry's gentian population
- Southern most Peck's penstemon population
- Highest drainage density
- Significant riparian reserves along streams
- High elevation meadows
- Highest percentage of nesting, roosting and foraging habitat (NRF) relative to LSR (44%)
- One reported prehistoric burial site, moderate density of heritage resources
- City of Sisters in subwatershed
- Popular hunting area
- Opportunities for partnerships

Limiting Factors:

- Extensive water diversions in lower reaches dewater creek through town
- Clean Water Act Section 303(d) listing-Water quality limited stream (Low flows and high water temperatures)
- Lack of flow in summer limiting fish habitat and riparian vegetation -Streambank instability
- Hydrologic recovery is limited by floodplain developments and water acquisitions
- Most number of large fires
- Private land is heavily subdivided
- Most serious urban interface problems
- Popular area for non-recreational forest living by transients and others
- High levels of dwarf mistletoe in pine
- Scenic quality on Road 16 needs improvement



POLE SUBWATERSHED

Total Acres: 10,662
% DNF: 95%
% Private: 5%

PHYSICAL:

Road Density: 5.3 mi/mi^2 (All 2^0) Riparian Road Density: 4.1 mi/mi^2

Streambank Erosion: Moderate from stream attempting to re-establish meanders

Hydrology: Pole Creek - major surface flow. Spring fed system with limited regulation by wet meadow release. Some ditching in meadow. Stream has been straightened and channelized in lower reaches.

AQUATIC:

Stream Name	H2O Temp	Barriers	Substrate	Large Wood	Pool Area	Pool Qualit y	Off-Channel	Channel Condition
Pole Creek	PF	N	PF	N	R	R	R	R
North Pole Cr.	PF	PF	PF	PF	PF	PF	PF	PF

Aquatic Habitat Ratings: Properly Functioning (PF) At Risk ® Not Properly Functioning (N) Unknown (?)

VEGETATION:

DISTRIBUTION OF VEGETATION		
Forested = 94%	Non-Forest = 3%	Not-Classified = 3%

SIZE DISTRIBUTION OF CLASSIFIED FORESTED VEGETATION			
DOMINANT SIZE CLASS	TREE SIZES	SIZE CLASS DISTRIBUTION	POTENTIAL OLD GROWTH
Seedling/Sapling	<5"	5%	---
Pole	5"-9"	25%	1%
Small	9"-21"	63%	27%
Medium/Large	21"+	7%	6%
TOTALS		100%	34%

Interior Forest	Late Successional Reserve
1,249 Acres	1,657 Acres

LUMPED PLANT ASSOCIATION GROUPS	
LPAG	% Acres
Lodgepole Pine	29%
Mixed Conifer Wet	25%
Ponderosa Pine	23%
Mixed Conifer Dry	18%
Special (Non-Forest)	2%
Riparian	1%
High Elevation	1%
Aquatic	---
Juniper Woodland	---
Meadow	---
TOTAL	100%

FISH/WILDLIFE/PLANTS STATUS:

Threatened, Endangered, & Sensitive Fish and WL
- Northern Spotted Owl (T)
- Wolverine (S)
- Marten (S)
- Fisher (S)

Survey and Manage Wildlife Species
- Lynx (S&M 3)
- Mollusks (S&M 1,2)

Threatened, Endangered, & Sensitive (TES) Plants
- No TES plant species

Survey and Manage Plant Species
- *Rhizopogon evadens* v. subalpinus (wilderness - east slope of N. Sister) (S&M 1,3)

Weeds
- *Senecio jacobaea*- Tansy Ragwort

Management Indicator Species
- Great Gray Owl
- Pileated ,White-headed,Black-backed Woodpecker
- Primary and secondary cavity nesters

Special Habitats
- Cold Springs
- Meadows/wetlands
- Deer Transition 2429 ac
- Deer Summer 8233 ac
- Deer Habitat (MA-7) 421 ac

POLE SUBWATERSHED

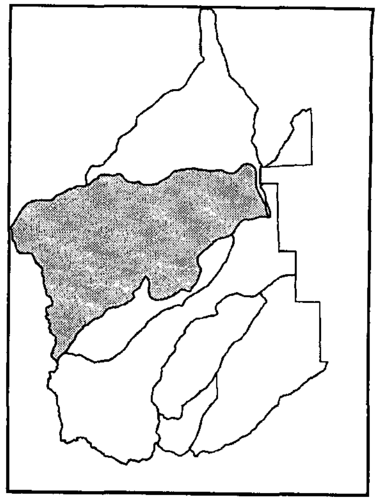
Subwatershed Unique Attributes:

- Municipal water supply for City of Sisters and irrigation water
- Pole Creek Swamp unique habitat
- Scenic background from popular viewpoints
- Road 15 is major access to wilderness, popular Pole Creek trailhead
- Woodcutting in lodgepole
- Cold water temperatures

Limiting Factors:

- Creek flows diverted for municipal water supply
- Creek flows diverted from Pole Creek Swamp
- Creek is channelized
- Winter ice dams
- Nesting, roosting, foraging habitat (NRF) (34% of potential acres available)
- Least amount of CHU (Critical Habitat Unit) for Spotted owls

TROUT SUBWATERSHED



Total Acres: 55,360
% DNF: 82%
% Private: 18%

PHYSICAL:

Road Density: 5.95 mi/mi^2 (5.23 mi/mi^2 = 2^0, 0.72 mi/mi^2 = 1^0)

Riparian Road Density: 4.7 mi/mi^2

Streambank Erosion:Low in a limited number of locations

Hydrology: Trout Creek - major surface flow. Spring fed system with limited regulation by wet meadow release. Some ditching of meadow. Cold Spring - spring fed system in Ponderosa Pine vegetation type. Black Pine Spring - spring fed system in Ponderosa Pine vegetation type. Has been diverted into ditch near head of stream.

AQUATIC:

Stream Name	H2O Temp	Barriers	Substrate	Large Wood	Pool Area	Pool Quality	Off-Channel	Channel Condition
Trout Creek	PF	R	PF	PF	PF	PF	PF	PF

Aquatic Habitat Ratings: Properly Functioning (PF) At Risk ® Not Properly Functioning (N) Unknown (?)

VEGETATION:

DISTRIBUTION OF VEGETATION		
Forested = 76%	Non-Forest = 15%	Not-Classified = 9%

SIZE DISTRIBUTION OF CLASSIFIED FORESTED VEGETATION			
DOMINANT SIZE CLASS	TREE SIZES	SIZE CLASS DISTRIBUTION	POTENTIAL OLD GROWTH
Seedling/Sapling	<5"	6%	---
Pole	5"-9"	15%	2%
Small	9"-21"	64%	18%
Medium/Large	21"+	16%	14%
TOTALS		100%	34%

Interior Forest	Late Successional Reserve
6,914 Acres	12,371 Acres

LUMPED PLANT ASSOCIATION GROUPS	
LPAG	% Acres
Ponderosa Pine	31%
Mixed Conifer Dry	27%
High Elevation	14%
Special (Non-Forest)	11%
Mixed Conifer Wet	8%
Lodgepole Pine	8%
Meadow	<1%
Riparian	<1%
Aquatic	<1%
Juniper Woodland	---
TOTAL	100%

FISH/WILDLIFE/PLANTS STATUS:

Threatened, Endangered, & Sensitive Fish and WL
- 2 Northern Spotted Owl Nest Sites (T)
- Redband Trout (S)
- Northern Goshawk (S)
- Wolverine (S)
- Marten (S)
- Fisher (S)

Threatened, Endangered, & Sensitive (TES) Plants
- *Penstemon peckii (S)*

Survey and Manage Plant Species
- *Cantharellus subalbidus* (S&M 3,4)
- *Gomphus floccosus* (S&M 3)

Survey and Manage Wildlife Species
◆Lynx (S&M 3)
◆Mollusks (S&M 1,2)

Management Indicator Species
◆All Woodpeckers

Special Habitats
◆Springs (Trout Creek, Twin Meadows)
◆Forested wetlands/Open wetlands
◆Deer Habitat (MA-7) 1519 ac
  ◆Transition Range 16,408 ac
  ◆Summer Range 38,956 ac

Weeds
◆*Centaurea diffusa*-Diffuse knapweed
◆*Centaurea maculosa* Spotted knapweed
◆*Senecio jacobaea*- Tansy Ragwort
◆*Linaria dalmatica*- Dalmation toadflax

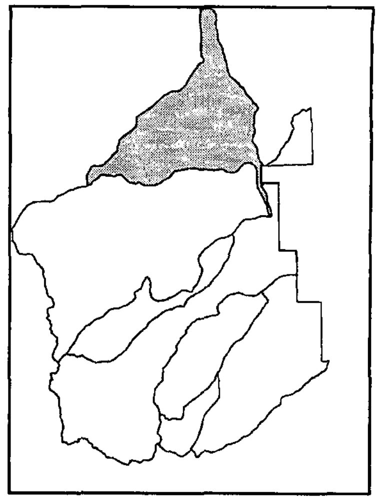
TROUT SUBWATERSHED

Subwatershed Unique Attributes:

- Largest subwatershed
- Second highest amount of wilderness in watershed
- Redband trout population
- Low surface stream densities
- Trout Creek "sinks" in lower reaches, flowing subsurface most of the time and only connecting with Indian Ford Creek during rare, winter flood events
- Highest road densities in the watershed (6.0 mi/mi^2)
- McKenzie Highway – popular scenic drive, lava flows, winter recreation use
- Popular recreation sites- Cold Springs, Black Crater Trail, Pacific Crest Trail
- Most deer transition range but least amount of deer winter range
- Most late-successional reserve (LSR), Critical Habitat Unit (CHU) for northern spotted owl, and nesting, roosting, and foraging (NRF) habitat acres within watershed
- Contains the highest number of northern spotted owl pairs within watershed (2)
- Highest potential plant association group (PAG) for developing owl habitat (18,730 ac)
- Largest number of acres within the "Old Growth" Management Area (493 ac)
- Historic Trout Creek Butte Lookout

Limiting Factors:

- Highest level of mortality occurring in Mixed Conifer Wet or Mixed Conifer Dry plant association groups
- Most documented weed sites in watershed (6)
- Dewatering of meadows (Trout Creek Swamp) resulting from ditching and possible road/meadow interaction
- Intermittent flows in Trout Creek
- Limited streamside vegetation due to clear cuts down to stream edge
- Spruce Springs developed as water supply
- Increasing urban interface



INDIAN FORD SUBWATERSHED

Total Acres: 28,248
% DNF: 72%
% Private: 28%

PHYSICAL:

Road Density: 4.0 mi/mi^2 (3.3 mi/mi^2 = 2^0, 0.6 mi/mi^2 = 1^0) Riparian Road Density: 3.9 mi/mi^2

Streambank Erosion: Low due to low stream gradient.

Hydrology: Indian Ford Creek - major surface flow. Spring fed system influenced by extensive wet meadow release. Some meadow ditching has occurred but little affect on bank erosion. Water diversion for irrigation causes total dewatering of stream in dry periods.

AQUATIC:

Stream Name	H2O Temp	Barriers	Substrate	Large Wood	Pool Area	Pool Qualit y	Off-Channel	Channel Condition
Indian Ford	N	PF	R	PF	PF	PF	PF	PF

Aquatic Habitat Ratings: Properly Functioning (PF) At Risk ® Not Properly Functioning (N) Unknown (?)

VEGETATION:

DISTRIBUTION OF VEGETATION		
Forested = 88%	Non-Forest = 4%	Not-Classified = 8%

SIZE DISTRIBUTION OF CLASSIFIED FORESTED VEGETATION			
DOMINANT SIZE CLASS	TREE SIZES	SIZE CLASS DISTRIBUTION	POTENTIAL OLD GROWTH
Seedling/Sapling	<5"	5%	---
Pole	5"-9"	21%	2%
Small	9"-21"	57%	14%
Medium/Large	21"+	16%	13%
TOTALS		100%	29%

Interior Forest	Late Successional Reserve
2,711 Acres	6,610 Acres

LUMPED PLANT ASSOCIATION GROUPS	
LPAG	% Acres
Ponderosa Pine	69%
Mixed Conifer Dry	21%
Mixed Conifer Wet	5%
Meadow	3%
Riparian	2%
Lodgepole Pine	<1%
Special (Non-Forest)	<1%
Aquatic	<1%
High Elevation	---
Juniper Woodland	---
TOTAL	100%

FISH/WILDLIFE/PLANT STATUS:

Threatened, Endangered, & Sensitive Fish and WL
- Northern Spotted Owl (T)
- Redband (S)
- Northern Goshawk (S)
- Flammulated Owl (S)
- Pygmy Owl (S)

Threatened, Endangered, & Sensitive (TES) Plants
- *Penstemon peckii (S)*

Survey and Manage Plant Species- None known

Weeds
- *Centaurea maculosa*- Spotted knapweed
- *Cirsium vulgare*- Bull thistle

Survey and Manage Wildlife Species
◆Lynx (S&M 3)
◆Mollusks (S&M 1,2)

Management Indicator Species
◆Primary and Secondary Cavity Nesters

Special Habitats
◆Low elevation wetlands
◆Springs
◆Deer Habitat (MA-7) 6924 ac
◆Winter 7631 ac
◆Transition 14,113 ac
◆Summer 6507 ac

INDIAN FORD SUBWATERSHED

Subwatershed Unique Attributes:

- Extensive riparian and wetland habitats including large low elevation meadows
- Second largest *Penstemon peckii* population known to exist and comprises 12% of global *Penstemon peckii* population
- Flows result from spring fed systems regulated by extensive meadow release, resulting in stable flows
- Most deer habitat (MA-7) 6924 ac
- Greatest percentage of nesting, roosting, and foraging (NRF) habitat relative to potential (2711 ac of NRF : 3163 ac of potential = 86%)
- Aspen groves
- Major Highway (Highway 20) bisects subwatershed
- Important old growth areas- Metolius "Old Growth" Management Area acres (1926 ac or 7%)
- Highest percent of stands in medium/large tree structure
- Highest mortality in high elevation zone
- Historic wagon roads
- Moderately high density of heritage resources

Limiting Factors:

- Diverted flows result in reduced flows, high water temperatures, and low dissolved oxygen levels
- Loss of riparian vegetation by grazing and removal of willows on private lands
- Nutrient enriched effluent and riparian camping lowers water quality
- Greatest number of deer/vehicle collisions along Highway 20
- Regeneration in Aspen stands is limited
- Lots of urban interface
- Point source pollution- Treated sewage effluent (nutrient rich) from Black Butte Ranch enters Indian Ford Creek in winter
- Raw sewage spill in 1997
- Fast speeds on Highway 20 limit opportunities to enjoy scenery, stops
- Removing old allotment fence may allow vehicle trespass

WHY-CHUS WATERSHED ANALYSIS

TRENDS

TREND	CAUSE	PROCESSES AFFECTED (ECOLOGICAL and SOCIAL)	RESOURCES AT RISK
Reduced stream flows during summer months **Trend 1**	Dewatering through stream diversion for irrigation use	Complete dewatering of some streams during summer months Lack of connectivity to down stream flows and increased water temperatures Loss of riparian vegetation along streams due to drying out during summer months Increased bank erosion due to lack of riparian vegetation Groundwater Recharge	Fish and Wildlife habitat and populations Riparian vegetation Streambank stability Water temperatures – Match to 303(d) Treaty rights for fishing
Reduction in riparian vegetation along streams Decrease in riparian habitat effectiveness **Trend 2**	Grazing on private and public lands Willow removal on private lands Dewatering caused by irrigation diversions Unscreened diversions Fire exclusion Loss of beaver User trails and campgrounds in riparian reserves	Increased bank erosion due to lack of riparian vegetation Reduced sediment filtration provided by riparian vegetation Reduced shading of water resulting in increased water temperatures Function of special habitats Nutrient input into streams supporting invertebrates	Fish and instream habitat Riparian species habitat/ populations Water quality Cultural plants protected by treaty rights
Decrease in cottonwood galleries and aspen and localized increase in structure and shrubs in some riparian areas **Trend 3**	Channelization and drainage Loss of beaver Fire exclusion Dewatering Timber harvest	Habitat function Water storage and release Growth and recruitment of cottonwoods and other species Natural succession	Neotropical migrant bird habitats and populations Aquatic species habitat Survey and manage species (lichens, wildlife, mollusks, and bryophytes)

TREND	CAUSE	PROCESSES AFFECTED (ECOLOGICAL and SOCIAL)	RESOURCES AT RISK
Hardening and channelization in lower reaches of Squaw Creek **Trend 4**	Flood control measures	Loss of sinuosity resulting in increased energy and increased bank erosion and down cutting of stream Channel formation	Fish and instream habitat Floodplain habitat Peck's penstemon habitat
Blocking of overflow channels in lower reaches of Squaw Creek **Trend 5**	Flood control measures	Concentration of high flows in main channel resulting in accelerated bank erosion Loss of energy disipation provided by overflow channels Loss of periodic scouring of floodplains Cottonwood growth and regeneration	Fish and instream habitat Floodplain habitat Peck's penstemon habitat Cottonwood galleries
Decrease in size and quality of wetlands and wet meadows **Trend 6**	Ditching Water diversion Fire exclusion	Hydrology Reproductive success Species composition	Species associated with special habitats Late summer flows Aquatic connectivity
Removal of large wood in and adjacent to streams and wetlands **Trend 7**	Timber harvest Channel clearing to protect irrigated dams Public water supply and demand	Pool development Flooding pattern Habitat development for survey and manage species, wildlife species, and aquatic species	Fish habitats and populations Survey and manage plant and wildlife habitat and populations Riparian soils and function
Increase in detrimental soil impacts, mainly detrimental soil compaction – trend has peaked **Trend 8**	Timber harvest Roading	Reduced soil productivity Reduced seedling survival Increased root disease associated with compaction Reduced water infiltration rates in compacted areas increasing run-off	Site productivity and tree growth Water quality Fish and wildlife habitat Heritage resources Scenic quality

TREND	CAUSE	PROCESSES AFFECTED (ECOLOGICAL and SOCIAL)	RESOURCES AT RISK
Increased run-off due to roads Decreased road maintenance **Trend 9**	Concentration of channelized water Increase in compaction on roads and landscape – changes infiltration rates Decreasing budgets and commercial activities which performed maintenance	Increased peak flows Sediment delivery Disruption of hydrologic process	Water quality Fish and wildlife habitat Riparian species habitat and populations Recreation traffic flow
Increased fuel loadings and increased risk of high intensity fires in PP, MCW, and MCD PAGs. Shift from a complex moderate fire severity regime in all PP, MCW, and MCD PAGs. Fire sizes and intensities have been increasing in the PP and Juniper PAGs. **Trend 10**	Fire exclusion Increased population growth Denser forests Increase in cheatgrass Insects and disease	Fire behavior/intensity Natural succession Age class distribution Insect and disease susceptibility	Late successional habitat and species Bald eagle habitat Dispersal habitat Forest/urban interface homes Big game forage, esp. winter range Firefighter/public safety Urban interface areas
Increase in human started fires, especially in the PP PAG near forest urban interface **Trend 11**	Increased population growth and use Urban interface development Fire exclusion	Fire behavior/intensity Natural succession Age class distribution Insect and disease susceptibility	Late successional habitat and species Bald eagle habitat Dispersal habitat Big game forage, esp. winter range Forest/urban interface homes Private forest lands Firefighter/public safety Urban interface areas

TREND	CAUSE	PROCESSES AFFECTED (ECOLOGICAL and SOCIAL)	RESOURCES AT RISK
Increased management to reduce fuels (mowing, thinning, burning, etc.) to lower wildfire risks and benefit fire evolved ecosystems **Trend 12**	Increased risk of extreme fire behavior Forest /urban interface homes Desire to reintroduce fire	Fire behavior/intensity Natural succession Age class distribution Insect and disease susceptibility	Late successional habitat and species Dispersal habitat Big game forage, esp. winter range Firefighter/public safety Urban interface areas
Increased need for additional fire camp sites **Trend 13**	Wildfire risk Urban interface Safety and costs	Efficiency Less transportation time for crews and equipment Fire behavior/intensity	Firefighter/public safety Late successional habitat and species Dispersal habitat Big game forage, esp. winter range Urban interface areas
Increase in management may cause blowdown in some lodgepole stands **Trend 14**	Timber harvest Unit design and layout Wind	Fire behavior Natural succession Insect and disease susceptibility Natural decay and recruitment	Focal species for the lodgepole PAG Soils
Decrease in med/large tree structure in MCW, MCD, PP, and Riparian PAGs **Trend 15**	Timber harvest Fire exclusion Insects and disease Roads Hazard tree reduction Land ownership patterns	Natural succession Reproductive success Fire behavior Predation Gene flow Microclimate Connectivity Nutrient cycling	Eagle/osprey nest sites NRF habitat for spotted owls, late successional species Woodpecker habitat Furbearer habitat Stream shading Loss of large wood imput into streams and forests

TREND	CAUSE	PROCESSES AFFECTED (ECOLOGICAL and SOCIAL)	RESOURCES AT RISK
Landscape Patterns have changed in PP, MCD, MCW, and Riparian PAGs. Fragmentation and edge have increased and patch size and connectivity have decreased **Trend 16**	Timber Harvest Fire exclusion Roads Increased Population Growth Land Ownership Patterns Conversion of agriculture lands to developments	Natural Succession Reproductive Success Fire Behavior Predation Gene Flow Microclimate Loss of Stand Stability Age Class Distribution Competition Migration	Late successional and interior forest species and habitats Dispersal ability of late successional species (spotted owls) Neotropical migrant bird species Low mobility species Deer and elk security Visual quality
Species composition has changed in MCD and MCW from pioneer species dominated stands to climax species dominated stands to white fir dominated stands. Stand densities have increased and vertical structure is more complex in PP, MCW, MCD PAGs Juniper has increased in the PP PAG. Increase in shrub component and decrease in grass and forb component **Trend 17**	Fire exclusion Timber Harvest Historic livestock grazing on grasses and forbs	Natural Succession Reproductive Success Fire Behavior Predation Grassland development Microclimate Loss of stand stability Age class distribution Insect and disease disturbance and susceptibility Disturbance processes	Late successional species and habitats Future nesting, roosting, and foraging habitat for spotted owls DF and PP associated species, especially woodpeckers and goshawks Forest structure Riparian reserves Juniper/grassland habitat and associated species Firefighter/public safety
Increase in old growth in Lodgepole and High Elevation PAGs. Decreased stand age diversity. **Trend 18**	Fire exclusion	Fire behavior Natural succession Loss of stand stability Insect and disease susceptibility Prey base cycling	Focal species for each PAG (i.e., black-backed woodpecker) Tree encroachment on high elevation meadows

TREND	CAUSE	PROCESSES AFFECTED (ECOLOGICAL and SOCIAL)	RESOURCES AT RISK
Decrease in connectivity between riparian reserves and uplands **Trend 19**	Timber harvest Roads Irrigation diversions	Natural succession Reproductive success Fire behavior Predation Gene flow Microclimate	Spotted owl dispersal habitat Survey and manage species habitat Aquatic species habitat
Decrease in large snags and down woody material **Trend 20**	Timber harvest Firewood cutting Hazard tree reduction	Natural Succession Reproductive Success Fire Behavior Predation Microclimate Natural decay and recruitment Nutrient cycling	Snag and log dependent species and nesting/denning habitat for woodpeckers, marten, fisher, etc. Aquatic species habitat Stream shading Loss of large wood input to streams and forests
Decrease in Late successional species and increase in early and mid seral species **Trend 21**	Timber harvest Fire exclusion Urban interface	Reproductive success Predation	Proposed, endangered, threatened, sensitive, and survey and manage species
Degradation/encroachment of meadows and special habitats **Trend 22**	Irrigation diversions Channelization Ditching Fire exclusion Timber harvest	Reproductive success Predation Genetic fitness Fire behavior Microclimate Stream flow Water quality	Great gray owl nest sites Townsends big eared bats – cave vandalism Aquatic species - habitat loss

TREND	CAUSE	PROCESSES AFFECTED (ECOLOGICAL and SOCIAL)	RESOURCES AT RISK
Decrease or extirpation of native fish species **Trend 23**	Dams Irrigation Diversions Dewatering Ditching Channelization Fish stocking – genetic concerns	Gene flow Food chains Aquatic connectivity Migration	Eagle and osprey foraging Aquatic species habitats and populations – unnatural predators Biodiversity Treaty rights Fishing Water quality
Increase in exotic and non-native wildlife and fish species **Trend 24**	Timber harvest Fire suppression Urban interface	Reproductive success Genetic fitness Predation	Neotropical migrant bird species, spotted owl, woodpeckers, fish and aquatic species populations and interactions
Increase in non-native plants **Trend 25**	Weed spread along roads Ground disturbance Contaminated equipment Horses/contaminated feed	Biodiversity Natural succession	Native plant and wildlife species and habitat
Increased contact with Tribes **Trend 26**	Joint projects	Management sensitivity to Federal Trust obligations	Cultural resources Treaty rights
Increasing resident population Increased tourism **Trend 27**	Rapid growth in Deschutes County Central Oregon popularity Increased urban interface	Fire ignitions Fire suppression techniques Forest ecology (reduction in habitat) Compaction, Degradation	Sensitive habitats in popular destinations Urban interface areas Recreational experience Heritage resources Firefighter/public safety

TREND	CAUSE	PROCESSES AFFECTED (ECOLOGICAL and SOCIAL)	RESOURCES AT RISK
Changes in land use and ownership especially the conversion of farm and forest lands into developed lands Homes being built on floodplains Shift towards light industry, tourism, and residential uses **Trend 28**	Increased population Agriculture Limited private lands in Sisters area available for public facilities such as school and sewer plants Limited water	Habitat connectivity Migration Flood processes/flooding homes Water quality/water distribution Fire behavior Natural succession	Experience to urban Loss of sense of place Flood damage to homes Riparian reserves Restoration options Urban interface areas Habitat quantity/quality Terrestrial wildlife and plant species and habitats Fire suppression – loss of resources
Increase in public lands due to land exchanges (1893-1998) **Trend 29**	Timber harvest Economics	Management options Habitat connectivity	Management costs Forest habitats
Continued proposals for land exchanges Decline in potential for future acquisition of private lands Current land ownership pattern limits development **Trend 30**	Developments Land ownership patterns Increasing growth	Management options Habitat connectivity	Management costs Forest habitats Peck's penstemon habitat
Decrease in grazing Lack of funding to monitor grazing **Trend 31**	Economics Environmental concerns Decline in large ranches Increase in small speciality operations raising exotics – llamas, etc.	Erosion Compaction Hydrologic process Habitat quality (introduction of noxious weeds Natural succession Migration (fences)	Aquatic species and habitats Special habitat and associated species Grass dependent species

TREND	CAUSE	PROCESSES AFFECTED (ECOLOGICAL and SOCIAL)	RESOURCES AT RISK
Increase in man-made ponds and irrigation canals **Trend 32**	Irrigation diversions to support agriculture and ranches and also associated with housing and development	Reproductive success Predation Genetic fitness Stream flows Water quality Migration Risk of stream dewatering Pond and chemical spills	Eagle and osprey foraging Aquatic species and habitats
Increased forest/urban interface Illegal dumping, OHV use, trespass **Trend 33**	Private lands surrounded by National Forest Increased population growth in Deschutes County	Fire behavior Natural succession Habitat connectivity Conflicts with traditional uses (hunting and target practice) Migration Reproductive success Predation Microclimate	Heritage resources Forest structure Interior forest species Large tree dependent species Aquatic species Big game forage and cover Quality of life Firefighter/public safety
Continued need for forest commodities, mineral sources, and special forest products (e.g., gravel, mushrooms, firewood, geothermal energy, etc.) **Trend 34**	Population growth Management philosophy	Food chain Natural decay and recruitment Nutrient cycling Changing public desires and values	Proposed, endangered, threatened, and sensitive species Public demand for non-renewable resources Survey and manage species Unique habitats Loss of large wood input to streams and forests

TREND	CAUSE	PROCESSES AFFECTED (ECOLOGICAL and SOCIAL)	RESOURCES AT RISK
Increase in utility easements on public lands – trend has leveled **Trend 35**	Population growth Urban interface – land ownership patterns Increased noxious weed spread Maintenance Technology	Erosion Fire behavior Natural succession Reproductive success Microclimate Migration	Scenic quality Wildlife/plant species and habitats Firefighter/public safety Heritage resources
Increase in road densities – trend has peaked Some unmaintained are closing themselves but need hydrological fix **Trend 36**	Timber harvest Recreational activity Lack of funding for road inventory	Successional patterns Reproductive success of some species Predation Microclimate Hydrologic process Sediment routing	Fish, wildlife and plant habitats Hunting success Heritage resources Recreational experience Special habitats Riparian reserves Disturbance to wildlife species from human presence
Road use has changed from logging to recreation **Trend 37**	Reduced logging Increased resident and tourist population Popularity of driving for pleasure	Management options Difficult and controversial to close roads Recreational funding does not support maintenance	Wildlife, fish, and plant habitats Spread of noxious weeds Safety
Traffic volume on Highway 20 (58%) and Highway 242 (40%) has increased **Trend 38**	Increased resident and tourist population	Migration corridors Spread of noxious weeds	Deer Air quality Recreational experience Safety Sanitation rest stops

TREND	CAUSE	PROCESSES AFFECTED (ECOLOGICAL and SOCIAL)	RESOURCES AT RISK
Increased recreation use including more people, horses, mountain bikes, OHV's, etc. Increased day use Increased dispersed use Increased facilities use More motor home, fewer tents **Trend 39**	Population growth Improved access More and improved facilities/opportunities	Infiltration Erosion Compaction Noxious weed sites Vegetation growth and reproduction Riparian zone function Reproductive success	Heritage resources Facility quality Localized impacts to special habitats (Three Creeks area, subalpine areas, etc.) Disturbance to wildlife and plant species and habitats Riparian habitats Recreational experience
Increase in non-recreational forest camping/living **Trend 40**	Economy – lack of affordable housing Population growth Increased access Riparian habitats created by canals	Floodplain functioning Erosion Compaction Reproductive success Vegetation growth and reproduction	Riparian species and habitats Recreational experience Heritage resources Water quality Disturbance to wildlife and plant species and habitats
Changes in wilderness use Overnight use has declined Day use has increased **Trend 41**	Increasing resident and tourist population	Localized damage to streams and lakes	Trailheads are inadequate Sensitive alpine habitats
Increase in wilderness trespass (i.e., snowmobile use, illegal digging of alpine plants, etc.) **Trend 42**	Lack of Forest Service presence Lack of recreational funding Inadequate signing of wilderness boundary Increased public use Increased populations Changes in recreational use	Reproductive success Migration/travel routes Succession Erosion Predation Genetic fitness	Wolverine, fisher, marten, lynx and other high elevation species Sensitive alpine habitats Recreational experience

TREND	CAUSE	PROCESSES AFFECTED (ECOLOGICAL and SOCIAL)	RESOURCES AT RISK
Scenery has grown in importance Changes in USFS scenery management philosophy to manage for ecological aesthetic **Trend 43**	Popularity of Sisters and Central Oregon Driving for pleasure People's expectations	Natural processes are not always understood or accepted by public	Management options Forest ecology
Degradation of scenic quality **Trend 44**	Timber harvest Fire exclusion Prescribed fire Localized high mortality areas Lack of big trees	Succession Fire behavior Biodiversity Insect and disease susceptibility Connectivity	Desired landscape character Forest ecology
Loss of important heritage resource information through removal of artifacts, development on private lands, and decomposition of wood and metal **Trend 45**	Increased recreational use Increase in population growth		Heritage resources Culturally sensitive plants
Recreation budgets have decreased Facilities need improvements **Trend 46**	General budget decline in Forest Service Increased age of facilities Increased use of facilities	Recreational experience	Localized site damage Quality of experience Safety

Recommendations

<u>Landscape Strategy Areas</u>
<u>Recommendations Common to All areas</u>
<u>Data Gaps</u>

"Never doubt that small groups of thoughtful committed citizens can change the world. Indeed, it's the only thing that ever has." Margaret Mead

"You gotta have a plan.
Otherwise you're like a blind dog in a meat house-
don't know which way to go…"

"Sometimes finding answers is like
trying to find a chicken with lips."

Slater Turner

Landscape Strategy Areas and Recommendations

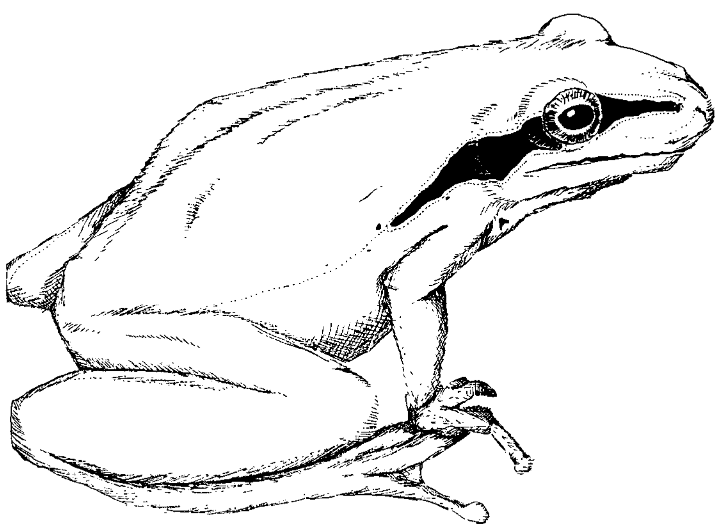
The analysis team divided the Why-chus Watershed analysis area into five **Landscape Strategy Areas**. These areas were delineated after synthesis and integration of trends and assessment of ecosystem risks. Where Strategy Areas are overlapping, several strategies may apply.

Priorities were determined by evaluating significance in terms of connectivity to other areas outside the analysis area, importance to humans and other species, legal requirements, and effects to rare or fragile components. Feasibility was rated by extent of cooperation required, complexity, resource constraints, and cost.

Recommendations are displayed in the narrative below. Recommendations common to all landscape areas follow specific area recommendations. Many problems will require community based solutions and likely partners are identified.

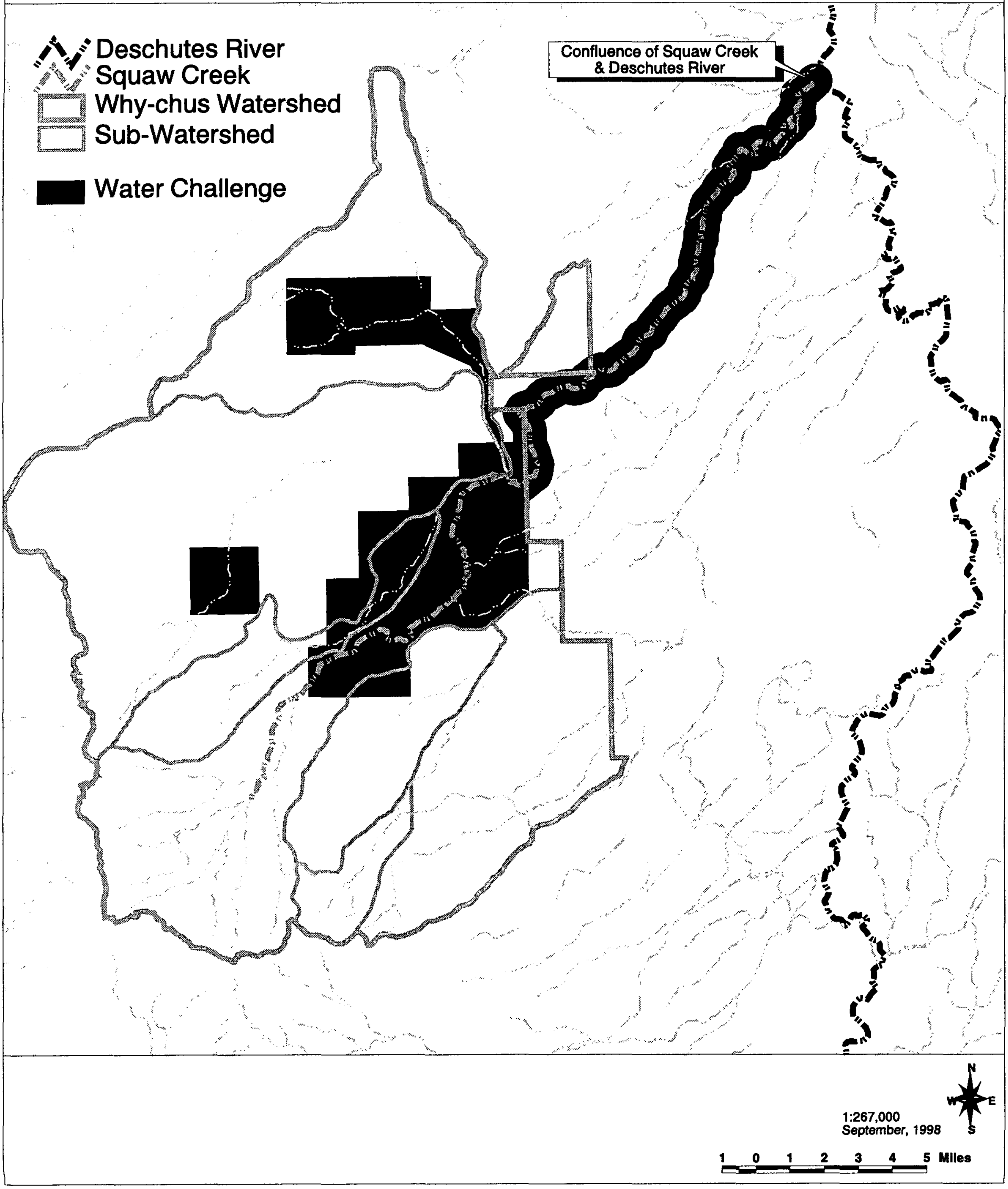
The area was analyzed as one functioning landscape and some recommendations are included that could be implemented on private lands by interested landowners. Private land restoration projects are voluntary.

Further rationale and links to Trends can be found in the Recommendations Work Table in Appendix R-1.



Why-chus Landscape Strategy Areas

Strategy Area 1 - Water Challenge



AREA 1 - WATER CHALLENGES

PRIORITY # 1- *MOST URGENT*
FEASIBILITY- *MOST DIFFICULT*

SUMMARY- Lack of instream water flows has degraded aquatic systems. This has affected fish, threatens other aquatic and riparian dependent species, and restricts restoration efforts. Water quality is degraded and improvements are federally mandated. Water availability and large areas of riparian habitats are under private control. Improvements will require extensive cooperation. Weakened aquatic systems are inherently more unstable. Housing developments are threatened and restoration projects are complicated. Fixes will be costly.

GOALS:

1) Restore stream flows to Squaw Creek, Indian Ford Creek, Pole Creek, and Trout Creek sufficient to provide connected aquatic habitats to the confluence with the Deschutes River.

2) Recover water quality sufficient to meet State water quality standards and support fish and other aquatic species.

3) Restore riparian habitats on private and public lands to enhance stream stability reduce water temperatures and provide habitat.

4) Reduce conflicts between irrigation needs and aquatic systems and species.

5) Encourage development that is compatible with functioning aquatic systems and that does not limit future restoration options.

RECOMMENDATIONS:

1) Work collaboratively with key partners and private landowners to restore stream flows, water quality, riparian and floodplain habitats, fish passage, and preserve restoration options.

***Specific Restoration Actions*:**

Restore flows on Squaw Creek and its tributaries -
- Purchase or lease water rights
- Trade surface water rights for ground water
- Trade effluent for surface water rights
- Return Pole Creek waters to Squaw Creek
- Increase efficiency of irrigation delivery systems to conserve water and make it available for return to streams
- Do a Feasibility Study in cooperation with interested partners to evaluate where water conservation projects would have the greatest effect, i.e., where to trade surface for ground water rights, key surface water areas to improve water quality.

Restore water quality on Squaw Creek and its tributaries
- Complete Water Quality Management Plan for Squaw Creek as required by the Clean Water Act Section 303-D.
- Reduce sedimentation and disturbance (i.e., close ford at Rd 6360)
- Rehab roads, trails, and camps in riparian reserves

Restore streambank, wetland, and floodplain habitats
- Remove berms, restore historic channels of Squaw Creek
- Plant cottonwoods and willow on streambanks with permanent flow
- Evaluate opportunities to restore beaver
- Evaluate/restore Trout Creek and Pole Creek Swamps
- Evaluate/restore Glaze Meadow, Indian Ford Meadow and Big Meadow
- Thin riparian reserves to develop large tree structure (i.e., Pole Creek area)
- Prevent removal of instream wood (i.e., Pole Creek), restore large wood and log jams in key areas
- Rehab roads, trails, and camps in riparian reserves (i.e., Pole creek, Squaw Creek)

Restore fish habitat and populations
- Install fish screens on all irrigation diversions
- Provide fish passage at dams (Pelton/Round Butte and local irrigation)
- Protect fish genetics by reducing interaction between wild and domestic populations

Limit floodplain development
- Purchase or conserve floodplains
- Work with City and County planners to define safe and appropriate locations for development

Manage access and habitat quality for a wide range of species
- Cooperate with private landowners, Ochoco National Forest/ Crooked River Grasslands, BLM, PGE, and Confederated Tribes of Warm Springs to improve habitat effectiveness
- Use land trades, purchases, and conservation easements to "block up" lands as suggested by the Metolius Winter Range Management Plan

KEY PARTNERSHIPS AND PROJECTS:

a. **Deschutes County Watershed Council (DCWC)-** Co-sponsor grants for projects that address watershed issues on private and public lands. Emphasis areas include:

- **Assist DEQ in the development of a Water Quality Management Plan for Squaw Creek to comply with the Clean Water Act- Section 303D**
- ♦ Update agricultural use statistics in the Deschutes Soil and Water Conservation District 1994 Watershed Assessment to better understand agricultural trends in the area and develop opportunities for water conservation.
- Community education and restoration projects to protect and restore riparian habitats, instream wood adjacent to private housing, and floodplains.
- Community education to reduce non-point and point source pollution related to agriculture and development
- Community education about watershed stewardship including volunteer and school involvement in watershed monitoring and restoration projects
- Cooperation with irrigators to conserve water and return it to instream use, screen ditches and provide fish passage at diversions
- Facilitate and help fund water and land acquisition, leases, or conservation easements

b. Deschutes Resource Conservancy (DRC) Co-sponsor grants to fund projects that address watershed issues on private and public lands. Emphasis areas include:
- Financing water acquisition, water leases, and water conservation projects
- Financing acquisition of significant riparian and floodplain habitats

c. City of Sisters- Collaborate with the city on the following emphasis areas:
- Opportunities for Sisters Sewer System to benefit Squaw Creek
- Options to reduce or eliminate use of Pole Creek as municipal water supply, re-water Pole Creek Swamp and restore Pole Creek as a tributary of Squaw Creek
- Options to restore large wood which has been removed from Pole Creek
- Education and prevention of non-point and point pollution and riparian habitat protection associated with housing in the Squaw Creek floodplain
- City planning to protect Squaw Creek floodplain from development
- Improvements to the Sisters City Park to restore habitats and channel stability

d. Squaw Creek Irrigation District (SCID)- Collaborate with SCID on the following emphasis areas:
- Restoring fish passage through irrigation dams on Squaw Creek
- Conserving Squaw Creek water flows and returning water to instream use
- Explore options for replacing surface water with ground water for irrigation
- Install fish screens on all irrigation ditches
- Prevent loss of native fish into ditches and prevent fish in irrigation ponds from entering Squaw Creek to preserve genetic integrity

e. Oregon Department of Fish and Wildlife (ODFW)- Collaborate with the ODFW regarding the Squaw Creek fishery and other riparian and aquatic species through the following emphasis areas:
- **Facilitate fish screens on all irrigation ditches on Squaw Creek and Indian Ford Creek**
- Facilitate restoring fish passage through irrigation dams on Squaw Creek
- Community education on preventing fish kills related to illegal water diversions and pond chemical treatments
- Community education on importance of protecting genetic purity and health of wild fish by preventing pond fish from entering stream systems
- **Resolution of who owns the fish in irrigation canals**
- Explore opportunities for beaver reintroduction

f. Pelton /Round Butte License Holder (FERC) Collaborate with license holder regarding Squaw Creek wildlife habitat and fishery through the following emphasis areas :
- **Provide fish passage at Round Butte/Pelton Dam**
- Purchase of water rights
- Purchase of riparian or floodplain habitats
- Funding watershed restoration projects

g. Deschutes Soil and Water Conservation District and National Resource Conservation Service (NRCS)- Collaborate with the District and NRCS to implement priority actions identified in the Districts 1994 Watershed Assessment. Priority actions identified in the 1994 report include:

- Water Conservation Project- Squaw Creek Irrigation canal lining or piping. (First stage, McKenzie Canyon Project, originally scheduled for 1995 has not been completed.)

- City of Sisters conversion from septic to wastewater treatment facility.
- Bio-engineering projects on Squaw Creek (First stage Sisters City Park streambank stabilization and cleanup, i.e., remove cement blocks from old bridge on Hwy 20, riparian plantings)
- Work to conserve water and improve practices on private lands affecting Squaw Creek, Three Creeks and Indian Ford Creek. Emphasis areas include:

- Projects to conserve irrigation water and return it to instream use
- **Improve agricultural practices to reduce point and non-point pollution**
- **Help work with landowners and irrigators to facilitate the development of the Water Quality Management Plan required by the Clean Water Act Section 303-D**

h. Oregon Water Trust-(OWT)- Collaborate with OWT to restore water flows. Emphasis areas include:
- Purchase or lease water rights
- Public education on conservation opportunities through water rights purchase or leases

i. Deschutes Basin Land Trust (DBLT)- Collaborate with DBLT and private landowners to protect Squaw Creek, Indian Ford Creek, and Trout Creek subwatersheds. Emphasis areas include:
- Land purchases or Conservation Easements to protect significant riparian and floodplain habitats
- Community education regarding protection of riparian , floodplain and other habitats for the future
- Work with Sisters School and Tollgate to enhance and protect Peck's penstemon on the Sisters School/Trout Creek Conservation Easement

j. Deschutes and Jefferson County - Collaborate with the Counties on the following areas:
- Education and prevention of non-point and point pollution and riparian habitat protection associated with housing in the Squaw Creek, Indian Ford, and Trout Creek floodplain
- County planning to protect Squaw Creek floodplain from development

k. Private land owners- Collaborate with private landowners on the following emphasis areas:
- Restoring fish passage on private irrigation dams
- Conserving Squaw Creek water flows and returning water to instream use
- Community education on importance of protecting genetic purity and health of wild fish by preventing pond fish from entering stream systems
- Restoring riparian areas on private lands including cottonwood galleries

2) Prepare for listing of Indian Ford Creek listed under the next Clean Water Act Section 303 D review. Work proactively with Deschutes County Watershed Council, NRCS, Deschutes Soil and Water District, Black Butte Ranch and private landowners to increase awareness and improve water quality on Indian Ford Creek.

Specific Restoration Actions

- **Update Management Plan for Indian Ford Grazing Allotment**
- Explore options to eliminate point source pollution of Indian Ford Creek by Black Butte Ranch sewage system. The major concerns are winter discharges of nutrient rich effluent and raw sewage spills.
- Work with private landowners to restore large areas of riparian habitats along Indian Ford Creek, including Black Butte Ranch's Big Meadow and Glaze Meadow. In these areas, virtually no riparian vegetation remains due to grazing and active removal. Management of as little as a 10 foot riparian

zone would improve conditions.

- Explore options with landowners for conservation of irrigation water and return to instream
- Explore options with landowners for purchase or lease of water rights and return to instream

3) Trout Creek

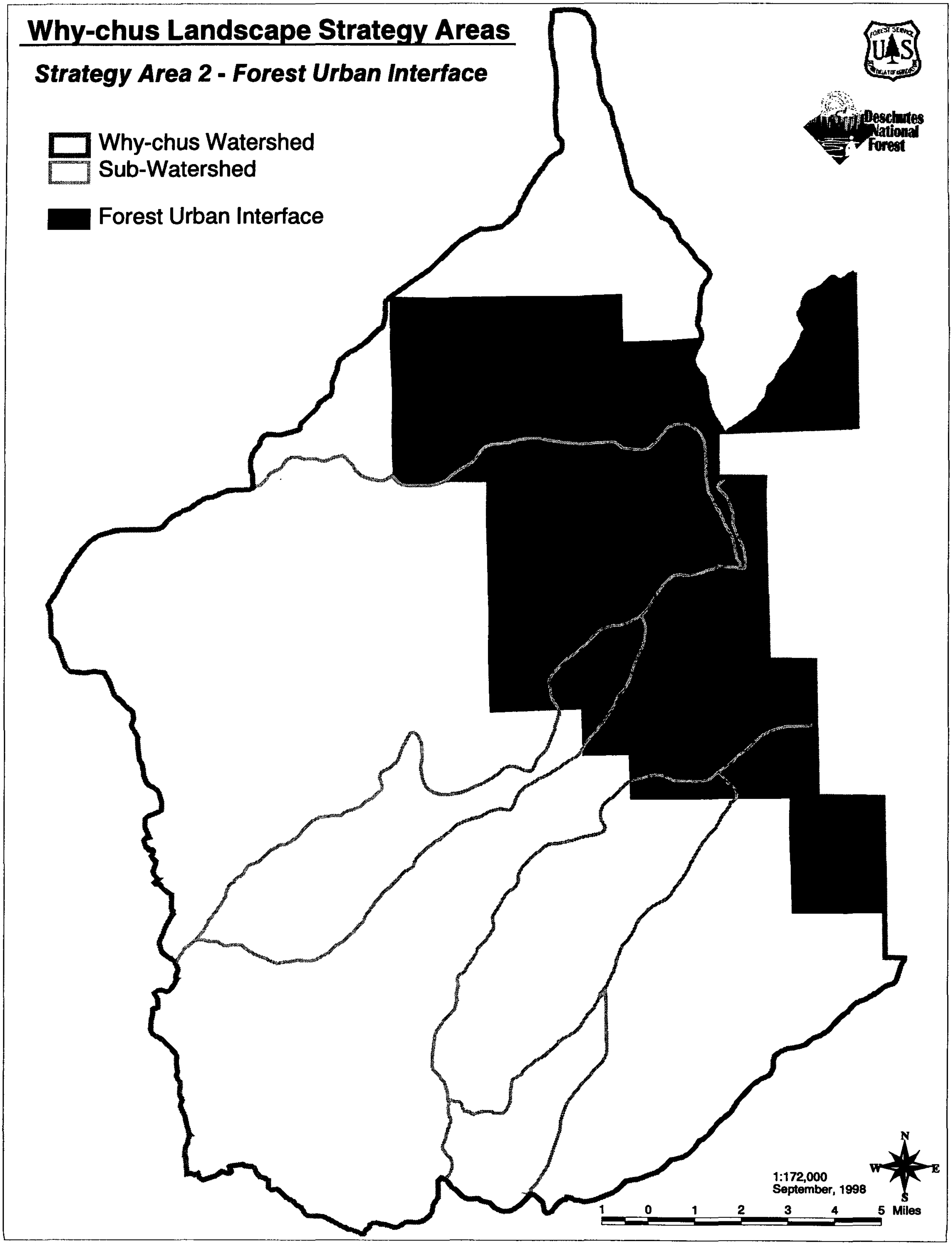
- Trout Creek Swamp -High priority for evaluation/restoration
- Eliminate horse watering along Trout Creek associated with Whispering Pines horse camp. Design and build a gravity feed horse watering tank.
- Reduce dispersed camping in Riparian Reserves- rehabilitate dispersed roads, trails and camps within reserves
- Work with appropriate agencies regarding protection of Trout Creek floodplain and reducing conflicts with private homes in floodplain without channelization/routing

<u>Key Monitoring Actions</u>:

1) **Monitor Water quality on Squaw Creek**
2) **Monitor Water quality on Indian Ford Creek**

<u>Key Data Needs</u>:

1) **Feasibility Study for well sites, water purchase (as discussed above)**
2) **Update Agricultural use statistics in Deschutes Soil and Water Conservation District 1994 Squaw Creek Watershed Analysis to understand agricultural trends relevant to water use.**


Why-chus Landscape Strategy Areas
Strategy Area 2 - Forest Urban Interface
Why-chus Watershed
Sub-Watershed
Forest Urban Interface
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AREA 2 - FOREST URBAN INTERFACE

PRIORITY # 2- *URGENT*
FEASIBILITY- *DIFFICULT*

SUMMARY- Population growth and development in the Sisters area are directly and indirectly affecting public forest lands and related resources. Most wildfires are started by humans in the pine forest/urban interface area. Most large stand replacement fires are started in this area and threaten homes and forest habitats. Illegal or harmful activities are increasing, including dumping, resource damage by off road vehicles, illegal woodcutting, careless use of firearms, and trespass. Lack of affordable housing for resort workers and low-income families and lack of emergency shelters is leading people to live in the forests for long periods of time. Noxious weed populations are rapidly expanding in this area, helped by ground disturbance associated with road maintenance, construction, and spread by vehicles. Easements and maintenance for utility lines to private inholdings cumulatively fragment forest habitats and introduce disturbance and weeds.

GOALS:

1) Protect urban forest interface areas to maintain scenic quality, watershed function, and habitat values. Accommodate urban/forest interface users and neighbors while protecting public forestlands.

2) Reduce urban interface fires starts and reduce the risk of high intensity stand replacement fires.

3) Reduce resource damage in the urban interface, i.e. reduce dumping, off-road vehicle damage, illegal tree cutting, trespass, weed spread, and firearm use that threatens forest users or protected wildlife.

4) Reduce non-recreational forest living/camping.

5) Reduce cumulative impacts of utility easements across public forestlands. Maintain scenic quality, reduce maintenance-related disturbance, weed spread and habitat fragmentation.

6) Promote orderly and environmentally benign patterns of development. Look for opportunities to reduce the amount of future forest/urban interface,

RECOMMENDATIONS:

1) Work collaboratively with key partners and private landowners to develop community-based stewardship and protect urban interface forests.

KEY PARTNERSHIPS AND PROJECTS:

a. Collaborate with partners listed below and other landowners to increase awareness of forest /urban interface problems, stewardship, and internal policing.

Public and Agency Partners:

Local Law Enforcement
Deschutes County Watershed Council (DCWC)
Oregon State Department of Forestry
Oregon Department of Fish and Wildlife
City of Sisters

Homeowners Associations:

Indian Ford Meadow
Pine Ridge,
Starr Ranch
Ridge at Indian Ford
The Hill
Sage Meadow
High Meadow
Squaw Back
Buck Run
Pine Meadow Ranch
Trapper Point
Crossroads
Tollgate
Black Butte Ranch
Cascade Meadow Ranch

Specific Restoration Actions:

- Education regarding fire prevention and making homes more fire safe
- Cooperative projects to reduce interface fuels and allow prescribed fire
- Community policing of dumping trash, yard debris, local gravel pit use
- Cooperative cleanup of trash and dumping sites
- Educational and interpretive programs oriented towards residents and tourists, enhancing appreciation of natural resources, native plants, wildlife, forest ecology
- Noxious Weed education, prevention, and control, community weed pulls
- Outreach to Off-road vehicle users regarding appropriate use and preventing resource damage
- Road closures and conversion of roads to trails
- Outreach regarding recreational gun use in populated areas
- Develop partnerships to monitor urban/interface use and impacts

2) Maintain or increase integrated fuels management program in strategic locations to protect urban interface forest habitats and private property from wildfire.

- Emphasize partnerships with homeowners associations to help increase understanding, reduce fire starts, and provide labor or cooperative funding

3) Complete and implement Cloverdale Bald Eagle Management Plan (now in draft form) and implement Cloverdale Bald Eagle Fire Management Plan.

4) Work with resorts and social service agencies to increase awareness about non-recreational forest living/camping. Cooperate on solutions such as affordable low-income housing and emergency shelters.

5) Implement an active noxious weed management program emphasizing education, prevention, and control.

KEY PARTNERSHIPS AND PROJECTS:

a) **City of Sisters-** USFS should assist the city in helping implement the city's new noxious weed ordinance, which penalizes landowners that allow noxious weeds on their property to spread to adjacent lands. Specifically:

- Identify and prioritize weed infested public lands in the urban interface for control
- Provide assistance with education and outreach on noxious weeds
- Work with the City and Oregon Department of Agriculture Weed Control specialists to present a yearly forum on weed prevention and control methods
- Apply "Pulling Together Weed Initiative" Program in highly visible city areas

b) Homeowners groups -USFS should collaborate with homeowners groups. Specifically:

- Prioritize weed infested public lands in the urban interface for control
- Provide weed education articles or information for newsletters
- Provide educational materials as available to meetings
- Attend and help initiate community weed pulls

c) County Road Crews and Utility Companies- USFS and other partners should continue educational efforts with the County and utility companies regarding the prevention of noxious weeds. Specifically:

- Work with the County on timing of road maintenance and weed spread.
- Continue and increase outreach to utility companies regarding identification and spread of noxious weeds and the need to clean equipment used in infested areas before entering clean areas
Work on timing of maintenance for utilities to avoid further weed spread
Develop restoration actions for targeted areas to reduce or eliminate weed spread

d) Black Butte Stables at Indian Ford- Work with this special use permittee to control knapweed on stables property and adjacent public lands to avoid spreading weeds further into the forest. Enlist the Stables as an active partner in monitoring horse trails for weeds and preventing and controlling spread.

6) Control motorized access in the urban/interface area to reduce fire starts and limit resource damage.

7) Work with the City of Sisters and Deschutes County Planning departments to increase understanding of Forest/urban interface issues and reduce potential for more urban interface. . Consider land exchanges to block up private and public lands or voluntary developmental restrictions in the form of conservation easements to limit development density. Key partners: City of Sisters, Deschutes County, Deschutes Basin Land Trust.

8) Manage day use near town by providing infrastructure and opportunities (Planning should be compatible with Squaw Creek Wild and Scenic River Management Plan). Key Partners: City of Sisters, Buck Run, Pine Meadow Ranch, Squaw Creek Irrigation District, Deschutes County Watershed Council.

9) Glaze Meadow/ Black Butte Swamp/ Graham Corral

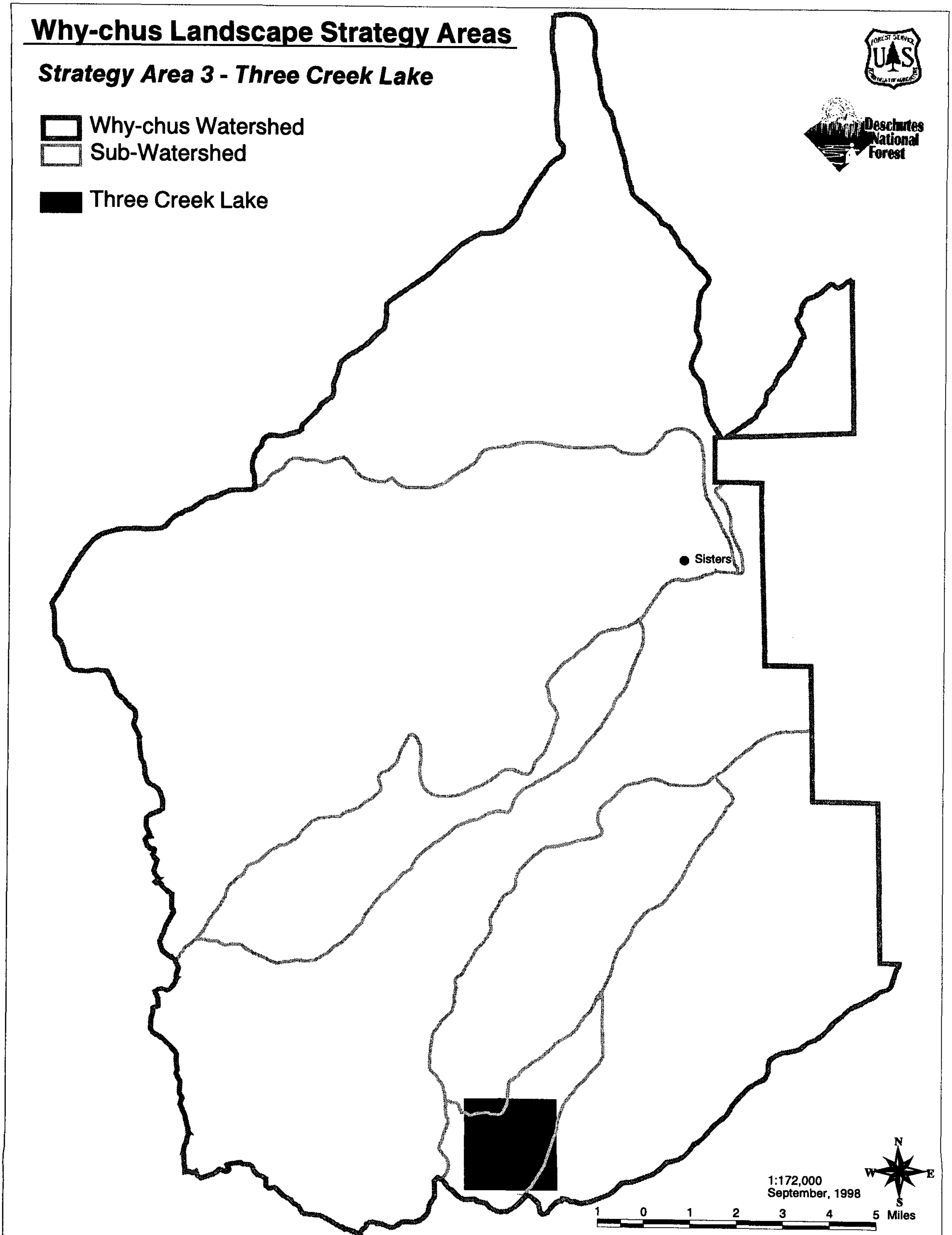
- Consider removal of allotment fences associated with Glaze Meadow allotment, which has been closed. Some fences or other barriers may need to be left to ensure no motor vehicle or OHV traffic in the old growth area or meadow habitat. Key partner- Black Butte Ranch.
- Evaluate need to rehabilitate ditching on Glaze Meadow to restore wet meadow habitat for Peck's penstemon and other wet meadow species
- Continue habitat restoration in Old Growth area to reduce wildfire risk to Black Butte ranch and restore fire in meadow and forest areas to benefit Peck's penstemon and other species.
- Develop Old Growth Management Plan for Glaze Old Growth area
- Evaluate horse trails under special use permit and restore, remove, and reroute problem trails, especially in riparian reserves. Reduce number of trails if possible. Key partners: Black Butte Stables, local horse groups.
- Consider adding trail opportunities from Graham Corral Campground, especially if this will reduce use/impacts to the Glaze Old growth Area.

Key Monitoring Actions:

1) Develop partnerships to monitor urban/interface use and impacts.
2) Develop partnerships to inventory and control noxious weed infestations

Key Data Needs:

1) More information on urban interface use
2) Noxious weed inventories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AREA 3- THREE CREEK LAKE AREA

PRIORITY # 3- *HIGH*
FEASIBILITY- *MODERATE*

The Three Creeks area is biologically unique and provides a unique, very popular recreational experience. It is one of the few places where you can drive to sub-alpine meadows and stroll into the wilderness. It was designated a key watershed because of its significance for amphibians. It is the longest known amphibian-monitoring site in the U.S. A unique morph of the long-toed salamander exists in the area, which may be a new endemic species. Many rare fungi have also been found in the area. The area receives high use which is increasing and it is inherently fragile because of the high altitude and short season for vegetation recovery. Horse use has damaged riparian reserves. Some improvements have been made but more are needed.

GOALS:

1) Protect and enhance unique habitats such as amphibian breeding areas (i.e. ponds, lakes, and streams), sub-alpine meadows, and rare fungi sites.

2) Restore, enhance, and protect riparian reserves with special consideration of their importance as amphibian dispersal corridors from known breeding sites to potential habitats.

3) Strive for a balance between recreational use and habitat protection. Maintain the unique recreational experience while limiting human impacts on this special and fragile place. Reduce recreational disturbance in sensitive habitat areas.

4) Restore natural hydrologic regimes at Three Creek Lake, Little Three Creek Lake, associated meadows such as Trapper Meadow, and associated ponds.

RECOMMENDATIONS:

1) Prepare a Master Plan/Site Restoration Plan for the Three Creek Recreational complex. Consider actions to reduce resource damage and improve the recreational experience consistent with Recreational Opportunity Spectrum (ROS). Related actions to consider:

- Relocation, improvement of Tam McArthur Trailhead
- Moving Park Meadow Trailhead to Rd 16, other parking improvements
- Connecting existing jeep road to Park Meadow trailhead
- Additional nordic skiing opportunities at Lower Three Creek Sno-park
- Rehabilitate dispersed roads, trails, and camps in riparian reserve areas
- Wetland restoration, including Three Creek, Trapper Meadow and Little Three Creek
- Work with Mycological Society to map extent of rare truffles and habitat at Three Creeks.

2) Special Vegetation Management guidelines to protect riparian reserves and adjacent forest areas for amphibian breeding and dispersal.

- Leave extra wood on the ground to provide dispersal corridors from known breeding sites to potential habitat.

- Protect riparian reserves to maintain extra wood for amphibian dispersal
- Manage forest vegetation to protect riparian reserves from intense large-scale fires, so that if a fire occurs total loss of habitat may be avoided.
- Salvage opportunities should be light on the land and follow key watershed guidelines
- Restore, enhance and protect riparian reserves as a high priority.

3) Obliterate and revegetate unnecessary roads and trails to reduce effects on amphibian dispersal. They have limited dispersal capabilities and roads are barriers to dispersal.

4) Evaluate effects of fish stocking on amphibian populations- in cooperation with Oregon Department of Fish and Wildlife and amphibian researchers. Work to reduce conflicts.

5) Continue to reduce recreational stock and hiker impacts in riparian reserves and wet meadows. Manage horse and other stock use to reduce activity and trails. Of special concern are riparian areas adjacent to the Three Creeks Horse Camp. Move trails and rehab riparian reserves.

6) Clean up and remove horse manure dumpsites because of the threat of weed spread.

7) Require stock feeds that are certified weed free

8) Rehabilitate areas of high impact including trails and camps around Three Creek Lake and Little Three Creek. Restructure to reduce future impacts.

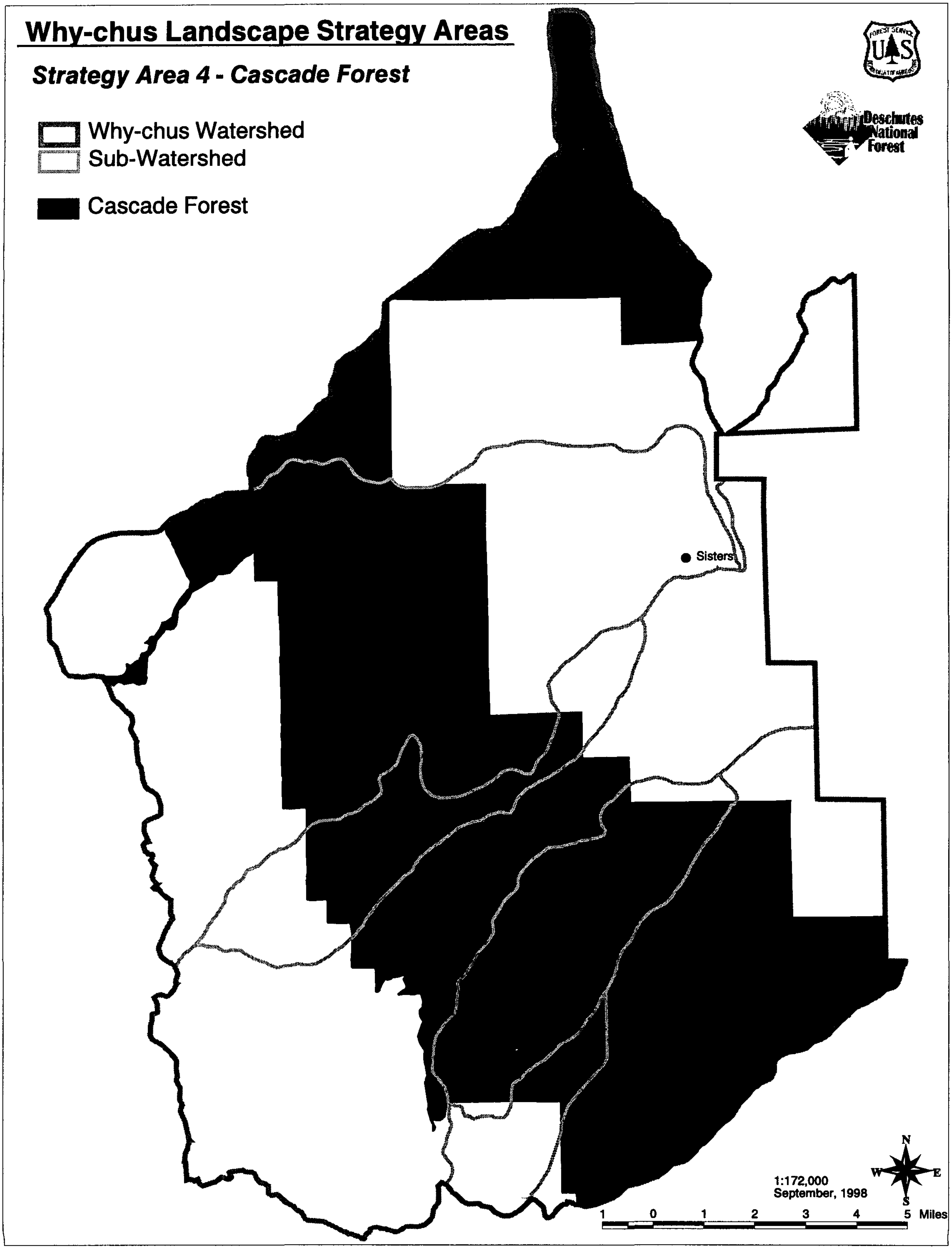
9) Rehabilitate Snow Creek Ditch

10) Resolve ownership issues on Three Creek dam and repair or remove.

11) Evaluate Little Three Creek dam for possible removal and restoration of natural hydrological regime.

<u>Key Monitoring Actions</u>:
1) Monitor effectiveness of site controls to reduce damage

<u>Key Data Needs:</u>
1) Ownership /legal status of Three Creek dam
2) Inventory of riparian areas where ACS objectives not being meet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AREA 4 - CASCADE FOREST

PRIORITY # 4- *MODERATE*
exception- Squaw Creek Wild and Scenic River Plan--- PRIORITY URGENT
FEASIBILITY- *MODERATE*

SUMMARY- Fire suppression, fire exclusion, and past logging have changed forest habitats, reducing connectivity, and removing important habitat components. Although most of this forest is green without widespread mortality, it is vulnerable to future large scale insect and disease outbreaks and higher intensity fires. Late-successional forest areas are fragmented and disconnected. There is a need to accelerate the growth of big trees, especially in late successional reserves and riparian reserves.

Favorite scenic vistas and recreation areas are located in this area. Of special concern is the Squaw Creek Wild and Scenic River. Planning for this river is overdue and the lack of a plan will reduce management options within the interim Wild and Scenic River corridor.

GOALS:

1) Restore forest habitats. Aim for a balance of vegetation within each Plant Association Group resulting in a healthy and resilient forest using the historic range of natural variability as a guideline. This includes consideration of size, structure, species composition, arrangement, distribution, and amount. *These are desired conditions, not static, and will change over time.*

2) Restore late-successional conditions in Late Successional Reserves, typical of eastern Oregon Cascade Province when succession of vegetation occurred under natural fire regimes. Provide late-successional habitat so that Late-Successional Reserves play an effective role in meeting the goals for which they were established.

3) Reduce potential for habitat loss due to stand replacement wildfires in areas where this type of fire behavior is outside the historic natural range of variability and when risks to public safety and large scale loss of property loss are unacceptable. Protect this habitat from loss due to large-scale fires, insects and disease epidemics, and major human impacts so that late-successional ecosystems and biodiversity are maintained.

4) Generate forest commodities as a result of implementing vegetation management opportunities to meet Goals 1, 2 and 3.

5) Use prescribed fire when possible, either in conjunction with other silvicultural treatments such as thinning, or alone, to achieve Goals 1,2 and 3. This benefits many species which have evolved with periodic fire and protects soils.

6) Maintain and restore scenic beauty of the "Front Country"
7) Protect and enhance the outstandingly remarkable resource values of Squaw Creek Wild and Scenic River. Meet our stewardship and legal obligations regarding the river.
8) Restore natural stream flows and protect springs in the Melvin watershed.
9) Protect the unique character, natural resources, and experience in recreational areas.
10) Provide mineral resources as needed with minimal social conflicts
11) Provide special forest products desired by the public without damage to natural resources.

RECOMMENDATIONS:

1) Restore Forest Habitats through Vegetation Management

*****For general applicable silvicultural guidelines by Plant Association Group (PAG) see section under <u>Common to all Landscape Areas</u>)*

Key Habitat Restoration Priorities:

- Promote connectivity between and within Late Successional Reserves (LSR)
- Promote connectivity between known activity centers for the Northern Spotted Owl
- Reduce risk of large scale fires to current owl habitat within the LSR
- Thin along scenic views and urban interface to promote large trees and reduce fire risk
- Aggressively thin plantations to accelerate large tree development, especially next to riparian reserves
- Thin around blocks of forest which are dominated by large trees to accelerate development of larger blocks. Examples are found in the flats between Sisters and Black Butte Ranch and Trout Creek Butte.
- Promote large tree character in ponderosa pine, mixed conifer dry and wet areas along riparian reserves to enhance connectivity

2) Squaw Creek Wild and Scenic River

- **Complete the Squaw Creek Wild and Scenic River Plan.**
- In the interim, protect outstandingly remarkable values and avoid direct, indirect or cumulative impacts to the river and its management corridor from vegetation management, or recreational developments.

Related actions to consider:

- Improvements to Squaw Creek Falls access road and trailhead
- Single log stringer foot-bridge at crossing of Squaw Creek along Metolius -Windigo trail

3) Melvin subwatershed

- Protect springs in the Melvin subwatershed from vehicle and foot traffic.
- Evaluate present irrigation water use in the Melvin subwatershed and work to restore flows to natural channels
- Fix ditch/road interactions
- Repair/ look for opportunities to eliminate Melvin ditch

4) Snow Creek-

- Repair/ look for opportunities to eliminate Snow Creek ditch

5) Pole Creek-

- Look for opportunities to eliminate Pole Creek ditch
- Thin along riparian areas near Pole Creek to accelerate large tree development
- Develop a Fire Camp site in the Pole Creek/Alder Creek area

6) Black Pine Springs-

- Assess removing facilities and converting Black Pine Springs campground to a dispersed site.
- Close and rehabilitate Off Road Vehicle Trails and hill climbs in the campground.

7) Lava Camp Lake

- Develop a management plan for the historic structure at Lava Camp Lake campground.
- Consider building a new warming shelter in that general area.
- Assess converting campground to a day use area or concessionaire operation
- Harden a stock watering site to reduce lake shore damage

8) Cold Springs

- Manage Cold Springs overflow dispersed site. Design site and install barriers to restrict area of impact to protect old growth pine and Peck's penstemon. Rehabilitate compacted areas.
- Construct interpretative trail as planned in Scenic Byway Plans sensitive to heritage resources and rare plants in the area.

9) Skylight Cave-

- Assess recreational impacts to the cave environment and sensitive species. Implement seasonal closure if necessary to protect R6 sensitive species
- Consider a trail to the cave. Evaluate effects of increased use.

10) Bear Wallow Roadless area- Consider building a snowmobile trail tie trail through this area to connect Rd 370 with the Triangle Hill trail.

11) Evaluate need for a new Sno-park on Hwy 242. Consider impacts of increased use and disturbance on LSR species and potential for wilderness snowmobile trespass.

12) Develop Deer and elk Management Plan for <u>winter and transitional ranges</u> before proposing vegetation management or increased recreational use in these areas.
13) Reduce road densities in key areas including deer winter range and mixed conifer wet forests used by wolverine
14) Reconstruct Rd 1514, 1608 and others listed in road priorities.
15) Evaluate vacant grazing allotments for closure and remove fences.

16) Gravel pits

- Evaluate non-active pits for rehabilitation and closure
- Survey pits for noxious weeds
- Evaluate pits as safe sites for target practice, Off road vehicle use

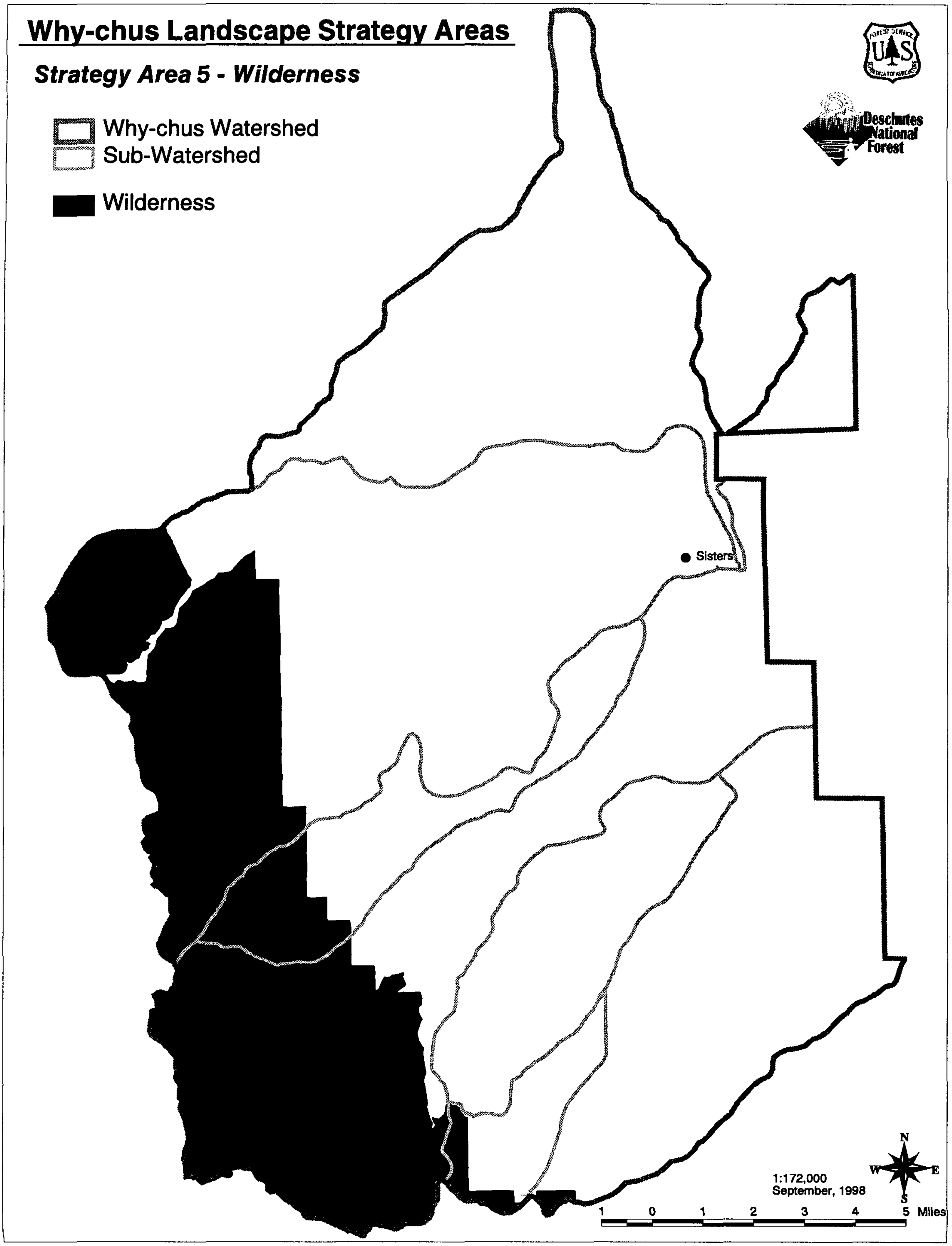
17) Look for opportunities to regenerate aspen stands (Also applies to Strategy Area 1&2)

18) Special Forest Products

- Design firewood units for easy access by public and monitoring

<u>Key Monitoring Actions</u>:
Road inventories
Continue monitoring owl sites

<u>Key Data Needs:</u>
Updated Stand inventories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AREA 5 - WILDERNESS

PRIORITY # 5- *LOW*
FEASIBILITY- *MODERATE*

The wilderness is comprised of high elevation forest, which for the large part have not been affected by forest management practices. Fire exclusion has occurred but because of long fire return intervals vegetation changes are subtle. Stand replacement fires are natural here and a wilderness fire plan is needed to allow natural processes to occur in the future within acceptable risks to public safety and large scale loss of property. Some areas of the wilderness have been impacted by recreational use, including camping, horse use, trespass by snowmobiles and illegal removal of alpine plants. Except for areas of high use, these are pristine environments.

GOALS:

1) Maintain a primitive setting and uncrowded wilderness experience.

2) Diminish human influence on natural processes and allow natural processes to continue.

3) Maintain function and quality of riparian areas.

4) Reduce potential impacts of human use on wildlife and alpine habitats, Restore impacted high use areas.

5) User education emphasizes stewardship and self-discovery.

RECOMMENDATIONS:

1) Develop Prescribed Natural Fire Plan for the Wilderness. -Restore fire to the wilderness.

2) Expand Limited Entry Areas (LEA's) in wilderness from the Willamette National Forest to the Deschutes National Forest. (i.e. expand Obsidian LEA to include Matthieu Lakes). Evaluate need for other use limits to protect recreational experience and resources.

3) Restore Priority areas: (i.e., Park Meadow, North and South Matthieu Lakes, Yapoah Lake, and Golden Lake)

- Rehabilitate overused campsites within 100 feet of lakes and waterways. Include rehabilitation of some meadow areas that are devoid of vegetation
- Rehabilitate trails through wet areas, wet meadows, and over steep slopes that channel water, result in multiple trails or unacceptable resource damage.

4) Wilderness lake fish stocking- In coordination with the Oregon Department of Fish and Wildlife develop recommendations for stocking wilderness lakes. Consider suitability of lakes for fish rearing, wilderness opportunity zones (primitive, pristine, etc.) and the importance of the lake to other resources, i.e. amphibians.

6) Continue to work on wilderness stewardship education, where the responsibility of the preservation of the wilderness falls on the wilderness user

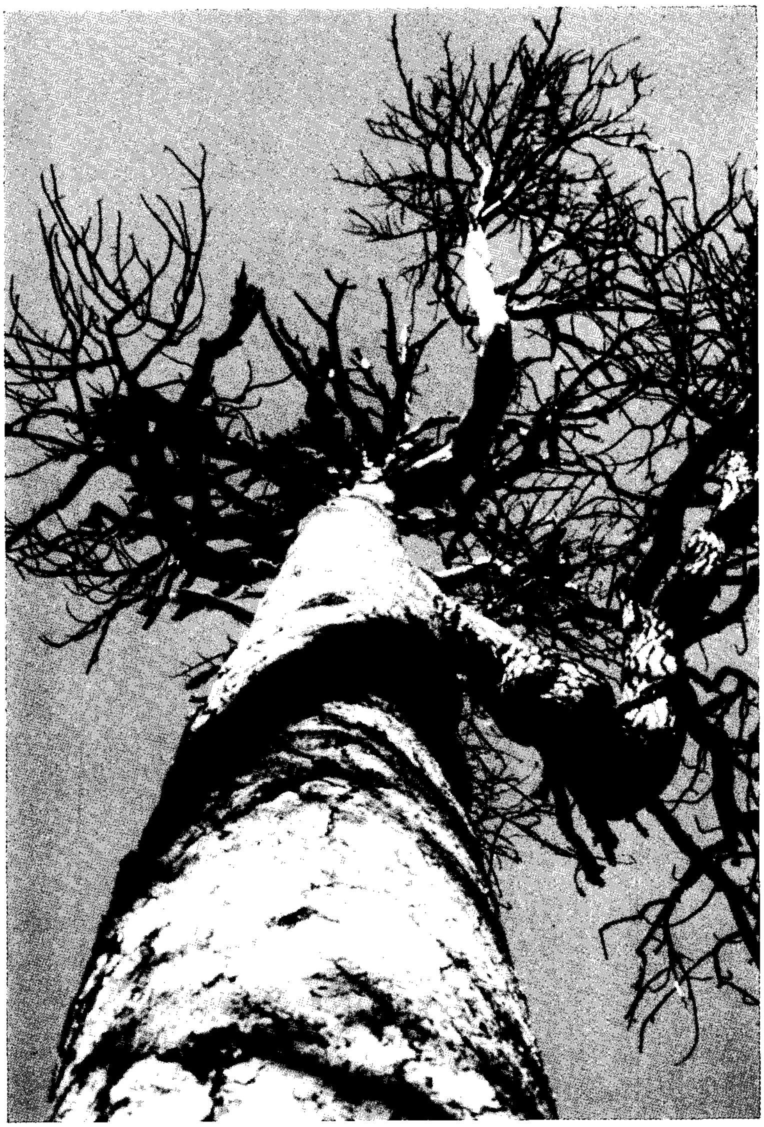
7) Close Squaw Creek Cattle and Horse Allotment, remove fences.

8) Post wilderness boundaries to reduce inadvertent snowmobile trespass.

9) Increase Wilderness Ranger presence

10) Improve trailhead and access road to Squaw Creek Falls.

<u>Key Monitoring Action and Data Need</u>:
Update LAC (Limits of Acceptable Change) Inventories to monitor effectiveness of current wilderness strategies and detect damaged areas



RECOMMENDATIONS COMMON TO ALL LANDSCAPE AREAS

Riparian reserve guidelines

See Riparian Reserve Section

Soils

General Recommendations To Minimize Soil Impacts

To protect the soil resource, where competing objectives allow, implement a harvest treatment that maximizes the time period between harvest entries. This will reduce soil impacts by reducing entries into a stand. Longer periods between harvest entries can also reduce the need to maintain a transportation system and increase the opportunity to do soil restoration activities such as subsoiling.

Reduce post harvest entries by treating stands as much as possible with the commercial timber harvest rather than post harvest. For example, treatment of material down to a smaller diameter may reduce the post harvest whip falling and thus, may avoid post harvest mechanical fuel treatments such as machine piling. It may also be possible to meet fuel treatment objectives with the timber harvest and, in some cases, avoid the need to treat fuels post harvest.

If possible, use prescribed fire to treat activity fuels rather than mechanical fuel treatments that increase soil compaction and displacement. Prescribed fire can also avoid the larger slash piles associated with mechanical piling, which can result in soil damage when burned.

Whenever possible, integrate less impactive harvest systems such as cable or helicopter into a portion of some sales. It is preferred to avoid soil damage over impacting an area and later rehabing it through soil restoration.

Soil Restoration By Subsoiling

Subsoiling is a restoration tool and should not be used as soil mitigation. Questions are continually raised both internally and outside the agency regarding the appropriateness and effectiveness of subsoiling. Some monitoring and evaluation of the program has been done and more is planned. Minimizing soil compaction through planning and implementation of projects is preferred over restoration through subsoiling.

Recommendation for Prescribed Burn Plans

The following mitigations are intended to be included in prescribed fire burn plans to protect soil and water resources.

1) where organic litter or duff layers exist prior to burning, avoid exposing more than 25-30% bare mineral soil.

Soils in the watershed have a moderate to severe rating for susceptibility to loss of productivity resulting from higher intensity fires (reference). This is mainly due to thin soil "A" surface soil horizons with less than two percent organic matter. Total nitrogen distribution in east side forests show approximately 70% of the nitrogen in the mineral soil and approximately 12% of the total nitrogen in the litter/duff layer (Boyer, 1980). Standards of 25-30% are recommended by (Boyer, 1980); by conserving some of the litter/duff we are assuring some of the nutrients will remain on site. Conserving some of the litter/duff layer on site is also important for preventing soil erosion, increasing nutrient cycling, mitigating soil compaction, and maintaining important soil micro-organisms species.

2) *minimize fire line construction by using existing barriers and/or wet line when possible*
Construction of fire lines results in the displacement of thin "A" soil horizons which contain most of the soils organic matter and nutrients. These disturbed areas also have the potential to intercept ground water during periods of high soil moisture. Surface flows or water may also be concentrated in fire lines. This results in increased soil erosion and sedimentation to lakes and streams. Fire line construction should be avoided wherever possible by taking advantage of roads, skid trails, subsoiled areas, unit boundaries with limited fuels, riparian areas, and other natural areas such as rock outcrops.

3) *do not construct fire lines in riparian areas*
Riparian areas are especially sensitive to fire line construction. Ground disturbing activities, such as digging fire line in riparian areas, are almost certain to intercept ground water and concentrate surface flow. Therefore, construction of fire lines needs to be avoided in riparian areas.

4) *minimize piling and burning*
Piling of slash before burning can adversely affect site productivity. Because of increased fire intensity, the loss of nutrients is anticipated to be higher than when fuels are broadcast burned. Also, the nutrients that remain after burning are no longer uniformly distributed across the site. This causes micro site differences in site productivity. Other soil characteristics, such as mineral soil organic matter and soil micro-organisms, can also be affected by increased fire intensity under piles.

5) *Minimize mop-up to what is necessary to prevent fire spread out of unit.*
Unnecessary mop-up activities need to be avoided in prescribed burn operations. Mop-up activities, while sometimes necessary to prevent spread of fire out of a unit, can result in displacement of thin "A" soil horizons which contain most of the soils organic matter and nutrients. It is important for the proper functioning of the soil that horizons remain intact as much as possible.

General Vegetation Management Guidelines by Plant Association Group (PAG)

The following opportunities and recommendations are designed to address the major trends and issues identified earlier in this document and to move the array of vegetation conditions within the watershed toward the midpoints of the historical range of variability in order to provide healthy sustainable ecosystems.

Common to all PAGs

Stand Structure:

- Thinning can be used to 1) reduce stand densities to help prolong the lives of the medium/large tree components, 2) help desirable tree species in all size classes less than 21" DBH grow faster and move into the medium and large size classes sooner.

Species Composition:

- Thinning can be used to favor desirable trees species.

Stand Densities:

- Thinning can be used to reduce stand densities. The objective should be to move densities below the upper management zone (UMZ).
- Understory removal could be use in stands in which there is sufficient stocking of overstory trees.
- Tree culturing could be used to reduce densities around individual desirable trees (i.e., medium and large sized trees).

Mortality and Salvage Guidelines:

- In areas of unacceptable mortality/fuel loading, remove dead trees to protect existing medium/large size classes from being burned by a catastrophic fire and to protect existing desirable forest structures and habitats. Balance this with the need for snags and down woody debris for habitat.
- Stands (acres) with greater than 10% mortality, especially those with greater than 30% mortality, will require special consideration for several reasons. First, most of the trees that have died during the last mortality event are white fir and have been dead so long that the majority are past merchantability for sawlogs. Under the best scenarios, these trees will be salvageable only as fiber or chip material. Second, the fire hazard is very high in the majority of these stands. Third, given that there is little merchantable product still available on most acres, treatment and/or restoration of these areas will require financing through some means other than a timber sale.
- Reforestation of ponderosa pine on most of the acres that have experienced moderate to very high levels of mortality will be difficult at best and has the potential to be extremely expensive. This is due to the length of time since the mortality has occurred. In most cases, the majority of the mortality occurred 4 to 5 years and maybe more from the present. This length of time has allowed high levels of competing vegetation, both grass and brush, to become established. To be successful, reforestation efforts will need to include plenty of financing for the control of competing vegetation and animal damage control.
- Opportunities to salvage dead material may exist in the event of a catastrophic insect or disease epidemic or fire.

Other Salvage Guidelines:

- Focus salvage to meet habitat restoration goals whenever possible
- Large -scale salvage (i.e. fire salvage) should proceed with a conservative and careful approach to avoid eliminating future management options and to avoid unnecessary impacts to other resources (i.e. soils). Temporal scales of ecosystem evolution and the value of natural recovery processes should be recognized prior to large -scale salvage, balanced with the desire to protect still existing late-successional habitat from large-scale high-intensity fires and insect and disease caused mortality.
- Retain some patches of dead trees or high mortality stands to provide habitat for wildlife species, look at patch sizes under HRV before deciding to salvage.
- Large dead and dying trees provide remnant down log and snag components in younger stands. Consider retaining many or all large dead or dying trees in deficient areas, especially in size classes larger than 21 inches dbh to provide these remnant late-successional components. Balance this consideration with

protecting habitats from large-scale fires.

Specific to Individual PAGs

MIXED CONIFER DRY (MCD) PAG

Stand Structure: See, Common to All PAGs.
Species Composition:
- To convert stands where white fir and other climax species are the dominant component, it will be necessary to formulate a strategy of treatments that will incorporate the regeneration of ponderosa pine over time.

Stand Densities:
- Thinning can be used to reduce stand densities. This will be most effective in pioneer and mixed species stands where, post thinning, the dominant species is ponderosa pine.
- Thinning of stands that are dominated by white fir is a questionable practice. Except under the best scenarios or unless done to meet some management objective other than stand heath, thinning white fir should only be done after careful consideration of the management objectives and all the stand variables involved. In most cases, it is best to treat pure white fir stands by regeneration harvests to accomplish species conversion to ponderosa pine.
- Understory removal could be used in stands in which the understories are dominated by white fir and the overstories are dominated by ponderosa pine and stands would be adequately stocked post treatment.
- Mortality: See, Common to All PAGs

MIXED CONIFER WET (MCW) PAG

Stand Structure: See, Common to All PAGs
Species Composition:
- Because of the higher site potential of these MCW plant associations compared to the MCD plant associations, the MCW plant associations should be able to carry higher stocking levels of Douglas-fir and true fir, primarily white fir. However, white fir should probably compose less than 30% of tree stocking (personal communication, H. Maffei).
- Thinning can be used to favor desirable trees species, primarily ponderosa pine and other early seral species (including Douglas-fir) to convert mixed species stands to primarily pioneer species stands.
- To convert stands where white fir and other climax species are the dominant component, it will be necessary to formulate a strategy of treatments that will incorporate the regeneration of ponderosa pine over time.

Stand Densities:
- Because of the higher site potential of these MCW plant associations compared to the MCD plant associations, the MCW plant associations should be able to carry higher levels of stocking (i.e., higher UMZs). Prior to treatment, site potentials should be determined on a site by site basis.
- Thinning can be used to reduce stand densities. This will be most effective in pioneer and mixed species stands where, post thinning, the dominant species is ponderosa pine.
- Thinning of stands that are dominated by white fir is a questionable practice. Except under the best scenarios or unless done to meet some management objective other than stand heath, thinning white fir should only be done after careful consideration of the management objectives and all the stand variables involved. In most cases, it is best to treat pure white fir stands by regeneration harvests to accomplish species conversion to ponderosa pine.
- Understory removal could be used in stands in which the understories are dominated by white fir and the overstories are dominated by ponderosa pine and stands would be adequately stocked by trees >20.9" DBH.

Mortality: See, Common to All PAGs

PONDEROSA PINE (PP - Wet and Dry) PAG

Stand Structure: See, Common to All PAGs
Species Composition:
- Thinning and prescribed burning can be used to reduce western juniper and true fir components where they occur.

Stand Densities: See, Common to All PAGs.
Dwarf Mistletoe:
- Develop integrated short and long-term plans to manage areas with moderate to heavy infestations of dwarf mistletoe.
- Initiate a program to survey and map dwarf mistletoe infestations and intensities.

LODGEPOLE PINE (LP) PAG

Outside of wilderness areas:
- Opportunities to salvage dead material may exist if a catastrophic mountain pine beetle epidemic or fire occurs.

Stand Structure: See, Common to All PAGs
Species Composition: See, Common to All PAGs
Stand Densities:
- Thinning can be used to reduce stand densities. This will be most effective in young stands (i.e., less than 50 years old).

Mortality: See, Common to All PAGs
In wilderness areas:
- Develop an integrated fire management plan to allow the reintroduction of wildfire into wilderness that would duplicate the frequency and intensity of historic wildfire.

HIGH ELEVATION MT HEMLOCK (MH) PAG

Outside of wilderness areas:
Stand Structure: See, Common to All PAGs
Species Composition: See, Common to All PAGs
Stand Densities:
Understory removal could be use in stands in which the understories are dominated by lodgepole pine and the overstories are dominated by Mt. Hemlock and the stands would be adequately stocked by the overstory component.
Mortality: See, Common to All PAGs
In wilderness areas:
Develop an integrated fire management plan to allow the reintroduction of wildfire into wilderness that would duplicate frequency and intensity of historic wildfire.

RIPARIAN PAG

Stand Structure: See, Common to All PAGs
- Thinning or understory removal can be used to 1) reduce stand densities to help prolong the lives of the medium/large tree components, 2) help desirable tree species in all size classes less than 21" dbh grow faster and move into the medium and large size classes sooner.

Species Composition: See, Common to All PAGs
- Thinning can be used to favor desirable trees species.

Stand Densities: See, Common to All PAGs

Plant, Fish, and Wildlife Species of Concern – Recommendations Common to all Areas

1) **Maintain and enhance Peck's penstemon habitats** with proven tools such as prescribed fire. Restore flooding to habitat areas. Prioritize population areas for noxious weed control. Continue to do Management Treatment monitoring to investigate new management techniques to improve habitat. Prevent destruction of populations in future land exchanges. May require innovative land protection agreements.

2) **Provide nest structures for Great Grey Owls** if large trees are absent and populations are found.

3) **Rehabilitate closed roads** to enhance forage for big game and prevent noxious weed invasion.

Heritage Resources

1) **Identify and evaluate Heritage Resources. Develop management plans for resources that are being damaged.** A prioritized list of heritage resources based on significance will aid in developing management plans, protecting significant sites and aid in implementing other activities in the watershed.

2) **Continue working with the Confederated Tribes of Warm Springs in meeting Federal Trust Responsibilities on ceded lands. Work to finalize preferred name for Squaw creek.**

Other Social

1) **Expand public involvement in planning projects to encourage community-based stewardship and ownership.**

2) **Develop natural resource interpretation and education opportunities oriented towards residents and visitors to expand perceptions of what is "natural", help build understanding and support of restoration projects such as prescribed fire, or hydrological reengineering, and to help the public understand tradeoffs and costs.**

3) **Consider opportunities to reduce prominence of old clearcuts by feathering edges during thinning and other vegetation management.**

Recreation

1) **Meet the American Disabilities Act requirements in recreational facilities.** Provide accessible facilities throughout the watershed.

2) **Require stock feeds that are certified weed free throughout the watershed.**

Data Gaps common to all areas

Forest Vegetation

- Re-evaluate snag and log condition standard and guidelines to provide a revised edition of the WTLIS that better reflects historic conditions.
- Determine levels of snags and down woody material currently on the landscape.
- Determine priority areas for treatment to enhance, create, and maintain late successional conditions in the LSR's.
- Determine if NRF habitat can be attained in the Three Creek LSR.
- Prioritize areas within quarter townships outside wilderness primarily in MCD and PP to enhance dispersal habitat through stand manipulation.
- Use CVS plots for areas in ponderosa pine stands in Melvin, Squaw, and Pole subwatersheds due to the lack of coverage of current stand exam information.
- Determine where encroachment of lodgepole is occurring in meadows and remove to restore habitat.
- Current stand exam data is limited to 11% of the watershed. Older exams can fill some of this gap. However, it will be necessary to develop a long-term plan for data accumulation and maintenance for future landscape analysis and vegetation management projects.
- It is known that dwarf mistletoe infects large acreage in this watershed, however, the locations and intensities are not known. To formulate an integrated strategy for treatment of this disease it will be necessary to survey for and map infected acres.
- Develop current and more reliable estimates of site potential (i.e., GBA) for the various plant associations, especially the major ones, found in the watershed. These would allow managers and decision makers to more confidently determined current stand conditions/site potential and weigh the tradeoffs of different management scenarios.
- The number of acres of old growth in the watershed are only estimates. Old growth stands should be identified and mapped using all the variables in the Region 6 Interim Definitions of Old Growth.
- Sources of historic vegetation information are scarce. Additional sources, such as the maps from the Samuel Johnson Foundation, should be preserved by inclusion into the Forest database/GIS system.

Botany

- Survey and map rare lichens and liverworts in Pole Creek, Snow Creek, and Trout Creek swamp.
- .Complete surveys to esatblish extent and location of rare plant species

Wildlife

- Need stream information on the Three creek Butte subwatershed
- Determine patch size, miles of edge, and interior forest acres by using Fragstats to in evaluation late-successional and old-growth habitat.
- More information is needed on effects of special forest products programs on wildlife and their habitats.
- Determine where high use sites are impacting riparian reserves and habitat and develop measures to reduce degradation.
- Survey for survey and manage species prior to ground disturbing activities.

- Survey suitable habitat and buffer known sites for great gray owls and Townsend's big-eared bats.
- Survey for proposed, endangered, threatened, and sensitive species.
- Take advantage of opportunistic sightings of wolverine and other wildlife to gather more information on habitat and occurrence.
- Determine opportunities to re-introduce extirpated species.
- Determine, through surveys, highly used areas by marten and protect habitat elements from wood cutting or other activities (down woody material and snags).
- More information is needed on the ecology of the black-backed woodpecker and its relationship to forest management.
- Assess impacts to deer habitat and the need to reduce fire risks adjacent to urban interface.
- Conduct a winter range analysis and impact of recreational use on winter range and deer.
- Update traffic counts and determine road use and effects to habitat.
- Evaluate closure of vacant stock allotments.

Aquatic Species

- Survey potential habitat to gather more data on amphibian occurrence. Document habitat conditions and where they are degraded. Develop management options to restore habitat.
- Confirm tailed frog sightings.
- Assess recreation damage and determine mitigation to reduce the effects.

Social

- Identify heritage resources.
- Evaluate heritage resources.
- Develop management plans for resources being damaged or that can't be avoided.
- Evaluate non-active pits for rehabilitation and closure.
- Survey pits for noxious weeds.
- Evaluate pits as safe sites for target practice, off road vehicle use, use as fire camps, etc.
- Determine accurate miles of road.
- Conduct road condition surveys to assess conditions of low use roads and determine if they are hydrologically sound or will need work prior to closing.
- Determine what category roads should be classified as according to the district ATM committee.
- Evaluate OHV use in the urban interface and consider what type of closure system should be instituted.

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APPENDIX EP-1.

GIS PROCESS FOR THE CREATION OF SOIL MAPS

Appendix EP-1. GIS Maps Developed During Watershed Analysis

Soil Maps
- (1) Land Types-SRI Groupings by Sensitivity
- (2) Soil Productivity-SRI Groupings by Site Class
- (3) Soil Condition Class-Developed from Forest Activity Layer

Hydrology Maps
- (4) Subwatersheds, Lakes and Streams, Wet Soil Types
- (5) Ash over Glacial Till/Outwash Soils-SRI Groupings by Soil Type
- (6) Sediment Yield Potential-SRI Groupings by Soil Type

Listed below is an explanation of criteria used to create maps and definitions of information displayed on maps.

(1) Land Types-SRI groupings by sensitivity
The following are groupings of soil map units based on similar soil or land type characteristics. Map units were taken from the Deschutes Soil Resource Inventory (SRI). Sensitive soil types are also identified along with typical management limitations. Criteria for identifying soils sensitive to management are found in the Deschutes LRMP, Appendix 14, Objective 5.

Lava Flows/ Rocky Areas - barren low density timber
01 Barren lava flows
03 Rocky mountain peaks
11 Lava flows with low density timber
13 Rocky, single slopes on buttes at high elevations
* Soils in these mapping units are considered sensitive soil areas due to extremely rocky areas. Those areas that do have timber are typically considered non-suitable for timber management due to the inability to regenerate sites.

Canyon Walls/ Narrow Draws/Rocky Slopes - rocky areas on steep slopes
06 High elevation canyon walls
10 Narrow draws
12 Steep, complex, rocky slopes at high elevations
14 Edges of lava flows
18 Steep slopes along glacial valley walls and cirques supporting mountain hemlock
* Soils in these mapping units are considered sensitive soil areas due to the large amount of rock and slopes greater than 30%. Those areas that do have timber are typically considered non-suitable for timber management due to the inability to regenerate sites.

51 Steeply sloping (30 to 60% slope) canyon walls/ Site Class 5 to 6 ponderosa pine
59 Steeply sloping (30 to 80% slope) south aspect of canyon walls/ Site Class 5 to 6 ponderosa pine
* Soils in these mapping units are considered sensitive soil areas due to the large amount of rock and slopes greater than 30%. Management limitations typically include cable or helicopter logging systems.

Barren Flats - barren pumice and cinder flats
07 Barren flats
* Soils considered sensitive soil areas due to slopes greater than 30% and also their limited extent which can provide unique habitats.

Frost Pocket Basins - frost hazard is high due to limited air drainage
15 Lodgepole basins
* Soils are considered sensitive soils due to poor regeneration success and also their limited extent which can provide unique habitats.

Barren Cinder Cones - non vegetated cinder cones
09 Barren cinder cones
* Soils considered sensitive soil areas due to slopes greater than 30% and also their limited extent which can provide unique habitats.

Cinder Cones - vegetated
80 Side slopes of cinder cones/ non-commercial for timber harvest
81 Side slopes of cinder cones/ Site Class 5 to 6 ponderosa pine
82 Side slopes of cinder cones/ Site Class 4 to 5 ponderosa pine
83 Higher elevations of cinder cones (slopes 25 to 70%)/ low to unproductive for timber harvest
* Soils in these mapping units are considered sensitive soil areas due to slopes greater than 30%. Management limitations in areas that have commercial timber include cable or helicopter logging systems.

Gently Sloping Glaciated Uplands/Outwash Plains
Low to very low site quality for timber production - ash over glacial till
16 Uneven glaciated uplands
17 Gently sloping glaciated uplands/ Site Class 6 to7 lodgepole
19 Gently sloping glaciated uplands/ Site Class 5 to 6 lodgepole
36 Gently sloping glaciated outwash plains/ site quality very low for timber production
48 Gently sloping glaciated outwash plains/ non forest

Low to very low site for timber production - with no glacial till or glacial outwash
53 Flats and ridgetops (scab flats)/ site quality very low for timber production
84 Steep side slopes of shield or composite volcanos/ low to unproductive for timber production
85 Ridgetops, benches, and toeslopes of shield or composite volcanos/ non-commercial for timber production
* Soils in these mapping units are considered sensitive soils due the their very low site quality for timber production.

Steep Slopes - slopes greater than 30%
Glaciated lands
18 Steep slopes along glacial valley walls and cirques supporting mountain hemlock
21 South slopes of glacial moraines (slopes 25 to 60%)/ Site Class 5

22 North slopes of glacial moraines (slopes 25 to 60%)/ Site Class 4-5
23 North slopes of glacial moraines and glacial valley walls (slopes 25 to 60%)/ Site Class 4
24 Hummocky side slopes along glacial valley walls and moraines (slopes 20 to 60%)/ Site Class 4
86 Steep protected slopes of composite volcanoes (slopes 30 to 60%)/ Site Class 4 to 5 mixed conifer
87 Steep exposed slopes of composite volcanoes (slopes 30 to 60%)/ Site Class 5 ponderosa pine

Non-glaciated lands
50 Steep side slopes of dissected canyons (slopes 30 to 70%)/ low potential for timber production
68 Steeply sloping lava domes and ridges (slopes 30 to 60%)/ Site Class 5 ponderosa pine
69 Steep slopes of lava domes and ridges (slopes 30 to 60%)/ Site Class 4 to 5 ponderosa pine
78 Side slopes of ridges (slopes 30 to 60%)/ Site Class 5 to 6 ponderosa pine
79 Side slopes of ridges (slopes 30 to 60%)/ Site Class 4 to 5 mixed conifer
* Soils in these mapping units are considered sensitive soil areas due slopes greater than 30%. Management limitations typically include cable or helicopter logging systems.

High Water Tables - seasonal or year long high water tables
02 High elevation drainages
04 Alpine meadows
05 Wet meadows
* Soils in these mapping units are considered sensitive soils due to high water tables and also their limited extent which can provide unique habitats.

08 Bottom lands
30 Gently sloping glaciated lands subject to high water tables during runoff periods/ Site Class 3-4
44 Glacial outwash plains, water table generally encountered at 2 to 5 feet/ Site Class 5 lodgepole
* Soils in these mapping units are considered sensitive soil areas due to seasonal high water tables. Management limitations typically include harvest period restrictions to times when water tables are not present and also prioritization of less impactive post harvest treatments.

Forested Lands - ash over glacial till
28 Uneven glaciated uplands/ Site Class 4 to 5 mixed conifer
29 Gently sloping glaciated uplands/ Site Class 4 to 5 mixed conifer
32 Gently sloping to uneven glaciated uplands/ Site Class 5 ponderosa pine
37 Gently sloping glacial outwash plains/ Site Class 5 to 6 ponderosa pine
* Soils in these mapping units are generally considered not to be sensitive soil areas.

Lava Plains - with no glacial till or glacial outwash
60 Uneven lava plains/ Site Class 6 ponderosa pine
61 Gently sloping uplands/ Site Class 5 to 6 ponderosa pine
62 Gently sloping uplands/ Site Class 4 to 5 mixed conifer
64 Gentle to uneven lava plains/ Site Class 5 ponderosa pine
65 Uneven lava plains/ Site Class 4 to 5 ponderosa pine
66 Benches or toe slopes of buttes/ Site Class 5 ponderosa pine
67 Benches or toe slopes of buttes/ Site Class 4 to 5 mixed conifer
6H Gently to moderately sloping lava plains/ Site Class 5 to 6 lodgepole pine

72 Uneven lava plains/ Site Class 6 ponderosa pine
* Soils in these mapping units are generally considered not to be sensitive soil areas

Mapping Unit Complexes (The following letter map unit attributes are complexes of two or more Landtype Components.)

Mapping Unit	Landtype Components
GB	17,19
GG	22,28
GS	37,64
GT	37,8
GX	28,21,22
HB	12,5,4
HC	12,6,4
HD	13,12,6
HE	13,4
HJ	18,2
HL	3,8
LG	64,14
LM	65,74
LX	76,64
MC	16,12,20
MD	17,12,16
MF	19,73
MH	28,65
MJ	29,65
MK	32,64
MM	36,6A
MW	36,5
RB	61,78,14
TB	50,53,55
WB	2,16,12
XD	36,6A,56
XL	60,53,61

Soil Groupings (for use in GIS)

Lava Flows/ Rocky Areas - Types 01,03,11,13,HD,HE,HL

Canyon Walls/ Narrow Draws/ Rocky Slopes - Types 06,10,12,14,18,51,59,HB,HC

Barren Flats - Types 07

Frost Pocket Basins - Types 15

Barren Cinder Cones - Types 09

Cinder Cones - Types 80,81,82,83

Low to Very Low Site Quality For Timber Production (with till or outwash) - Types 16,17,19,36,48,GB,MC,MD,MF,MM,MW

Low to Very Low Site Quality For Timber Production (no till or outwash) - Types 53,84,85

Steep Slopes (with till or outwash) - Types 18,21,22,23,24,86,87,GG,HJ

Steep Slopes (no till or outwash) - Types 50,68,69,78,79,TB

High Water Tables - Types 02,04,05,08,30,44,WB

Forested Lands - Types 28,29,32,37,GX,MH,MJ,MK,XD

Lava Plains - Types 60,61,62,64,65,66,67,6H,72,GS,GT,LG,LM,LX,RB,XL

(2) Soil Productivity - SRI Groupings by Site Class

(3) Soil Condition Class - Developed from Forest Activity Layer

(4) Subwatersheds, Lakes and Streams, Wet Soil Types

(5) Ash over Glacial Till/Outwash Soils - SRI Groupings by Soil Type

(6) Sediment Yield Potential - SRI Groupings by Soil Type
Sediment yield potential of soils in this watershed was evaluated using the Deschutes Soil Resource Inventory (SRI), Erosion and Hydrologic Interpretations Table (pp 222-226). This reference rates the potential for water sedimentation and pollution from sand, silt, and clay particles following timber harvest, road construction, or other management activities. Factors considered in making ratings included soil texture and structure, drainage patterns, landform, and climate. Ratings of low, moderate, and high sediment yield potential are defined below.

Low - Sedimentation levels of silt and clay particles are not expected to be significant following management activities.

Moderate - Sedimentation levels may be significantly increased following management activities with moderate loss of water quality and damage to fisheries.

High - Sedimentation levels are expected to by high following management activities. Streams can become turbid and there can be considerable loss of water quality and damage to fisheries.

APPENDIX W-1

WILDLIFE SPECIES KNOWN OR SUSPECTED

TO OCCUR ON

THE SISTERS RANGER DISTRICT

Appendix W1. Species known or expected to occur on the Sisters Ranger District, Deschutes National Forest, Sisters Ore. 1998. See below for data dictionary.

Class	Species Code	Common Name	Scientific Name	Riparian Use	Residence Status	Abundance	Versatility Rating	Dispersal Capability	Population Trend	Patch Matrix	Agency	Category
A	RACAS	CASCADES FROG	RANA CASCADAE	Primary	PR	U	12	2	D	4	ONHP	L3
A	RACAS	CASCADES FROG	RANA CASCADAE	Primary	PR	U	12	2	D	4	State	SV
A	RACAS	CASCADES FROG	RANA CASCADAE	Primary	PR	U	12	2	D	4	USFWS	C2
A	SCIN	GREAT BASIN SPADEFOOT	SCAPHIOPUS INTERMONTANUS	Primary	PR	U	22	2	U	4		
A	AMMA	LONG-TOED SALAMANDER	AMBYSTOMA MACRODACTYLUM	Primary	PR	C	19	3	U	4		
A	AMGR	NORTHWESTERN SALAMANDER	AMBYSTOMA GRACILE	Primary	PR	C	19	1	S	4		
A	PSRE	PACIFIC TREEFROG	PSEUDACRIS REGILLA	Primary	PR	C	21	2	U	4		
A	TAGR	ROUGH-SKINNED NEWT	TARICHA GRANULOSA	Primary	PR	C	19	1	D	4		
A	RAPR	SPOTTED FROG	RANA PRETIOSA	Primary	EX	U	11	3	S	1	ONHP	L1
A	RAPR	SPOTTED FROG	RANA PRETIOSA	Primary	EX	U	11	3	S	1	State	SC
A	RAPR	SPOTTED FROG	RANA PRETIOSA	Primary	EX	U	11	3	S	1	USFWS	C2
A	ASTR	TAILED FROG	ASCAPHUS TRUEI	Primary	PR	R	14	3	D	1	FEMAT	Y
A	ASTR	TAILED FROG	ASCAPHUS TRUEI	Primary	PR	R	14	3	D	1	ONHP	L3
A	ASTR	TAILED FROG	ASCAPHUS TRUEI	Primary	PR	R	14	3	D	1	State	SV
A	BUBO	WESTERN TOAD	BUFO BOREAS	Primary	PR	C	19	2	S	4	ONHP	L3
A	BUBO	WESTERN TOAD	BUFO BOREAS	Primary	PR	C	19	2	S	4	State	SV
B	BOLE	AMERICAN BITTERN	BOTAURUS LENTIGINOSUS	Primary	SR	R	6	1	S	1		
B	FUAM	AMERICAN COOT	FULICA AMERICANA	Primary	PR	C	10	1	S	1		
B	COBR	AMERICAN CROW	CORVUS BRACHYRHYNCHOS	Primary	PR	C	32	1	S	4		
B	CIME	AMERICAN DIPPER	CINCLUS MEXICANUS	Primary	PR	C	4	1	S	1		
B	CATR	AMERICAN GOLDFINCH	CARDUELIS TRISTIS	Primary	SR	U	23	1	D	1		
B	FASP	AMERICAN KESTREL	FALCO SPARVERIUS	Primary	PR	C	30	1	U	5		
B	TUMI	AMERICAN ROBIN	TURDUS MIGRATORIUS	Primary	PR	C	37	1	S	4		
B	ANAAM	AMERICAN WIGEON	ANAS AMERICANA	Primary	PR	C	10	1	S	1		
B	CAAN	ANNA'S HUMMINGBIRD	CALYPTE ANNA	Primary	SR	U	7	1	S	2		
B	MYICI	ASH-THROATED FLYCATCHER	MYIARCHUS CINERASCENS	Other	SR	R	18	1	S	4		
B	HALE	BALD EAGLE	HALIAEETUS LEUCOCEPHALUS	Primary	PR	U	19	1	I	5	ONHP	L1
B	HALE	BALD EAGLE	HALIAEETUS LEUCOCEPHALUS	Primary	PR	U	19	1	I	5	State	ST
B	HALE	BALD EAGLE	HALIAEETUS LEUCOCEPHALUS	Primary	PR	U	19	1	I	5	USFS	FSS
B	HALE	BALD EAGLE	HALIAEETUS LEUCOCEPHALUS	Primary	PR	U	19	1	I	5	USFWS	T
B	RIRI	BANK SWALLOW	RIPARIA RIPARIA	Secondary	SR	U	5	1	D	4	ONHP	L3
B	RIRI	BANK SWALLOW	RIPARIA RIPARIA	Secondary	SR	U	5	1	D	4	State	SU
B	TYAL	BARN OWL	TYTO ALBA	Primary	SR	R	19	1	S	5		
B	HIRU	BARN SWALLOW	HIRUNDO RUSTICA	Primary	SR	U	17	1	?	1		
B	BUIS	BARROW'S GOLDENEYE	BUCEPHALA ISLANDICA	Primary	PR	U	9	1	D	1	ONHP	L4
B	BUIS	BARROW'S GOLDENEYE	BUCEPHALA ISLANDICA	Primary	PR	U	9	1	D	1	State	SP
B	CEAL	BELTED KINGFISHER	CERYLE ALCYON	Primary	PR	U	7	1	S	1		
B	THBE	BEWICK'S WREN	THRYOMANES BEWICKII	Primary	?		14	1	S	4		
B	LEARA	BLACK ROSY FINCH	LEUCOSTICTE ARCTOA ATRATA	Primary	SR	O	6	1	D	1		
B	CHNI	BLACK TERN	CHLIDONIAS NIGER	Primary	O	R	7	1	S	1		
B	PIAR	BLACK-BACKED WOODPECKER	PICOIDES ARCTICUS	Other	PR	U	12	1	D	3	FEMAT	Y
B	PIAR	BLACK-BACKED WOODPECKER	PICOIDES ARCTICUS	Other	PR	U	12	1	D	3	ONHP	L4
B	PIAR	BLACK-BACKED WOODPECKER	PICOIDES ARCTICUS	Other	PR	U	12	1	D	3	State	SC
B	PIAR	BLACK-BACKED WOODPECKER	PICOIDES ARCTICUS	Other	PR	U	12	1	D	3	DNF	MIS
B	PIPI	BLACK-BILLED MAGPIE	PICA PICA	Primary	PR	C	16	1		1		
B	PAAT	BLACK-CAPPED CHICKADEE	PARUS ATRICAPILLUS	Primary	PR	R	18	1	S	4		
B	ARAL	BLACK-CHINNED HUMMINGBIRD	ARCHILOCHUS ALEXANDRI	Primary	SR	R	17	1	S	3		
B	PHME	BLACK-HEADED GROSBEAK	PHEUCTICUS MELANOCEPHALUS	Primary	SR	U	28	1	I	4		
B	DENI	BLACK-THROATED GRAY WARBLER	DENDROICA NIGRESCENS	Secondary	SR	U	28	1	S	4		
B	DEOB	BLUE GROUSE	DENDRAGAPUS OBSCURUS	Other	PR	U	29	2	S	4		
B	ANDI	BLUE-WINGED TEAL	ANAS DISCORS	Primary	SR	R	10	1	?	1		
B	BOGA	BOHEMIAN WAXWING	BOMBYCILLA GARRULUS	Secondary	WR	O	8	1	S	2		
B	AEFU	BOREAL OWL	AEGOLIUS FUNEREUS	Primary	PR	U		2	S	3		
B	EUCY	BREWER'S BLACKBIRD	EUPHAGUS CYANOCEPHALUS	Primary	PR	C	24	1		1		
B	SPBR	BREWER'S SPARROW	SPIZELLA BREWERI	Other	SR	C	19					
B	CEAM	BROWN CREEPER	CERTHIA AMERICANA	Secondary	PR	C	29	1	D	4		
B	MOAT	BROWN-HEADED COWBIRD	MOLOTHRUS ATER	Primary	SR	C	34	1	I	4		
B	BUAL	BUFFLEHEAD	BUCEPHALA ALBEOLA	Primary	PR	U	9	1	D	4	ONHP	L2
B	BUAL	BUFFLEHEAD	BUCEPHALA ALBEOLA	Primary	PR	U	9	1	D	4	State	SP
B	PSMI	BUSHTIT	PSALTRIPARUS MINIMUS	Primary	PR	U	22	1	S	1		
B	LACAL	CALIFORNIA GULL	LARUS CALIFORNICUS	Primary	MI	U	13	1	S	4		
B	CACAL	CALIFORNIA QUAIL	CALLIPEPLA CALIFORNICA	Primary	PR	C	22	2	S	1		
B	STCAL	CALLIOPE HUMMINGBIRD	STELLULA CALLIOPE	Other	SR	U	22	1	D	1		
B	BRCA	CANADA GOOSE	BRANTA CANADENSIS	Primary	PR	C	8	1	I	3		
B	AYVA	CANVASBACK	AYTHYA VALISINERIA	Primary	SR	U	6	1	U	1		
B	CATME	CANYON WREN	CATHERPES MEXICANUS	Other	?							
B	CACAS	CASSIN'S FINCH	CARPODACUS CASSINII	Primary	PR	U	23	1		5		
B	BOCE	CEDAR WAXWING	BOMBYCILLA CEDRORUM	Primary	PR	U	7	1	S	4		
B	SPPAS	CHIPPING SPARROW	SPIZELLA PASSERINA	Primary	SR	U	36	1	U	4		
B	ANCY	CINNAMON TEAL	ANAS CYANOPTERA	Primary	SR	C	10	1	?	1		
B	NUCO	CLARK'S NUTCRACKER	NUCIFRAGA COLUMBIANA	Primary	PR	U	15	1	S	4		
B	HIPY	CLIFF SWALLOW	HIRUNDO PYRRHONOTA	Primary	SR	U	12	1	S	1		
B	BUCL	COMMON GOLDENEYE	BUCEPHALA CLANGULA	Primary	WR	C	6	1	S	1		
B	GAIM	COMMON LOON	GAVIA IMMER	Primary	WR	R	2	1	S	4	ONHP	L2
B	GAIM	COMMON LOON	GAVIA IMMER	Primary	WR	R	2	1	S	4	USFS	FSS
B	MERME	COMMON MERGANSER	MERGUS MERGANSER	Primary	PR	C	9	1	S	1		
B	CHMI	COMMON NIGHTHAWK	CHORDEILES MINOR	Secondary	SR	C	37	1	S	4		
B	PHNU	COMMON POORWILL	PHALAENOPTILUS NUTTALLII	Other	SR	R	16	1	I	1		
B	CORCO	COMMON RAVEN	CORVUS CORAX	Primary	PR	C	36	1	I	4		
B	CAFL	COMMON REDPOLL	CARDUELIS FLAMMEA	Secondary	?							
B	GAGA	COMMON SNIPE	GALLINAGO GALLINAGO	Primary	PR	C	9	1	S	1		
B	GETR	COMMON YELLOWTHROAT	GEOTHLYPIS TRICHAS	Primary	SR	U	8	1	S	4		
B	ACCCO	COOPER'S HAWK	ACCIPITER COOPERII	Primary	PR	U	32	1	S	4	DNF	MIS

Appendix W1. Species known or expected to occur on the Sisters Ranger District, Deschutes National Forest, Sisters Ore. 1998. See below for data dictionary.

Class	Species Code	Common Name	Scientific Name	Riparian Use	Residence Status	Abundance	Versatility Rating	Dispersal Capability	Population Trend	Patch Matrix	Agency	Category
B	JUHY	DARK-EYED JUNCO	JUNCO HYEMALIS	Primary	PR	C	33	1	S	4		
B	PIPU	DOWNY WOODPECKER	PICOIDES PUBESCENS	Primary	PR	U	21	1	S	4		
B	EMOB	DUSKY FLYCATCHER	EMPIDONAX OBERHOLSERI	Secondary	SR	C	22	1	S	3		
B	PODNI	EARED GREBE	PODICEPS NIGRICOLLIS	Secondary	MI	R	4	1	U	4		
B	STVU	EUROPEAN STARLING	STURNUS VULGARIS	Primary	IN	C	27	1	I	5		
B	COVE	EVENING GROSBEAK	COCCOTHRAUSTES VESPERTINUS	Primary	PR	C	33	1	S	4		
B	BURE	FERRUGINOUS HAWK	BUTEO REGALIS	Primary	?	R					ONHP	L3
B	BURE	FERRUGINOUS HAWK	BUTEO REGALIS	Primary	?	R					State	SC
B	BURE	FERRUGINOUS HAWK	BUTEO REGALIS	Primary	?	R					USFS	FSS
B	BURE	FERRUGINOUS HAWK	BUTEO REGALIS	Primary	?	R					USFWS	C2
B	OTFL	FLAMMULATED OWL	OTUS FLAMMEOLUS	Other	SR	U	11	1	?	5	ONHP	L4
B	OTFL	FLAMMULATED OWL	OTUS FLAMMEOLUS	Other	SR	U	11	1	?	5	State	SC
B	PAIL	FOX SPARROW	PASSERELLA ILIACA	Primary	SR	U	34	1	S	4		
B	ANST	GADWALL	ANAS STREPERA	Primary	SR	C	10	1	?	1		
B	AQCH	GOLDEN EAGLE	AQUILA CHRYSAETOS	Other	PR	R	17	1	S	3	DNF	MIS
B	RESA	GOLDEN-CROWNED KINGLET	REGULUS SATRAPA	Other	PR	C	18	1	?	4		
B	ZOAT	GOLDEN-CROWNED SPARROW	ZONOTRICHIA ATRICAPILLA	Other	MI	U	13	1	U	1		
B	EMWR	GRAY FLYCATCHER	EMPIDONAX WRIGHTII	Primary	SR	U	24	1	U	1		
B	PECA	GRAY JAY	PERISOREUS CANADENSIS	Other	PR	C	23	1	S	4		
B	ARHE	GREAT BLUE HERON	ARDEA HERODIAS	Primary	PR	C	14	1	S	4	DNF	MIS
B	STRNE	GREAT GRAY OWL	STRIX NEBULOSA	Other	PR	U	9	1	D	4	ONHP	L4
B	STRNE	GREAT GRAY OWL	STRIX NEBULOSA	Other	PR	U	9	1	D	4	State	SV
B	STRNE	GREAT GRAY OWL	STRIX NEBULOSA	Other	PR	U	9	1	D	4	DNF	MIS
B	BUVI	GREAT HORNED OWL	BUBO VIRGINIANUS	Primary	PR	C	35	1	I	5		
B	AYMA	GREATER SCAUP	AYTHYA MARILA	Primary	WR	R	10	1	U	1		
B	PICH	GREEN-TAILED TOWHEE	PIPILO CHLORURUS	Primary	SR	U	16	1	S	1		
B	ANCR	GREEN-WINGED TEAL	ANAS CRECCA	Primary	PR	C	10	1	?	1		
B	PIVI	HAIRY WOODPECKER	PICOIDES VILLOSUS	Other	PR	C	22	1	?	4		
B	EMHA	HAMMOND'S FLYCATCHER	EMPIDONAX HAMMONDII	Other	SR	U	26	1	U	4		
B	HIHI	HARLEQUIN DUCK	HISTRIONICUS HISTRIONICUS	Primary	O	R	6	1	?	1	ONHP	L2
B	HIHI	HARLEQUIN DUCK	HISTRIONICUS HISTRIONICUS	Primary	O	R	6	1	?	1	State	SP
B	HIHI	HARLEQUIN DUCK	HISTRIONICUS HISTRIONICUS	Primary	O	R	6	1	?	1	USFS	FSS
B	HIHI	HARLEQUIN DUCK	HISTRIONICUS HISTRIONICUS	Primary	O	R	6	1	?	1	USFWS	C2
B	CAGU	HERMIT THRUSH	CATHARUS GUTTATUS	Primary	PR	C	30	1	D	4		
B	DEOC	HERMIT WARBLER	DENDROICA OCCIDENTALIS	Other	SR	C	25	1	U	4		
B	LOPCU	HOODED MERGANSER	LOPHODYTES CUCULLATUS	Primary	PR	C	12	1	S	1		
B	POAU	HORNED GREBE	PODICEPS AURITUS	Secondary	WR	R	3	1	?	4	ONHP	L4
B	POAU	HORNED GREBE	PODICEPS AURITUS	Secondary	WR	R	3	1	?	4	State	SP
B	ERAL	HORNED LARK	EREMOPHILA ALPESTRIS	Other	SR	C	7	1	S	1		
B	CARME	HOUSE FINCH	CARPODACUS MEXICANUS	Primary	PR	C						
B	PADO	HOUSE SPARROW	PASSER DOMESTICUS	Primary	IN	R	12	1	I	4		
B	TRAE	HOUSE WREN	TROGLODYTES AEDON	Primary	SR	C	18	1	S	4		
B	CHVO	KILLDEER	CHARADRIUS VOCIFERUS	Primary	PR	C	4	1	S	1		
B	CHGR	LARK SPARROW	CHONDESTES GRAMMACUS	Other	SR	R	12	1	D	1		
B	PASAM	LAZULI BUNTING	PASSERINA AMOENA	Primary	SR	U	18	1	S	1		
B	CAPS	LESSER GOLDFINCH	CARDUELIS PSALTRIA	Primary	?							
B	AYAF	LESSER SCAUP	AYTHYA AFFINIS	Primary	PR	C	10	1	U	4	ONHP	L4
B	MELE	LEWIS' WOODPECKER	MELANERPES LEWIS	Other	SR	U	14	1	D	4	ONHP	L3
B	MELE	LEWIS' WOODPECKER	MELANERPES LEWIS	Other	SR	U	14	1	D	4	State	SC
B	MELI	LINCOLN'S SPARROW	MELOSPIZA LINCOLNII	Primary	SR	C	23	1	S	1		
B	LALU	LOGGERHEAD SHRIKE	LANIUS LUDOVICIANUS	Primary	PR	R	24	1	?	1	ONHP	L3
B	LALU	LOGGERHEAD SHRIKE	LANIUS LUDOVICIANUS	Primary	PR	R	24	1	?	1	State	SU
B	LALU	LOGGERHEAD SHRIKE	LANIUS LUDOVICIANUS	Primary	PR	R	24	1	?	1	USFWS	C2
B	ASOT	LONG-EARED OWL	ASIO OTUS	Primary	PR	R	26	1	U	4		
B	OPTO	MACGILLIVRAY'S WARBLER	OPORORNIS TOLMIEI	Primary	SR	C	14	1	?	1		
B	ANPL	MALLARD	ANAS PLATYRHYNCHOS	Primary	PR	C	10	1	I	1		
B	CIPA	MARSH WREN	CISTOTHORUS PALUSTRIS	Primary	SR	R	8	1	S	1		
B	FACO	MERLIN	FALCO COLUMBARIUS	Primary	MI	R	17	1		3		
B	SICU	MOUNTAIN BLUEBIRD	SIALIA CURRUCOIDES	Secondary	PR	C	16	5	S	1		
B	PARGA	MOUNTAIN CHICKADEE	PARUS GAMBELI	Other	PR	C	20	1	S	4		
B	ORPI	MOUNTAIN QUAIL	OREORTYX PICTUS	Primary	PR	R	32	2	S	1	ONHP	L4
B	ORPI	MOUNTAIN QUAIL	OREORTYX PICTUS	Primary	PR	R	32	2	S	1	USFWS	C2
B	ZEMA	MOURNING DOVE	ZENAIDA MACROURA	Primary	PR	C	28	1	S	4		
B	VERU	NASHVILLE WARBLER	VERMIVORA RUFICAPILLA	Other	SR	R	30	1	S	4		
B	COAU	NORTHERN FLICKER	COLAPTES AURATUS	Primary	PR	C	33	1	D	4		
B	ACGE	NORTHERN GOSHAWK	ACCIPITER GENTILIS	Primary	PR	U	19	1	D	3	ONHP	L3
B	ACGE	NORTHERN GOSHAWK	ACCIPITER GENTILIS	Primary	PR	U	19	1	D	3	State	SC
B	ACGE	NORTHERN GOSHAWK	ACCIPITER GENTILIS	Primary	PR	U	19	1	D	3	USFWS	C2
B	ACGE	NORTHERN GOSHAWK	ACCIPITER GENTILIS	Primary	PR	U	19	1	D	3	DNF	MIS
B	CICY	NORTHERN HARRIER	CIRCUS CYANEUS	Primary	PR	C	13	4	I	3		
B	ICGA	NORTHERN ORIOLE	ICTERUS GALBULA	Primary	SR	C	20	1	?	4		
B	ANAC	NORTHERN PINTAIL	ANAS ACUTA	Primary	PR	U	8	1	D	1		
B	GLGN	NORTHERN PYGMY-OWL	GLAUCIDIUM GNOMA	Secondary	PR	U	36	1	S	4	ONHP	L3
B	GLGN	NORTHERN PYGMY-OWL	GLAUCIDIUM GNOMA	Secondary	PR	U	36	1	S	4	State	SU
B	STSE	NORTHERN ROUGH-WINGED SWALLOW	STELGIDOPTERYX SERRIPENNIS	Secondary	SR	C	9	1	S	4		
B	AEAC	NORTHERN SAW-WHET OWL	AEGOLIUS ACADICUS	Primary	PR	U	15	1	S	4		
B	ANCL	NORTHERN SHOVELER	ANAS CLYPEATA	Primary	PR	C	8	1	?	1		
B	LAEX	NORTHERN SHRIKE	LANIUS EXCUBITOR	Secondary	WR	R	16	1	?	1		
B	COBO	OLIVE-SIDED FLYCATCHER	CONTOPUS BOREALIS	Primary	SR	C	24	1	D	5		
B	VECE	ORANGE-CROWNED WARBLER	VERMIVORA CELATA	Primary	SR	C	31	1	D	1		
B	PAHA	OSPREY	PANDION HALIAETUS	Primary	SR	C	10	1	I	5	DNF	MIS
B	POPO	PIED-BILLED GREBE	PODILYMBUS PODICEPS	Secondary	PR	U	4	1	S	4		
B	DRPI	PILEATED WOODPECKER	DRYOCOPUS PILEATUS	Other	PR	U	27	1	D	3	ONHP	L3

Appendix W1. Species known or expected to occur on the Sisters Ranger District, Deschutes National Forest, Sisters Ore. 1998. See below for data dictionary.

Class	Species Code	Common Name	Scientific Name	Riparian Use	Residence Status	Abundance	Versatility Rating	Dispersal Capability	Population Trend	Patch Matrix	Agency	Category
B	DRPI	PILEATED WOODPECKER	DRYOCOPUS PILEATUS	Other	PR	U	27	1	D	3	State	SC
B	DRPI	PILEATED WOODPECKER	DRYOCOPUS PILEATUS	Other	PR	U	27	1	D	3	DNF	MIS
B	CARPI	PINE SISKIN	CARDUELIS PINUS	Primary	PR	C	32	1	S	4		
B	GYCY	PINYON JAY	GYMNORHINUS CYANOCEPHALUS	Secondary	PR	C	17	1	?	2		
B	FAME	PRAIRIE FALCON	FALCO MEXICANUS	Secondary	PR	U	10	1	?	3		
B	CARPU	PURPLE FINCH	CARPODACUS PURPUREUS	Primary	PR	U	29	1		4		
B	PRSU	PURPLE MARTIN	PROGNE SUBIS	Primary	?	R	24	1	D	4	ONHP	L3
B	PRSU	PURPLE MARTIN	PROGNE SUBIS	Primary	?	R	24	1	D	4	State	SC
B	SIPY	PYGMY NUTHATCH	SITTA PYGMAEA	Other	PR	C	8	1	S	4	ONHP	L4
B	SIPY	PYGMY NUTHATCH	SITTA PYGMAEA	Other	PR	C	8	1	S	4	State	SV
B	LOXCU	RED CROSSBILL	LOXIA CURVIROSTRA	Other	PR	C	23	1	D	4		
B	SICAN	RED-BREASTED NUTHATCH	SITTA CANADENSIS	Other	PR	C	24	1	S	4		
B	SPRU	RED-BREASTED SAPSUCKER	SPHYRAPICUS RUBER	Primary	PR	U	14	1	S	4		
B	VIOL	RED-EYED VIREO	VIREO OLIVACEUS	Primary	?							
B	PODGR	RED-NECKED GREBE	PODICEPS GRISEGENA	Secondary	?O						ONHP	L2
B	PODGR	RED-NECKED GREBE	PODICEPS GRISEGENA	Secondary	?O						State	SC
B	BUJA	RED-TAILED HAWK	BUTEO JAMAICENSIS	Primary	PR	C	29	1	I	5	DNF	MIS
B	AGPH	RED-WINGED BLACKBIRD	AGELAIUS PHOENICEUS	Primary	PR	C	11	1	S	1		
B	AYAM	REDHEAD	AYTHYA AMERICANA	Primary	SR	U	6	1	U	1		
B	AYCO	RING-NECKED DUCK	AYTHYA COLLARIS	Primary	PR	U	18	1	U	4	ONHP	L4
B	COLI	ROCK DOVE	COLUMBA LIVIA	Other	IN	U	12	1	I	4		
B	SAOB	ROCK WREN	SALPINCTES OBSOLETUS	Other	SR	C	12	1	S	1		
B	BULA	ROUGH-LEGGED HAWK	BUTEO LAGOPUS	Secondary	WR	R	9	1	U	3		
B	RECA	RUBY-CROWNED KINGLET	REGULUS CALENDULA	Other	PR	C	16	1	S	4		
B	OXJA	RUDDY DUCK	OXYURA JAMAICENSIS	Primary	SR	O	6	1	S	1		
B	BOUM	RUFFED GROUSE	BONASA UMBELLUS	Primary	PR	C	21	2	S	4		
B	SELRU	RUFOUS HUMMINGBIRD	SELASPHORUS RUFUS	Primary	SR	C	37	1	D	4		
B	PIER	RUFOUS-SIDED TOWHEE	PIPILO ERYTHROPHTHALMUS	Other	PR	C	31	1	S	4		
B	ORMO	SAGE THRASHER	OREOSCOPTES MONTANUS	Primary	SR	C	18	1	S	1		
B	GRCA	SANDHILL CRANE	GRUS CANADENSIS	Primary	SR	U	4	1	I	1	ONHP	L4
B	GRCA	SANDHILL CRANE	GRUS CANADENSIS	Primary	SR	U	4	1	I	1	State	SV
B	GRCA	SANDHILL CRANE	GRUS CANADENSIS	Primary	SR	U	4	1	I	1	USFS	FSS
B	PASA	SAVANNAH SPARROW	PASSERCULUS SANDWICHENSIS	Other	SR	C	15	1	S	1		
B	SAYSA	SAY'S PHOEBE	SAYORNIS SAYA	Other	SR	U	9	1	I	1		
B	APCO	SCRUB JAY	APHELOCOMA COERULESCENS	Primary	PR	R	24	1	S	1		
B	ACST	SHARP-SHINNED HAWK	ACCIPITER STRIATUS	Primary	PR	U	33	1	S	4	DNF	MIS
B	ASFL	SHORT-EARED OWL	ASIO FLAMMEUS	Primary	SR	R	11	1	S	2		
B	VISO	SOLITARY VIREO	VIREO SOLITARIUS	Secondary	SR	U	28	1		4		
B	MELME	SONG SPARROW	MELOSPIZA MELODIA	Primary	PR	C	24	1	S	4		
B	PORCA	SORA	PORZANA CAROLINA	Primary	SR	U	10	1		1		
B	STOC	SPOTTED OWL	STRIX OCCIDENTALIS	Other	PR	U	12	1	D	3	ONHP	L1
B	STOC	SPOTTED OWL	STRIX OCCIDENTALIS	Other	PR	U	12	1	D	3	State	LT
B	STOC	SPOTTED OWL	STRIX OCCIDENTALIS	Other	PR	U	12	1	D	3	USFWS	T
B	ACMA	SPOTTED SANDPIPER	ACTITIS MACULARIA	Primary	SR	U	4	1	S	1		
B	CYST	STELLER'S JAY	CYANOCITTA STELLERI	Secondary	PR	C	32	1	S	4		
B	BUSW	SWAINSON'S HAWK	BUTEO SWAINSONI	Primary	?	R			D			
B	CAUS	SWAINSON'S THRUSH	CATHARUS USTULATUS	Primary	SR	C	26	1	D	4		
B	PITR	THREE-TOED WOODPECKER	PICOIDES TRIDACTYLUS	Other	PR	R	10	1	?	3	ONHP	L4
B	PITR	THREE-TOED WOODPECKER	PICOIDES TRIDACTYLUS	Other	PR	R	10	1	?	3	State	SC
B	MYTO	TOWNSEND'S SOLITAIRE	MYADESTES TOWNSENDI	Other	PR	C	25	1	S	4		
B	DETO	TOWNSEND'S WARBLER	DENDROICA TOWNSENDI	Other	SR	U	22	1	S	4		
B	TABI	TREE SWALLOW	TACHYCINETA BICOLOR	Primary	SR	C	14	1	S	4		
B	CATAU	TURKEY VULTURE	CATHARTES AURA	Primary	SR	U	32	1	D	5		
B	IXNA	VARIED THRUSH	IXOREUS NAEVIUS	Other	PR	U	17	1	S	4		
B	CHVA	VAUX'S SWIFT	CHAETURA VAUXI	Secondary	SR	U	34	1	S	4		
B	POEGR	VESPER SPARROW	POOECETES GRAMINEUS	Other	SR	C	8	1	S	1		
B	TATH	VIOLET-GREEN SWALLOW	TACHYCINETA THALASSINA	Primary	SR	C	14	1	S	4		
B	RALI	VIRGINIA RAIL	RALLUS LIMICOLA	Primary	PR	U	10	1	S	1		
B	VIGI	WARBLING VIREO	VIREO GILVUS	Primary	SR	C	26	1	D	4		
B	SIME	WESTERN BLUEBIRD	SIALIA MEXICANA	Secondary	PR	U	20	1	S	1	ONHP	L4
B	SIME	WESTERN BLUEBIRD	SIALIA MEXICANA	Secondary	PR	U	20	1	S	1	State	SV
B	EMDI	WESTERN FLYCATCHER	EMPIDONAX DIFFICILIS	Primary	SR	R	18	1	U	3		
B	AEOC	WESTERN GREBE	AECHMOPHORUS OCCIDENTALIS	Primary	SR	C	4	1	S	4		
B	TYVE	WESTERN KINGBIRD	TYRANNUS VERTICALIS	Primary	SR	R	17	1	I	1		
B	STUNE	WESTERN MEADOWLARK	STURNELLA NEGLECTA	Other	SR	C	16	1	S	1		
B	CALMA	WESTERN SANDPIPER	CALIDRIS MAURI	Secondary	MI	U	2	1	S	1		
B	OTKE	WESTERN SCREECH-OWL	OTUS KENNICOTTII	Primary	PR	U	35	1	S	4		
B	PILU	WESTERN TANAGER	PIRANGA LUDOVICIANA	Other	SR	U	30	1	S	4		
B	COSO	WESTERN WOOD-PEWEE	CONTOPUS SORDIDULUS	Primary	SR	C	29	1	U	4		
B	SICAR	WHITE-BREASTED NUTHATCH	SITTA CAROLINENSIS	Other	PR	U	8	1	D	4		
B	ZOLE	WHITE-CROWNED SPARROW	ZONOTRICHIA LEUCOPHRYS	Primary	PR	C	34	1	D	1		
B	PIAL	WHITE-HEADED WOODPECKER	PICOIDES ALBOLARVATUS	Other	PR	U	12	1	S	4	ONHP	L3
B	PIAL	WHITE-HEADED WOODPECKER	PICOIDES ALBOLARVATUS	Other	PR	U	12	1	S	4	State	SC
B	PIAL	WHITE-HEADED WOODPECKER	PICOIDES ALBOLARVATUS	Other	PR	U	12	1	S	4	DNF	MIS
B	LOLE	WHITE-WINGED CROSSBILL	LOXIA LEUCOPTERA	Other	?	?	13	1	S	2		
B	MEGA	WILD TURKEY	MELEAGRIS GALLOPAVO	Secondary	IN	U	?	2	I	4		
B	CASE	WILLET	CATOPTROPHORUS SEMIPALMATUS	Primary	MI	R						
B	SPHTH	WILLIAMSON'S SAPSUCKER	SPHYRAPICUS THYROIDEUS	Other	PR	U	12	1	S	4	ONHP	L4
B	SPHTH	WILLIAMSON'S SAPSUCKER	SPHYRAPICUS THYROIDEUS	Other	PR	U	12	1	S	4	State	SU
B	SPHTH	WILLIAMSON'S SAPSUCKER	SPHYRAPICUS THYROIDEUS	Other	PR	U	12	1	S	4	DNF	MIS
B	EMTR	WILLOW FLYCATCHER	EMPIDONAX TRAILLII	Primary	SR	U	20	1	D	4		
B	WIPU	WILSON'S WARBLER	WILSONIA PUSILLA	Primary	SR	C	33	1	S	4		
B	TRTR	WINTER WREN	TROGLODYTES TROGLODYTES	Primary	PR	C	19	1	D	4		

Appendix W1. Species known or expected to occur on the Sisters Ranger District, Deschutes National Forest, Sisters Ore. 1998. See below for data dictionary.

Class	Species Code	Common Name	Scientific Name	Riparian Use	Residence Status	Abundance	Versatility Rating	Dispersal Capability	Population Trend	Patch Matrix	Agency	Category
B	AISP	WOOD DUCK	AIX SPONSA	Primary	PR	U	25	1	D	1		
B	DEPET	YELLOW WARBLER	DENDROICA PETECHIA	Primary	SR	U	19	1	S	1		
B	ICVI	YELLOW-BREASTED CHAT	ICTERIA VIRENS	Primary	SR	R	8	1	U	1		
B	XAXA	YELLOW-HEADED BLACKBIRD	XANTHOCEPHALUS XANTHOCEPHALUS	Primary	SR	U						
B	DENCO	YELLOW-RUMPED WARBLER	DENDROICA CORONATA	Secondary	PR	C	18	1	S	4		
M	TATA	BADGER	TAXIDEA TAXUS	Secondary	PR	U	28	2	S	3		
M	CASCA	BEAVER	CASTOR CANADENSIS	Primary	PR	C	24	2	I	4		
M	SPBEL	BELDING'S GROUND SQUIRREL	SPERMOPHILUS BELDINGI	Other	PR	C	42	2	S	1		
M	EPFU	BIG BROWN BAT	EPTESICUS FUSCUS	Secondary	PR	C	33	1	S	5		
M	URAM	BLACK BEAR	URSUS AMERICANUS	Secondary	PR	U	36	1		4		
M	ODHE	BLACK-TAILED & MULE DEER	ODOCOILEUS HEMIONUS	Primary	PR	C	40	1	S	4		
M	LECA	BLACK-TAILED JACK RABBIT	LEPUS CALIFORNICUS	Other	PR	C	14	1	S	2		
M	FERU	BOBCAT	FELIS RUFUS	Secondary	PR	U	34	1	?	4		
M	SCLA	BROAD-FOOTED MOLE	SCAPANUS LATIMANUS	Primary	?	?			U			
M	NECI	BUSHY-TAILED WOODRAT	NEOTOMA CINEREA	Secondary	PR	?	42	2	?	4		
M	SPBEE	CALIFORNIA GROUND SQUIRREL	SPERMOPHILUS BEECHEYI	Other	?	?		2	?	1		
M	MYOCA	CALIFORNIA MYOTIS	MYOTIS CALIFORNICUS	Primary	PR	C	27	1	U	5		
M	PECR	CANYON MOUSE	PEROMYSCUS CRINITUS	Other	PR	?	11	3	U	1		
M	CANLA	COYOTE	CANIS LATRANS	Primary	PR	C	42	1	I	4		
M	MIOR	CREEPING VOLE	MICROTUS OREGONI	Other	PR	?	20	2	?	1		
M	MIME	DARK KANGAROO MOUSE	MICRODIPODOPS MEGACEPHALUS	Other	PR	?	?	2	?	1		
M	PEMA	DEER MOUSE	PEROMYSCUS MANICULATUS	Primary	PR	C	42	3	U	4		
M	TADO	DOUGLAS' SQUIRREL	TAMIASCIURUS DOUGLASII	Secondary	PR	C	19	2	S	4		
M	SOMO	DUSKY SHREW	SOREX MONTICOLUS	Other	?	?						
M	CEEL	ELK	CERVUS ELAPHUS	Primary	PR	C	32	1	I	5	DNF	MIS
M	MAPE	FISHER	MARTES PENNANTI	Primary	PR	R	15					
M	SPLA	GOLDEN-MANTLED GROUND SQUIRREL	SPERMOPHILUS LATERALIS	Secondary	PR	C	37	2	?	4		
M	URCI	GRAY FOX	UROCYON CINEREOARGENTEUS	Other	PR	O	25	1		4		
M	PEPA	GREAT BASIN POCKET MOUSE	PEROGNATHUS PARVUS	Other	PR	?	18	3	U	4		
M	PHIN	HEATHER VOLE	PHENACOMYS INTERMEDIUS	Primary	PR	?	15	3	U	1		
M	LACI	HOARY BAT	LASIURUS CINEREUS	Primary	PR	R	28	1	U	4	FEMAT	Y
M	MUMU	HOUSE MOUSE	MUS MUSCULUS	Secondary	IN	C	9	3	S	1		
M	TAMI	LEAST CHIPMUNK	TAMIAS MINIMUS	Other	PR	C	8	2	S	1		
M	MYLU	LITTLE BROWN MYOTIS	MYOTIS LUCIFUGUS	Primary	PR	C	34	1	S	5		
M	MYEV	LONG-EARED MYOTIS	MYOTIS EVOTIS	Other	PR	C	30	1	S	4	FEMAT	Y
M	MYVO	LONG-LEGGED MYOTIS	MYOTIS VOLANS	Primary	PR	C	32	1	U	4	FEMAT	Y
M	MILO	LONG-TAILED VOLE	MICROTUS LONGICAUDUS	Primary	PR	?	32	2	?	1		
M	MUFR	LONG-TAILED WEASEL	MUSTELA FRENATA	Secondary	PR	C	40	2	S	4		
M	MAAM	MARTEN	MARTES AMERICANA	Secondary	PR	R	14	1	D	3	FEMAT	Y
M	MAAM	MARTEN	MARTES AMERICANA	Secondary	PR	R	14	1	D	3	ONHP	L3
M	MAAM	MARTEN	MARTES AMERICANA	Secondary	PR	R	14	1	D	3	State	SC
M	MAAM	MARTEN	MARTES AMERICANA	Secondary	PR	R	14	1	D	3	DNF	MIS
M	SOME	MERRIAM'S SHREW	SOREX MERRIAMI	Other	?	R	8	3	U	1		
M	MUVI	MINK	MUSTELA VISON	Primary	PR	U	38	2	U	4		
M	MIMO	MONTANE VOLE	MICROTUS MONTANUS	Primary	PR	?	20	2	?	1		
M	APRU	MOUNTAIN BEAVER	APLODONTIA RUFA	Primary	PR	C	28		S	3		
M	FECO	MOUNTAIN LION	FELIS CONCOLOR	Secondary	PR	U	36	1	D	4		
M	ODHE	MULE DEER	ODOCOILEUS HEMIONUS	Secondary	PR	C			S		DNF	MIS
M	ONZI	MUSKRAT	ONDATRA ZIBETHICUS	Primary	PR	C	9	1	S	2		
M	GLSA	NORTHERN FLYING SQUIRREL	GLAUCOMYS SABRINUS	Other	PR	U	26	2		1		
M	ONLE	NORTHERN GRASSHOPPER MOUSE	ONYCHOMYS LEUCOGASTER	Other	PR	?	16	1	?	1		
M	THTA	NORTHERN POCKET GOPHER	THOMOMYS TALPOIDES	Primary	PR	?	18	3		1		
M	RANO	NORWAY RAT	RATTUS NORVEGICUS	Other	IN	C	8	2	S	1		
M	SYNU	NUTTALL'S COTTONTAIL	SYLVILAGUS NUTTALLII	Primary	PR	R	27	2	S	1		
M	DIOR	ORD'S KANGAROO RAT	DIPODOMYS ORDII	Other	PR	C	16	1	S	2		
M	ANPA	PALLID BAT	ANTROZOUS PALLIDUS	Primary	SR	U	16	1	?	2	FEMAT	Y
M	ANPA	PALLID BAT	ANTROZOUS PALLIDUS	Primary	SR	U	16	1	?	2	ONHP	L3
M	ANPA	PALLID BAT	ANTROZOUS PALLIDUS	Primary	SR	U	16	1	?	2	State	SV
M	OCPR	PIKA	OCHOTONA PRINCEPS	Primary	PR	C	5	3	S	1		
M	PETRU	PINON MOUSE	PEROMYSCUS TRUEI	Other	PR	?	12	3	U	1		
M	ERDO	PORCUPINE	ERETHIZON DORSATUM	Secondary	PR	C	32	2	S	4		
M	SOPR	PREBLE'S SHREW	SOREX PREBLEI	Primary	?	?					OHNP	L4
M	SOPR	PREBLE'S SHREW	SOREX PREBLEI	Primary	?	?					USFWS	C2
M	BRID	PYGMY RABBIT	BRACHYLAGUS IDAHOENSIS	Other	?	U	6	1	U	1	ONHP	L2
M	BRID	PYGMY RABBIT	BRACHYLAGUS IDAHOENSIS	Other	?	U	6	1	U	1	State	SV
M	BRID	PYGMY RABBIT	BRACHYLAGUS IDAHOENSIS	Other	?	U	6	1	U	1	USFWS	C2
M	PRLO	RACCOON	PROCYON LOTOR	Primary	PR	C	37	2	S	4		
M	VUVU	RED FOX	VULPES VULPES	Primary	PR	O	36	1	S	3		
M	LUCA	RIVER OTTER	LUTRA CANADENSIS	Primary	PR	C	32	2	S	4		
M	LECU	SAGEBRUSH VOLE	LEMMISCUS CURTATUS	Other	PR	?	8	1	?	2		
M	NEGI	SHREW-MOLE	NEUROTRICHUS GIBBSII	Other	PR	?	20	2	?	2		
M	LANO	SILVER-HAIRED BAT	LASIONYCTERIS NOCTIVAGANS	Other	SR	?	28	1	U	5	FEMAT	Y
M	LEAM	SNOWSHOE HARE	LEPUS AMERICANUS	Primary	PR	C	33	2	S	4		
M	MEPME	STRIPED SKUNK	MEPHITIS MEPHITIS	Primary	PR	C	24	2	S	3		
M	PLTO	TOWNSEND'S BIG-EARED BAT	PLECOTUS TOWNSENDII	Secondary	PR	U	11	1	S	4	ONHP	L2
M	PLTO	TOWNSEND'S BIG-EARED BAT	PLECOTUS TOWNSENDII	Secondary	PR	U	11	1	S	4	State	SC
M	PLTO	TOWNSEND'S BIG-EARED BAT	PLECOTUS TOWNSENDII	Secondary	PR	U	11	1	S	4	USFS	FSS
M	PLTO	TOWNSEND'S BIG-EARED BAT	PLECOTUS TOWNSENDII	Secondary	PR	U	11	1	S	4	USFWS	C2
M	PLTO	TOWNSEND'S BIG-EARED BAT	PLECOTUS TOWNSENDII	Secondary	PR	U	11	1	S	4	DNF	MIS
M	TATO	TOWNSEND'S CHIPMUNK	TAMIAS TOWNSENDII	Primary	PR	?	18	1	S	4		
M	SPTO	TOWNSEND'S GROUND SQUIRREL	SPERMOPHILUS TOWNSENDII	Secondary	?	?	20					
M	SOTR	TROWBRIDGE'S SHREW	SOREX TROWBRIDGII	Other	PR	?	18	2	U	1		
M	SOVA	VAGRANT SHREW	SOREX VAGRANS	Primary	PR	U	8	3	?	4		

Appendix W1. Species known or expected to occur on the Sisters Ranger District, Deschutes National Forest, Sisters Ore. 1998. See below for data dictionary.

Class	Species Code	Common Name	Scientific Name	Riparian Use	Residence Status	Abundance	Versatility Rating	Dispersal Capability	Population Trend	Patch Matrix	Agency	Category
M	SOPAL	WATER SHREW	SOREX PALUSTRIS	Primary	PR	?	16	3		1		
M	MIRI	WATER VOLE	MICROTUS RICHARDSONI	Primary	PR	?	9	2	?	1		
M	SCIGR	WESTERN GRAY SQUIRREL	SCIURUS GRISEUS	Other	PR	U	19	2	U	4		
M	REME	WESTERN HARVEST MOUSE	REITHRODONTOMYS MEGALOTIS	Secondary	PR	?	25	2	U	1		
M	ZAPR	WESTERN JUMPING MOUSE	ZAPUS PRINCEPS	Primary	PR		18	3	S	1		
M	PIHE	WESTERN PIPISTRELLE	PIPISTRELLUS HESPERUS	Secondary	PR	U			?			
M	THMA	WESTERN POCKET GOPHER	THOMOMYS MAZAMA	Other	PR	?	20	3		1		
M	CLCA	WESTERN RED-BACKED VOLE	CLETHRIONOMYS CALIFORNICUS	Primary			16	3	?	4		
M	MYOCI	WESTERN SMALL-FOOTED BAT	MYOTIS CILIOLABRUM	Secondary	PR	C		1	U	4		
M	SPGR	WESTERN SPOTTED SKUNK	SPILOGALE GRACILIS	Secondary	PR	?	28	2	?	3		
M	GUGU	WOLVERINE	GULO GULO	Secondary	PR	R	18	1	U	3	ONHP	L2
M	GUGU	WOLVERINE	GULO GULO	Secondary	PR	R	18	1	U	3	State	LT
M	GUGU	WOLVERINE	GULO GULO	Secondary	PR	R	18	1	U	3	USFS	FSS
M	GUGU	WOLVERINE	GULO GULO	Secondary	PR	R	18	1	U	3	USFWS	C2
M	MAFL	YELLOW-BELLIED MARMOT	MARMOTA FLAVIVENTRIS	Secondary	PR	C	11	2	S	1		
M	TAAM	YELLOW-PINE CHIPMUNK	TAMIAS AMOENUS	Primary	PR	C	30	1	S	4		
M	MYYU	YUMA MYOTIS	MYOTIS YUMANENSIS	Primary	PR	C	30	1		4		
R	THSI	COMMON GARTER SNAKE	THAMNOPHIS SIRTALIS	Primary	PR	C	32	3	S	1		
R	PICA	GOPHER SNAKE	PITUOPHIS CATENIFER	Primary	PR	C	31	3	S	1		
R	HYTO	NIGHT SNAKE	HYPSIGLENA TORQUATA	Other		U	16	3	U	1		
R	ELCO	NORTHERN ALLIGATOR LIZARD	ELGARIA COERULEA	Primary	PR	C	38	3	U	4		
R	COLCO	RACER	COLUBER CONSTRICTOR	Secondary	PR	R		2	U	1		
R	CHBO	RUBBER BOA	CHARINA BOTTAE	Primary	PR	U	17	3	S	4		
R	SCEGR	SAGEBRUSH LIZARD	SCELOPORUS GRACIOSUS	Other	PR	C	18	3	S	4		
R	PHDO	SHORT-HORNED LIZARD	PHRYNOSOMA DOUGLASSII	Other	PR	R	22	3	U	4		
R	UTST	SIDE-BLOTCHED LIZARD	UTA STANSBURIANA	Other	PR	U	16	3	U	1		
R	ELMU	SOUTHERN ALLIGATOR LIZARD	ELGARIA MULTICARINATA	Primary		C	26	3	U	4		
R	MATA	STRIPED WHIPSNAKE	MASTICOPHIS TAENIATUS	Secondary		U	22	3	U	1		
R	SCOC	WESTERN FENCE LIZARD	SCELOPORUS OCCIDENTALIS	Primary	PR	C	26	3	S	4		
R	CLMA	WESTERN POND TURTLE	CLEMMYS MARMORATA	Primary		R	12	3	D	1	ONHP	L2
R	CLMA	WESTERN POND TURTLE	CLEMMYS MARMORATA	Primary		R	12	3	D	1	State	SC
R	CLMA	WESTERN POND TURTLE	CLEMMYS MARMORATA	Primary		R	12	3	D	1	USFS	FSS
R	CLMA	WESTERN POND TURTLE	CLEMMYS MARMORATA	Primary		R	12	3	D	1	USFWS	C2
R	CRVI	WESTERN RATTLESNAKE	CROTALUS VIRIDIS	Secondary	PR	U	30	3	S	4		
R	EUSK	WESTERN SKINK	EUMECES SKILTONIANUS	Primary	PR	C	24	3	S	1		
R	THEL	WESTERN TERRESTRIAL GARTER SNAKE	THAMNOPHIS ELEGANS	Secondary	PR	C	36	3	S	1		

Appendix W-1. Data dictionary.

Data Dictionary:

Class: A=amphibian, B=bird, M=mammal, R=reptile

Species Code: First two/three letters of genus and species.

Riparian Use: Primary-needs riparian areas for nesting, roosting, or foraging. Secondary-benefits from riparian areas and may use them for nesting, roosting, or foraging.

Residence Status: PR=permanent resident, SR=summer resident only, WR=winter resident only, MI=migrant seen only in transit, IN=introduced species, EX=probably extirpated.

Abundance: C=common, U=uncommon, R=rare, O=occasional/vagrant.

Versatility Rating: The sum of the number of plant communities and stand conditions used for breeding plus the number of plant communities and stand conditions used for feeding by a species. Score from 0 (specialist) to 42 (generalist).

Dispersal Capability: 1=High migratory or capable of dispersing across landscapes e.g., ducks and geese. 1=Moderate, capable of dispersing at the landscape scale, e.g., spotted owls, big game. 3=Low, disperse within patch only or between adjacent patches only, e.g., short horned lizard.

Population Trend: D=decreasing, S=stable, I=increasing.

Patch/Matrix: This field is used to indicate how a species would be categorized using different distributions and patterns of habitat. 1=Patch species - likely use only 1 homogeneous patch during life cycle or breeding period for migrants. 2= Mosaic species - uses aggregates of patches of habitat. 3=Generalist - will use all or many patch types. 4=Contrast - requires 2 major structural stages in close proximity. 5= Edge - requires or prefers edge habitat.

Agency: USFWS - United States Fish and Wildlife Service, USFS - United States Forest Service, State - Oregon Dept of Fish and Wildlife, ONHP - Oregon Natural Heritage Program, FEMAT - Federal Ecosystem Management Assessment Team. DNF - Deschutes National Forest.

Category: For USFWS, T=threatened, E=endangered, C2=category 2 (sensitive), P=proposed for listing. For USFS FSS=on the current sensitive species list. FR= recommeded by forest for addition to the sensitive species list. State: SE - state endangered, ST - state threatened, SP - sensitive - periperal or naturally rare, SC – state sensitive – critical, SV – state sensitive – vulnerable, SU – state sensitive – undetermined status. ONHP: L1=threatened with extincition, L2=threatened with extirpation, L3=review list, more information needed, L4=species of concern, rare or declining. FEMAT: Y=a species of concern, those species with <80% chance of Outcome A under Option 9.

APPENDIX W-2

BREEDING BIRD TRENDS FOR OREGON

Appendix W-2. Breeding bird Trends for Oregon (USGS, Patuxent Wildlife Research Center, North American Breeding Bird Survey, Laurel, Maryland 1998).

Oregon Trend Results

	1966-1996 trends						1966-1979			1980-1996		
Species	Trend	P	N	(95% CI	)	R.A.	Trend	P	N	Trend	P	N
Ring-billed Gull	-3.5		19	-21.3	14.3	7.68	-3.0		6	5.9		14
Common Merganser	-1.4		18	-9.0	6.2	0.15	-20.9		3	-3.0		16
Mallard	2.3		62	-4.4	9.0	4.61	0.0		23	2.6		55
Cinnamon Teal	-3.1		23	-8.1	1.9	1.80	0.2		7	-0.5		22
Canada Goose	0.4		27	-34.2	34.9	5.73	-5.4		6	-1.0		23
Great Blue Heron	-2.3	*	41	-5.0	0.4	0.61	7.4	****	19	-7.9	***	38
Green Heron	-6.4		15	-18.5	5.7	0.14	-6.2		4	-3.9		14
Sandhill Crane	-3.2		19	-11.6	5.2	1.87	6.0		6	-5.3		20
Common Snipe	-1.0		46	-3.6	1.6	2.89	5.3	**	19	-3.0	**	42
Spotted Sandpiper	-2.1		40	-5.6	1.4	0.48	3.4		22	0.9		38
Long-billed Curlew	4.5	*	20	-1.5	10.5	2.27	-1.1		5	6.5		19
Killdeer	-1.2		74	-8.6	6.3	4.14	-3.9	***	40	-4.6	****	70
Chukar	-6.4	*	16	-13.9	1.1	2.90	-2.2		6	-10.6	***	16
Mountain Quail	0.3		24	-1.5	2.0	0.62	2.2		10	0.3		23
California Quail	-2.1		62	-9.0	4.7	3.40	1.4		31	-3.9		57
Ring-necked Pheasant	-2.2	***	43	-4.4	0.0	5.20	-0.5		24	-3.2	***	37
Band-tailed Pigeon	-2.4	****	29	-3.5	-1.4	3.22	-1.7		13	-10.5	****	29
Rock Dove	-0.9		35	-8.2	6.3	3.01	21.5	****	15	-5.1		34
Mourning Dove	-3.3	****	83	-4.5	-2.2	7.87	-4.5	***	44	-2.8	***	77
Turkey Vulture	-0.9		52	-3.6	1.7	1.53	1.1		21	3.3		49
Northern Harrier	2.6		32	-3.2	8.4	0.62	1.9		9	2.1		32
Red-tailed Hawk	1.6	*	96	-0.4	3.5	2.05	1.4		40	2.2	*	92
Swainson's Hawk	-3.2		15	-9.4	3.0	0.32	-5.8		7	-4.0		13
Golden Eagle	0.7		24	-9.4	10.8	0.33	0.2		8	5.0	*	21
Prairie Falcon	-1.2		19	-10.0	7.6	0.30	5.1		2	9.1		16
American Kestrel	-3.5	****	71	-5.3	-1.7	1.31	2.5		35	-2.3	*	64
Osprey	7.1	****	24	2.2	11.9	0.31	35.7	**	6	3.6		22
Great Horned Owl	-4.1		24	-10.6	2.4	0.13	-1.6		6	-5.3		19
Belted Kingfisher	-3.7	****	37	-6.3	-1.1	0.25	3.9		18	-4.9	****	34
Hairy Woodpecker	0.8		65	-1.4	3.0	1.09	-4.9	***	21	3.0	***	62
Downy Woodpecker	-3.8	*	39	-8.5	0.9	0.35	-2.6		13	-3.6	**	36
Red-naped Sapsucker	0.3		17	-10.0	10.6	0.47	--	****	--	-4.6		15
Red-breasted Sapsucker	1.6		39	-1.9	5.1	0.49	5.2	*	14	-3.4		35
Williamson's Sapsucker	-2.7		18	-8.7	3.3	0.73	-4.3		4	-16.3	**	19
Pileated Woodpecker	1.1		55	-2.0	4.2	0.83	2.2		13	0.4		54
Red-shafted Flicker	-0.6		102	-1.9	0.6	4.29	4.8	***	43	-0.7		100
Common Nighthawk	-0.1		69	-4.2	4.0	2.37	-2.1		35	2.2		60
Vaux's Swift	3.5		40	-2.7	9.8	0.56	9.9		11	28.3		37
Rufous Hummingbird	-5.3	****	50	-7.7	-3.0	1.28	-1.4		23	-6.4	***	44
Western Kingbird	-0.5		44	-3.6	2.7	3.09	3.5	*	19	1.2		42
Ash-throated Flycatcher	1.3		19	-1.1	3.8	0.50	-0.4		7	2.4		16
Say's Phoebe	27.5		26	-28.1	83.0	0.77	26.3		7	9.0		21
Olive-sided Flycatcher	-5.1	****	69	-6.4	-3.9	3.76	-4.2	***	28	-4.1	***	64
Western Wood-pewee	-3.5	****	80	-5.2	-1.8	5.65	-3.6	***	38	-0.9		76
Pacific-slope Flycatchr	-3.5	***	46	-6.8	-0.2	5.15	-3.0		16	-5.7	***	45
Willow Flycatcher	-5.8	****	61	-10.2	-1.3	2.31	-4.8	**	29	-2.6	*	57
Hammond's Flycatcher	-0.3		52	-4.2	3.6	3.56	6.2		15	-2.0		50
Dusky Flycatcher	2.2		56	-3.0	7.3	3.84	5.1		16	5.9	****	52
Gray Flycatcher	7.9	*	29	-2.3	18.1	2.87	15.4		6	13.0	****	29
Horned Lark	0.7		43	-2.6	4.0	27.79	-3.4		18	0.5		43
Black-billed Magpie	-3.5	*	41	-7.9	0.9	7.26	-7.9	****	20	2.0		39
Steller's Jay	-0.2		82	-1.1	0.6	5.15	4.2	****	31	1.8	*	80
Western Scrub-jay	1.9	*	29	-0.5	4.4	1.61	7.4	****	15	-0.7		28

Gray Jay	3.1	**	32	-0.2	6.4	0.91	4.3		9	4.5		30
Common Raven	-0.2		102	-3.8	3.3	6.72	-7.2	***	36	4.1	**	97
American Crow	1.9	*	60	-0.6	4.3	6.70	4.0	*	28	2.3		57
Clark's Nutcracker	-1.1		27	-11.1	9.0	1.13	-5.9	*	6	7.1		24
European Starling	0.8		86	-0.7	2.3	23.41	5.6	***	41	1.8		84
Brown-headed Cowbird	-1.7	**	94	-3.6	0.2	8.27	-4.1	**	39	1.7		93
Yellow-head. Blackbird	-0.2		28	-4.9	4.6	6.25	8.9		9	-1.4		27
Red-winged Blackbird	-2.1	**	83	-4.5	0.3	24.04	-0.1		36	-1.7		81
Western Meadowlark	-1.0	*	77	-2.5	0.5	36.22	0.5		37	-2.9	****	71
Bullock's Oriole	-1.7	*	47	-4.0	0.5	1.91	-2.1		22	-1.5		43
Brewer's Blackbird	-18.6		93	-47.4	10.2	34.16	-0.6		45	-3.4	****	87
Evening Grosbeak	3.5		53	-3.5	10.4	2.91	8.4	***	16	-1.7		50
Purple Finch	-2.2		47	-7.0	2.6	2.02	-4.0		22	-6.8	***	45
Cassin's Finch	1.3		44	-2.3	5.0	4.07	2.5		15	1.4		44
House Finch	-1.6		60	-4.4	1.3	3.33	-4.1	*	28	2.3	**	53
Red Crossbill	2.0		47	-4.4	8.4	8.63	-3.4		13	8.1	*	47
American Goldfinch	-3.7	****	56	-5.3	-2.0	4.08	-1.8	*	28	-1.0		52
Lesser Goldfinch	-6.7	****	17	-10.7	-2.6	1.30	-9.4	*	11	2.9		14
Pine Siskin	-3.6		58	-9.9	2.7	3.85	-3.8		21	-8.4	***	58
Vesper Sparrow	-1.4		52	-4.1	1.2	8.83	4.2		21	-2.9	****	50
Savannah Sparrow	-2.1		61	-6.7	2.5	4.03	-8.1	***	26	-0.9		60
Lark Sparrow	-4.6	*	35	-10.2	1.1	1.80	-3.0		17	-6.9	***	28
White-crowned Sparrow	-4.3	****	44	-6.9	-1.8	2.72	-3.3		20	-3.6	***	42
Chipping Sparrow	-4.8	****	80	-6.8	-2.7	9.71	-2.7		39	-0.1		75
Brewer's Sparrow	-1.9		40	-5.4	1.7	29.86	-1.0		14	-3.1	*	39
Oregon Junco	-2.1	*	85	-4.7	0.6	11.48	-2.1		34	1.2		81
Sage Sparrow	0.2		22	-12.9	13.2	9.14	0.2		8	5.6		19
Song Sparrow	-1.5	****	87	-2.2	-0.9	8.00	-2.1	*	37	-1.7	****	84
Lincoln's Sparrow	3.7		17	-17.1	24.6	0.34	-13.9		6	35.5	*	13
Fox Sparrow	-3.0	**	21	-5.9	-0.1	0.57	0.2		11	-3.4	*	16
Spotted Towhee	-1.0		62	-3.1	1.1	3.64	2.8	*	25	0.1		61
Green-tailed Towhee	-2.1	***	26	-4.0	-0.2	1.32	2.0		12	-2.3	*	24
Black-headed Grosbeak	0.3		70	-1.2	1.8	3.87	-5.9	****	28	4.5	****	68
Lazuli Bunting	-1.1		58	-5.6	3.4	2.39	-4.5		20	2.9		56
Western Tanager	-2.2	****	84	-3.6	-0.8	8.31	-2.4	*	34	-1.2		82
Cliff Swallow	0.8		75	-1.7	3.3	22.92	0.2		33	5.5	***	72
Barn Swallow	-2.6	****	80	-4.2	-1.0	9.74	0.6		40	-1.5		78
Tree Swallow	-3.7	*	69	-8.5	1.0	2.48	-3.8		34	-0.5		63
Violet-green Swallow	-2.1	****	61	-3.5	-0.7	3.71	-0.4		27	0.4		58
Bank Swallow	-8.5		16	-47.2	30.2	2.02	44.9		6	1.0		13
N. Rough-winged Swallow	-0.1		52	-5.6	5.4	1.52	-2.5		27	4.0		43
Cedar Waxwing	-3.3	**	41	-7.0	0.4	1.51	-1.5		18	-4.7		40
Loggerhead Shrike	-2.5	**	18	-5.3	0.2	0.80	0.3		9	1.7		15
Warbling Vireo	0.7		70	-0.8	2.2	4.07	2.2	*	29	1.1		67
Solitary Vireo	-0.8		57	-4.3	2.7	1.24	1.8		22	0.8		51
Hutton's Vireo	7.0		21	-4.8	18.8	0.74	31.6		4	8.3		20
Nashville Warbler	-0.3		34	-3.7	3.1	1.67	5.8	*	14	-3.0	*	34
Orange-crowned Warbler	-2.8	****	53	-3.9	-1.8	2.00	-2.4		16	-6.3	****	52
Yellow Warbler	-1.5		64	-5.2	2.3	3.13	-2.7		32	1.2		54
Audubon's Warbler	-0.8		58	-2.1	0.5	6.90	-0.8		18	-1.8	*	55
Black-thr. Gray Warbler	-0.7		38	-6.2	4.9	2.59	3.4		10	0.1		38
Townsend's Warbler	-1.3		30	-5.5	3.0	2.19	6.0		7	-0.8		29
Hermit Warbler	-0.8		39	-6.1	4.4	14.60	6.5	***	14	0.1		37
Macgillivray's Warbler	-3.0	**	65	-6.0	0.0	2.82	-0.1		20	-2.0	*	61
Common Yellowthroat	4.1	***	47	0.6	7.7	1.99	1.7		16	5.7	****	45
Yellow-breasted Chat	-1.4		33	-3.7	1.0	1.08	-0.5		19	3.1		27
Wilson's Warbler	0.6		50	-1.6	2.7	3.88	2.1		19	-3.3	****	46
House Sparrow	-1.4		51	-4.6	1.8	8.17	0.0		27	-1.3		49
Sage Thrasher	2.6	****	28	0.8	4.4	23.89	9.8		11	1.6	*	27
Rock Wren	0.2		56	-2.5	2.9	4.37	-1.5		19	0.7		53
Bewick's Wren	1.8		33	-2.7	6.3	0.59	-5.5	*	15	7.8	***	29
House Wren	-0.4		77	-4.9	4.0	3.07	1.0		26	0.8		73
Winter Wren	1.4		38	-1.8	4.7	5.29	8.4	****	11	-0.7		38
Marsh Wren	8.5	**	14	-0.8	17.7	1.60	5.2		3	0.0		13

Brown Creeper	-4.6	****	48	-7.1	-2.1	0.85	-12.7	****	14	-6.4		47
White-breasted Nuthatch	-3.1	*	40	-7.2	1.0	0.89	1.5		18	-4.7	**	33
Red-breasted Nuthatch	-0.9	*	78	-2.1	0.3	5.94	-0.9		27	-0.2		77
Black-capped Chickadee	-1.7	*	53	-4.1	0.8	1.91	-2.1		20	-1.9		53
Mountain Chickadee	-2.6	****	47	-4.5	-0.7	6.03	-6.0		17	-2.2	**	47
Chestnut-bkd Chickadee	-8.3	****	39	-14.7	-2.0	3.10	-4.7		11	0.9		39
Wrentit	0.9		17	-1.9	3.6	1.26	3.5		7	-0.1		16
Common Bushtit	-9.1		37	-24.2	6.0	0.55	-9.4		17	3.9		27
Golden-crowned Kinglet	-5.7	****	58	-9.1	-2.4	4.14	-3.7	*	20	-3.4		54
Ruby-crowned Kinglet	0.5		33	-11.5	12.5	2.62	-6.6		12	-2.2		30
Townsend's Solitaire	3.0	*	38	-1.5	7.5	0.71	-8.5	***	11	-2.1		38
Swainson's Thrush	-1.6	****	63	-2.9	-0.4	15.87	-1.2		25	-2.4	****	56
Hermit Thrush	-0.5		56	-2.6	1.7	7.07	-1.3		19	3.5	**	53
American Robin	-1.6	****	108	-2.4	-0.7	28.45	0.1		47	-2.2	****	107
Varied Thrush	-1.2	*	26	-2.8	0.5	3.69	-2.0		5	-4.0	**	24
Western Bluebird	4.4		26	-3.8	12.7	0.48	-9.0	****	7	5.7		25
Mountain Bluebird	3.4	*	41	-0.8	7.5	3.72	-4.6		17	8.8	*	37

For Breeding Bird Survey population trends.
Statistical significance: * = P<0.20; ** = P<0.10; *** = P<0.05; **** = P<0.01.

APPENDIX W-3

BREEDING BIRD SPECIES LIST FOR ROAD 16

Appendix W-3. Bird species identified along the North American Breeding Bird Survey Route on road 16 near Sisters Ore. 1996-1997 (USGS Patuxent Wildlife Research Center). Status in Oregon: S=stable, D=decreasing, and I=increasing.

Species	Status in Oregon
American Crow	I
American Robin	D
Audubon's Warbler	S
Black-Throated Gray Warbler	S
Black-billed Magpie	D
Brown Creeper	D
Brown-headed Cowbird	D
California Quail	S
Cassin's Finch	S
Cassin's Vireo	N/A
Chipping Sparrow	D
Clark's Nutcracker	S
Common Nighthawk	S
Common Raven	S
Cordilleran Flycatcher	N/A
Dusky Flycatcher	S
European Starling	S
Evening Grosbeak	S
Fox Sparrow	D
Golden-crowned Kinglet	D
Gray Flycatcher	S
Green-tailed Towhee	D
Hairy Woodpecker	S
Hammond's Flycatcher	S
Hermit Thrush	S
House Finch	S
House Sparrow	S
House Wren	S
Macgillivray's Warbler	D
Mountain Bluebird	I
Mountain Chickadee	D
Mourning Dove	D
Olive-sided Flycatcher	D
Oregon Junco	D
Pine Siskin	S
Pygmy Nuthatch	D
Red Crossbill	S
Red-breasted Nuthatch	D
Red-naped Sapsucker	S
Red-shafted Flicker	S

Ruby-crowned Kinglet	S
Rufous Hummingbird	D
Song Sparrow	D
Spotted Towhee	S
Steller's Jay	S
Swainson's Thrush	N/A
Townsend's Solitaire	I
Tree Swallow	D
Turkey Vulture	S
Varied Thrush	D
Warbling Vireo	S
Western Bluebird	S
Western Tanager	D
Western Wood-Pewee	D
White-breasted Nuthatch	D
White-headed Woodpecker	N/A
Williamson's Sapsucker	D

APPENDIX S-1

SISTERS HISTORY

Sisters Area Timeline

(assembled by Jo Anne Heinzel & Vaunell Temple for the Sisters Watershed History Fest, 1998)

45,000,000 yrs ago	Volcanic eruptions in the Cascade crest
36,000,000 - 18,000,000 yrs ago	Powerful eruptions blast huge volumes of ash into ancient skies. Widespread destruction. Remains of plants and animals become fossils.
17,000,000 - 15,000,000 yrs ago	Great lava floods. Flows damned the ancestral Deschutes River below Round Butte Dam. Sediments form the Simtustus Formation.
9,000,000 yrs ago	Violent volcanoes in Sisters area
8,000,000 yrs ago	Castle Rock volcano (Five Fingered Sentinal) - oldest land in Sisters country
4.5 - 2.5 million yrs ago	Violent earthquakes cause top of Cascades to break up and sink
2.5 million yrs ago	First familiar landforms take shape: Green Ridge, Metolius River Canyon, Deschutes River Canyon, Lower Desert, Dry Canyon NE of Sisters.
400,000 yrs ago	Abbott Butte glaciation
390,000 yrs ago	Huge eruption at Tumalo Highlands
280,000 yrs ago	First of six volcanoes erupt in Mt. Jefferson
130,000 yrs ago	Jack Creek glaciation
100,000 yrs ago	Broken Top and first of Three Sisters erupt. (North Sister) Three Fingered Jack and Mt. Washington begin to erupt, Middle Sister and South Sister erupt.
25,000 yrs ago	Ice Age - ice sheets and glaciers carve deep canyons
10,000 yrs ago	Glaciers retreat, land warms up
7,700 yrs ago	Tenino and North Paiute Tribes used Metolius area: Mt. Jefferson for huckleberries Black Butte for roots, berries, nuts Green Ridge for hunting Metolius River for fishing
3,200 yrs ago	Eruption of Sand Mountain
1,500 yrs ago	Blue Lake fills a crater
1640-1870	Glaciers return and grow larger and longer during Little Ice-Age. Glaciers begin to retreat in 1950 leaving behind 14 moraine-dam lakes from South Sister to Mt. Jefferson
July 6,1825	Peter Skene Ogden of the Hudson Bay Co. camped by Squaw Creek two miles west of Squaw Flat. The next day he fed horses on meadows thought to be at Indian Ford.
1840's	Explorers, Fremont and Abbot, encounter Indians along the Metolius
Sept 23, 1855	Pacific Railroad survey company camps on Why-chus Creek (Squaw Creek)
Sept. 28, 1865	Captain Charles La Follette and forty men from Company A, 1st Oregon Volunteer Infantry, establish a military camp at Camp Polk.

May 24, 1866	Camp Polk abandoned
1869-71	Diversion of water from Squaw Creek for use on individual farms
1870	Samuel Hindman and family, one of the first settlers in Central Oregon, establishes a homestead near the abandoned Camp Polk.
1870's	Fire suppression starts in forest area near early settlements.
1871	First recorded water rights in Central Oregon taken by Charles J. Hindman, who took water out of the Big Slough on Indian Ford Creek at Camp Polk.
1872-1895	Water rights from Squaw Creek are appropriated
May 18, 1875	Post office established at Hindman Ranch. At about the same time a Cemetery was started on the Ranch.
Mid 1880's	20 families settle in Sisters. Sheep and later cattle are driven through Sisters in the summer and early fall (to and from grazing lands.)
1883	First school opens a couple of miles North of Sisters
1885	John and Mark Wilt clear forest land and secure the water rights on Pole Creek for their 320 acre homestead. The Wilts construct log cabins and barns using lumber from the Cox sawmill on Squaw Creek.
July 1888	Post Office at Camp Polk closes and moves to John J. Smith store located 3 miles South of Camp Polk. Post office named "Sisters."
1880's	Stanton Mill (near Graham Corral)
1889	First Squaw Creek Canal built by Sam Davis
1890	Cox Mill - run by water power (Ellis Edgington Ranch)
1890	One-room school house built (Sisters Pumphouse and Country Store location.)
1892	Oscar Maxwell builds the Maxwell ditch, drawing water from Squaw Creek to the Plainview View.
1893	Cascade Forest Reserve established
1895	The Squaw Creek Irrigation District organized
Before 1900	Ralph Towne, a Presbyterian minister drives to Sisters from his farm in Lower Bridge in a two-wheeled cart drawn by a pony every Sunday.
1900	2-room School built on present grade school sight. Later moved twice, now The Conklin House bed and breakfast
1900	Water rates are increased from 14 cents an acre foot to 35 cents.
July 10,1901	Alex and Robert Smith plat the town of Sisters. Plat reads: "All lots (will be) 40 feet front by 114 feet and all blocks 140 feet square ...bisected east and west by alleys 12 feet wide. Streets (are) 80 feet wide..."
1902	Mill near Melvin Butte
1903	Cascade Range Forest Reserve Report

(Attempt to protect forest lands for the future)

1906 First mill in Plainview

1907 Plainview School, burned in 1973

1908 Deschutes National Forest established

1908 Mill near Lazy Z Ranch

1908 The Hardy Allen House, Main & Larch

Hardy Allen's father, Albert, had been a soldier in Camp A at Camp Polk in 1865-66. He returned in 1868. Hardy Allen initially homesteaded along the Metolius. He moved to Sisters in 1905 and operated a blacksmith shop in Sisters and later worked on automobiles. The house, built on Main and Fir, was said to be one of the most attractive homes in town. In 1990 the house was saved from demolition and moved three blocks to 310 E. Main. It currently houses the shop known as "Nettie's Flowers." Remodeled in 1990, maintaining the original architectural style of the home, it is now recognized as an historic landmark.

1910 Mill in Sisters

1910 Fire lookout on Black Butte

1911 Court degree orders Squaw Creek Irrigation District to complete appropriations, build ditches, clear lands and put water on the lands by October 1, 1912.

1912 Mill at Indian Ford

1912 The Hotel Sisters is built. The Bend Bulletin reported on the plans for construction of a new hotel in Sisters: " A modern hotel that would be a credit to a town considerably larger than Sisters is being erected by John Dennis...it will be two stories in height...the dimensions are 64 x 38 feet and will contain 19 rooms with two additional bathrooms....There will be hot and cold water accessible to all rooms..."(April 10, 1912.)

The Hotel was remodeled in 1930 after surviving two devesting fires in the 20s. From 1946 to 1974, the hotel was operated by Gertrude Smalley. It was then purchased by a group of Portland businessmen, giving it the name "Cosmic Cowboys", who used it only sporadically. In 1978, the Reed family of Sisters purchased it and leased the building to an antique dealer and a mountaineering store.

In 1983 the hotel was extensively remodeled including new foundation, installing a heating system and completely rewiring and replumbing the building. The saloon was gutted and remodeled to look like the era of the turn of the century. The first floor remains a popular dining place. The upstairs provides private dining facilities with seven separate rooms that can seat groups from six to forty people.

1912 2-story building built to house 2 year High School and Grade School

1913 One-room school built on the William Wilt homestead

1914 First Annual Fair and Race Meet - a three day event with a horse racing program, agricultural exhibits including grains, melons, corn, tomatoes, and grasses. About 150 Warm Springs Indians participated (some winning) in horse races. At night Indian dances attracted large crowds. Music was provided by the Sisters cornet band and by the Bend Band.

1915	May Day celebration. A celebration by the Sisters Fair Association to promote cooperation between farmers and businessmen. Visitors from Bend arrived in 15 cars and reportedly enjoyed Sisters hospitality. "The women of Sisters served a very bounteous luncheon to about 200 people. The program included musical selections by the Bend band, speeches, a baseball game, and running events." The Bend Bulletin
October 1915	Second annual Sisters Fair. The fair featured various exhibits, i.e. livestock, agricultural products, arts and crafts including bead work by Warm Springs Indians. Agricultural exhibits from the farm of Mr. and Mrs. Waldron of Cloverdale displayed 76 different products.
May 13, 1916	Sisters stages a Race Meet. About 200 people attend to see many of the country's best horses compete in harness races.
1917	Settlers in the Squaw Creek Irrigation District vote $175,000 in bonds to purchase the Long Hollow Ranch from the Black Butte Land and Livestock Company, including the water rights, ditches, and diversion works.
1919	New dam & head gate at Squaw Creek
1920	Flood destroys the 1919 dam
1920	Brook Trout introduced to Squaw Creek
1921	Log dam built
1923	Three Creeks Road built. Provides access to lake & recreation
May 11, 1923	Devastating fire breaks out from an unattended garage. Loss of Sisters Drug Store and the Post Office. Fire destroys ten businesses and residences. Damage estimated at $25,000. Records of the Squaw Creek Irrigation District were destroyed in the office fire.
1923	The Palace. After the 1923 fire destroyed the Sisters Drug Store and post office building, the owners, George and Grace Aitken moved a one-story building from another location to this site. In 1931, George Aitken made $1500 improvements to the building. A second story was added for living quarters and storage. Later some of the rooms upstairs were rented. The first floor housed the drug store, soda fountain, and the post office. The marble top soda fountain was purchased from a Portland saloon in 1917. George Aitken made his own ice cream. " During the winter, George obtained ice from nearby ponds and stored the ice for summer use in a building that had been specially insulated with sawdust." - Georgia Gallagher. The ice cream soon became famous for its quality. In 1974 the building then known as the Sisters Drug company, was leased by pharmacist Frank Kristovich and his wife Penny. The store sold a variety of goods and maintained the historic soda fountain. In 1987, the Sisters Drug Company was leased to a new owner and renamed " The Palace. Ice cream is served to this day from the old soda fountain and marble counter top.

Sept. 11, 1924	Fire starts in a defective flue in the Gist Hotel and spreads quickly. "Half of Pioneer Town is Leveled by Flames" The Bend Bulletin Fire fought by every man in the community Efforts hampered by the lack of fire fighting equipment.. Estimated damage, $25,000.
1928	Camp Polk - Spoo Mill (a.k.a.M.G. Hitchcock Mill)
1930	Seventh-Day Adventists began, closed in 1960's
1934	Mill in Sundown Ranch
1937	Separate Sisters High School built on location of present Administration Offices
1939	Jan. 27th, Sisters library opens as a branch of the Deschutes County Library. Books in the library include donations by Sisters residents. Library expands in 1949 when Leonard Lundgren donates his old office and volunteers attached the office to the original building. In 1980 library building is moved to Spruce Street and is renovated.
1939	Sisters City Park created in Dec. 1939 as a State of Oregon park.
1940	Sisters first motel, Sisters Motor Lodge opens.
1940	The first annual Sisters Rodeo held at the Creighton place near the Sisters airport.
1940s (early)	The Church of Christ purchased the Presbyterian Church building.
1946	Sisters becomes and incorporated City
1946	Brooks-Scanlon moves 37 houses including a schoolhouse and store from Brooks-Scanlon Bull Springs logging camp to its present site west of Sisters
1950	Black Butte School built; a one room school house with an enrollment of 13
1951	Artificial propagation of Steelhead in Squaw Creek
1951	Hitchcock Mill sold to Dant and Russell
1952	Dant and Russell mill closed
1953	Estimated 1,000 Steelhead spawn in Squaw Creek
1953	Dant & Russell mill purchased by Leonard Lundgren and reopened
1954	New Sisters grade school built to replace 1912 structure
1957	First hatchery reared Steelhead adults return
1958	Pelton dam built (Deschutes River)
1958	Sisters Baptist Church conducts services in a building located at Main and Elm.
1958	The Church of Jesus Christ of Latter-Day Saints starts meeting in the homes of members who live in The Pines, (Brooks-Scanlon's old logging camp.)
1963	St. Edward's Catholic Church constructed on land donated by Mr. and Mrs. Rex Trowbridge.
1964	Major flood - flooded Sisters, took out highway bridge

1964	Round Butte dam built (Deschutes River)
1967	Last Steelhead seen in Squaw Creek
1968	High School closes, students go to Redmond High
1971	The Episcopal Church of the Transfiguration members first meet at the old Sisters High School twice a month.
1975	First annual quilt show in Sisters. Jean Wells and Cathi Howells exhibit 11 quilts.
1975	The Lutheran church begins with an experimental ministry at the home on Pastor Ylvisaker on Fir and Main
1978	Sisters ordinance requires the 1880s style store fronts
1979	Commercial development includes: the Three Winds Shopping Center which included a supermarket and restaurant, and the Gallery Annex which included ten small stores.
1979	New Branch for members of the Assembly of God for the Trinity Christian Center established in sisters. Meet in school rooms.
1980	New fire station constructed.
1980	Citizen's planning advisory committee proposes the idea of a city park (Village Green) across the street from the new fire station. Work on the park began in 1983.
1981	New construction includes: 5,000 square foot Reed Bros. Realty office, 4,000 square feet Miller and Poole building, and a new post office.
1983	Construction includes: City Center retail building, Phase II of the Town square project, and Barclay Square.
Jan 27, 1989	Construction of the new library starts on library's 50th birthday. In 1990, grade school students form a book brigade, passing thousands of books from hand to hand from the old library to the new one next door.
1990	Cascade Community Church members began meeting at the Sisters residents homes and later in the Elementary School
1992	New High School opens
1990(mid)	Office space construction including the Arthur Pratt building (Pine St.) and the Main Street office building.
1997	Three Sisters Fellowship formed
1997	Seventh Day Adventist Church re-opens
1998	Cascade Community Church merged with Sisters Baptist to become Sisters Community Church
1998	Sisters Sewer vote passes
1998	Construction starts on Pine Meadow Ranch Development

APPENDIX S-2

RECREATION SITE INFORMATION

RECREATION SITES IN WHY-CHUS WATERSHED

Appendix S-2 Type of Facility, PAOT, Recreation Use, Rate, Season, and Type of Use, Issues and Opportunities, Data Gaps, Special Features/Attractions, and ROS Class.

Facility $ *	PAOT +	Rec Use in Visitors	Rate of Use H, M, L	Season of Use♦	Type of Use	Issues and Opportunities	Data Gaps	Special Features and Attractions	ROS •
TRAILHEADS/TRAILS									
Park Meadow Trailhead $	30	1055	Mod	Su, F	Horse (17.8%)	Impacts to Streams from stock watering Horses and Feed may serve as weed vectors Require weed free feed for stock Move trailhead to Road 16 Convert Jeep Road to trail	Noxious weed inventory in meadow needed	Park Meadow	RN
Pole Creek Trailhead $	45	1902	Mod to High	Su, F	Horse (7%)	Impact to streams from stock watering Horses and people may serve as weed vectors Reconstruct trailhead to restrict off-site parking Trailhead pit toilet to be replaced in 1998	Noxious weed inventory needed	Access to several attractions	RN

Scott Pass Trailhead $	24	539	Low	Su, F	High Stock Use (30%) Close to Whispering Pines Horse Camp	Horses and people may serve as weed vectors	Noxious weed inventory needed	Accesses several areas	RM
Millican Crater Trailhead $	24	301	Low	Su, F	High Stock Use (73%) Close to Whispering Pines Horse Camp	Horses and people may serve as weed vectors	Noxious weed inventory needed	Accesses several areas	RM
Squaw Creek Falls Trailhead $	24	648	Low	Su, F	Day Hiking	Minor improvement needed to access road and trailhead		Water Falls	RM
Black Crater Trailhead $	42	1085	Mod to High	Su, F	Popular Day Hike area Minor Stock Use	People may serve as weed vectors		View from Summit On Scenic Byway	RN
Lava Camp Trailhead $	45	2425	Mod to High	Su, F	Day and overnight hiking Minor stock use (4%)	Minimal impacts to lakes from fishing, swimming, etc. People and horses may serve as weed vectors Expand Obsidian LEA to include Matthiew Lakes Designate camp sites to control use/impacts	Noxious weed inventory needed	North and South Matthiew Lakes PCT Access On Scenic Byway	RN

Tam McArthur Trailhead $	30	2485	High	Su, F	Day Hiking Stock Use (7%)	Heavy maintenance needs on trail due to use and soils Snowmobile trespass into wilderness Reconstruction and minor relocation needed on trailhead People and stock may serve as weed vectors		Views from top of Rim	RN
Little Three Creek Trailhead $	20	2610	High	Su, F	Day Hiking Moderate Stock Use	People and stock may serve as weed vectors Snowmobile trespass in wilderness Reconstruction of trailhead needed Minimal recreation impacts to lake and shoreline		Little Three Creek Lake (fishing and views)	RN
Three Creek Meadow Trailhead $	32	1210	Mod to High	Su, F	Day and Overnight Hiking High Stock Use	People and stock may serve as weed vectors	Noxious weed inventory needed	Accesses several areas	RN
Sisters Tie Trailhead									
Suttle Tie Trailhead									

Metolius-Windigo Trail	N/A	N/A	Mod	Sp, Su, F	Horse Hiking	Horses and people may serve as weed vectors Increasing mountain bike use Ties to Whispering Pines Campground No specific trailhead - ties horse camps together Footbridge at Squaw Creek crossing needed			RN RM
Sisters Mountain Bike Trail	N/A	N/A	Mod	Year Round	Mountain Biking Hiking	Trailhead is located at Sisters City Park Weeds Closed roads have been breached (re-opened)	Counter needed	Easy access from town and canals - loop options	RN RM
SNO-PARKS									
Upper Three Creek Sno-Park $	224	3758	Mod	W	Snowmobile Use	Use is increasing and becoming crowded			RN
Lower Three Creek Sno-Park $	242	680	Low	W	Snowmobile Use	Add nordic trails to disperse use Becomes overflow lot if upper lot is crowded			RN
Unofficial Sno-Park off Highway 242/1028	32	Est. 1500	Mod	W	Snowmobile Use	Use is increasing each year Wilderness trespass off McKenzie Pass		Close to Sisters	RN

CAMPGROUNDS									
Sisters Horse Camp	30	?	Low to Mod	4/15 to 10/15	Developed Rec. Camping Horse Camp	Adjacent to Private land Potential weed source Long time transient campground	Better use figures needed Determine carrying capacity	Historic Site On Metolius - Windigo Trail	RN
Lava Camp Lake Campground	60	2480	Mod	7/1 to 10/15	Camping Horse Camp?	Lacks official presence or management Historic warming shelter in need of repair Shoreline damage by stock watering at lake near wilderness trailhead	Better use figures needed Determine carrying capacity	Adjacent to Scenic Byway and wilderness	RN
Cold Springs Campground $	175	4820	Mod	4/15 to 10/15	Camping	Wetland Cold Springs ditched for irrigation	Better use figures needed Determine carrying capacity	On Scenic Byway Good Birding Prehistoric Rock Shelter Dendroglyphs - Old Sheep Camp	RN
Indian Ford Campground $	200	4178	Mod to Low	5/15 to 10/15	Overnight through traffic camping	Indian Ford wetlands More of a rest area than a campground Increased traffic on Highway 20/126 affecting character of campground	Better use figures needed Determine carrying capacity	On Scenic Byway Good Birding	RN

Graham Corral Campground $	70	2261	Low to Mod	4/15 to 10/15 Used primarily in early season	Horse Camp	Potential weed source Adjacent to Black Butte Ranch and private land Additional trail opportunities needed	Better use figures needed Determine carrying capacity	Non-significant historic site On Metolius - Windigo Trail	RM
Black Pine Springs Campground	35	539	Low	5/15 to 10/15		Hill Climb (OHV) area and sledding hill causing some damage Removal of facilities and rehabilitating site being considered	Better use figures needed Determine carrying capacity		RN
Whispering Pines Horse Camp $	55	1955	Mod	5/15 to 10/15	Horse Camp	No water for stock - watering occurring at creek with significant bank erosion Need additional trail/wilderness access and system trails maintained Some overflow camping occurring on high use weekends Potential weed source Oregon Equestrian Trails involved with trail construction and improvement	Better use figures needed Determine carrying capacity	Near Trout Creek Easy wilderness access	RN

Three Creek Meadow and Horse Camp $	145	4967	High to Mod	7/1 to 10/15	Camping Horse Camp	Moderate to high use area near meadow and creek Potential weed source Damage occurring in meadow Sensitive plant interpretation and education opportunities Horse watering trough reducing impacts to creek	Better use figures needed Determine carrying capacity	Trailhead originating from campground	RN
Three Creek Lake Campground $	65	7371	High esp. week-ends	7/1 to 10/15	Camping Boating Unofficial day use area with beach	Concessionaire presence assures camping in designated sites only - reduced over-use Congested Area	Better use figures needed Determine carrying capacity	Boat rental, boat ramp and store nearby Trailheads nearby	RN
Driftwood (on Three Creeks Lake) $	75	7650	High esp. week-ends	7/1 to 10/15		Concessionaire assures camping in designated sites only- reduced over-use More day use parking areas for trailhead needed	Better use figures needed Determine carrying capacity	Trailhead near Boat ramp and store nearby	RN

* = Indicates if facility is fee generated

+ = People at one time. Indicates the capacity of said facility.

◆ = Sp = Spring; Su = Summer; F = Fall; and W = Winter

• = RN = Roaded Natural; RM = Roaded Modified?

APPENDIX S-3

ROAD CATEGORIZATION

Appendix S-3. Road Categorization.

An active road management program, the Access and Travel Committee, and the District Leadership Team have formulated a strategy for prioritizing the management of roads in this and other areas of the district. The criteria used for this strategy include:

Interdisciplinary Input	Wildlife/Riparian Concerns
Land Allocation	Vegetation Management/Fire Suppression Access
Public Safety	Cost Efficiency and Economic Flexibility
Access to Private Lands	Previous Decisions

All roads have been categorized as either Primary, Secondary, or "Other". Primary and Secondary roads are needed for land management purposes and will, for the most part, be a part of the long term Forest Transportation System. Within this watershed, there are approximately 390 miles of Primary and Secondary roads. The remaining roads (those roads that have not been categorized as Primary or Secondary) are called Other roads. There are approximately 384 miles of these in this watershed. These catergorizations represent a strategy and/or recommendations, but are not a NEPA decision.

Roads assigned to the "Other" category are not automatically intended for closure or to be kept open. Proposals for road closures will be made through site specific NEPA analysis.

The projects recommended or initiated by this program is the most efficient way to analyze and accomplish this decision. Current miles of road include the following:

Primary Roads	=	70miles
Secondary Roads	=	320 miles
Other Roads	=	384 miles
Total Miles of Roads	=	774 miles

Mtc Level 3–5 : Open, maintained for public use (passenger cars).	70 miles
Mtc Level 2: Open, maintained for high clearance vehicles only.	607 miles
Mtc Level 1: Closed, possibly needed for future access.	97 miles

APPENDIX WQ-1

TEMPERATURE MODELING FOR SQUAW CREEK

Temperature modeling of Squaw Creek from the Squaw Creek Irrigation District dam to the Crooked River Grasslands.

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June 18, 1998

Objectives:

I. Provide year round connectivity along entire length of stream.

II. Meet Oregon Department of Environmental Quality requirements for water temperature for rearing salmonids.

III. Provide fish habitat through determination of minimal flow requirements and water temperature tolerances for rainbow trout (*Oncorhynchus mykiss*).

Introduction:

Anthropogenic impacts have occurred in Squaw Creek for nearly 130 years. Among these impacts are irrigation diversions. Diversions were first introduced in 1871 and the current Squaw Creek Irrigation District was created in 1917 (Hall 1984). In 1964 the largest flood event on record occurred flooding the town of Sisters, Oregon. By 1968 U.S. Army Corps of Engineers deepened and placed channel spoil intermittently along stream banks for nearly 5 miles (Army Corps of Engineers 1978) to prevent side channels from being used during high flow events. Over appropriation of water rights has at times left Squaw Creek disconnected for approximately 4 miles from de-watering. Moreover, a thermal barrier can occur during low flow as water becomes heated from exposure to the summer sun, reaching temperatures in excess of 78^{o}F (Burke 1997, Ochoco NF unpublished data). Lee and Rinne (1980) found water temperatures reaching 84^{o}F to be the critical thermal maxima for juvenile and adult rainbow trout. Oregon DEQ (1996) requires the 7-day average maximum water temperature not to exceed 64^{o}F. Raleigh et al. (1984) also suggest 64^{o}F be the upper maximum limit for juvenile and adult rainbow trout.

Methods:

A single reach temperature model, called SSTEMP (Thuerer et al. 1984), was used to determine minimal flow requirements to maintain a 64^{o} Fahrenheit maximum water temperature at the FS road 6360 crossing. Data was provided by stream surveys performed along the entire length of stream (Burke 1997, Dachtler 1997), monitoring programs (USFS unpublished data), National Weather Service (Internet downloads) and Hatton (1995). Assumptions were established using Bartholow (1996) and assessments from local specialists. The program predicts a 24-h average, maximum and minimum temperature of which the average temperature is most reliable (Thuerer et al. 1984). The seven day average maximum temperature used by ODEQ is a 7 day moving average using maximum daily temperatures.

Eight scenarios were established to determine the effects of discharge on downstream water temperatures. These scenarios are grouped by the amount of water released from the SCID dam at river mile 24.75. Twelve cfs was determined to be average release under existing conditions (OWDR personal communication). Forty cfs is a condition in which water rights were bought above the diversion and added to average release of 12 cfs under existing conditions. The ninth and tenth scenarios were used to determine the effects of increased shade and reduced stream width.

S1= Existing conditions with Indian Ford Creek flowing.

S2= Twelve cfs released from SCID diversion and no other diversions taking water.

S3= Forty cfs released from SCID diversion and no other diversions taking water.

S4= Scenario 3 without Indian Ford Creek inflow.

S5= Scenario 2 without Indian Ford Creek inflow.

S6= Drought conditions. Dry through town and no flow from Indian Ford Creek.

S7= S3 with diversions below the SCID taking full water rights.

S8= Average August discharge as determined from gauging station upstream from SCID.

S9= S1 with shade increased to 60% throughout the stream and width reduced approximately 4ft.

S10= S1 with shade increased to 75% throughout the stream and width reduced approximately 4ft.

Results:

Table 1. Maximum and Mean daily temperatures for August in Squaw Creek at the Grasslands FS road 6360..

Scenario	Maximum temperature (°F)	Mean temperature (°F)
S1	77.4	71.5
S2	78.3	70.5
S3	73.1	66.2
S4	73.2	66.2
S5	78.6	70.5
S6	72.3	72.3
S7	73.8	66.8
S8	66.5	60.5
S9	74.9	68.9
S10	71.4	67.1

Conclusions:

I. Indian Ford Creek has little influence on mean daily temperatures regardless of Squaw Creek discharge (Table 1).

II. Increased discharge from SCID increases the number of stream miles of fish habitat having water temperatures < 64°F (Figures 1 and 2)

III. Insteam flow gain below the SCID provides connectivity and increases suitable habitat appoximately 0.8 miles (Figure 3).

IV. Natural average discharge without diversions provide water temperatures required by ODEQ (1996).

V. Our results fall into the range of past temperatures recorded by stream surveyors and recordable thermometers.

VI. Minimum flow of 10 cfs below Camp Polk as suggested by Fies et al. (1996) will not adequately maintain water temperatures required by ODEQ (1996).

VII. Decreasing stream width and increasing shade reduces the rate in which water temperature increases (Figure 3).

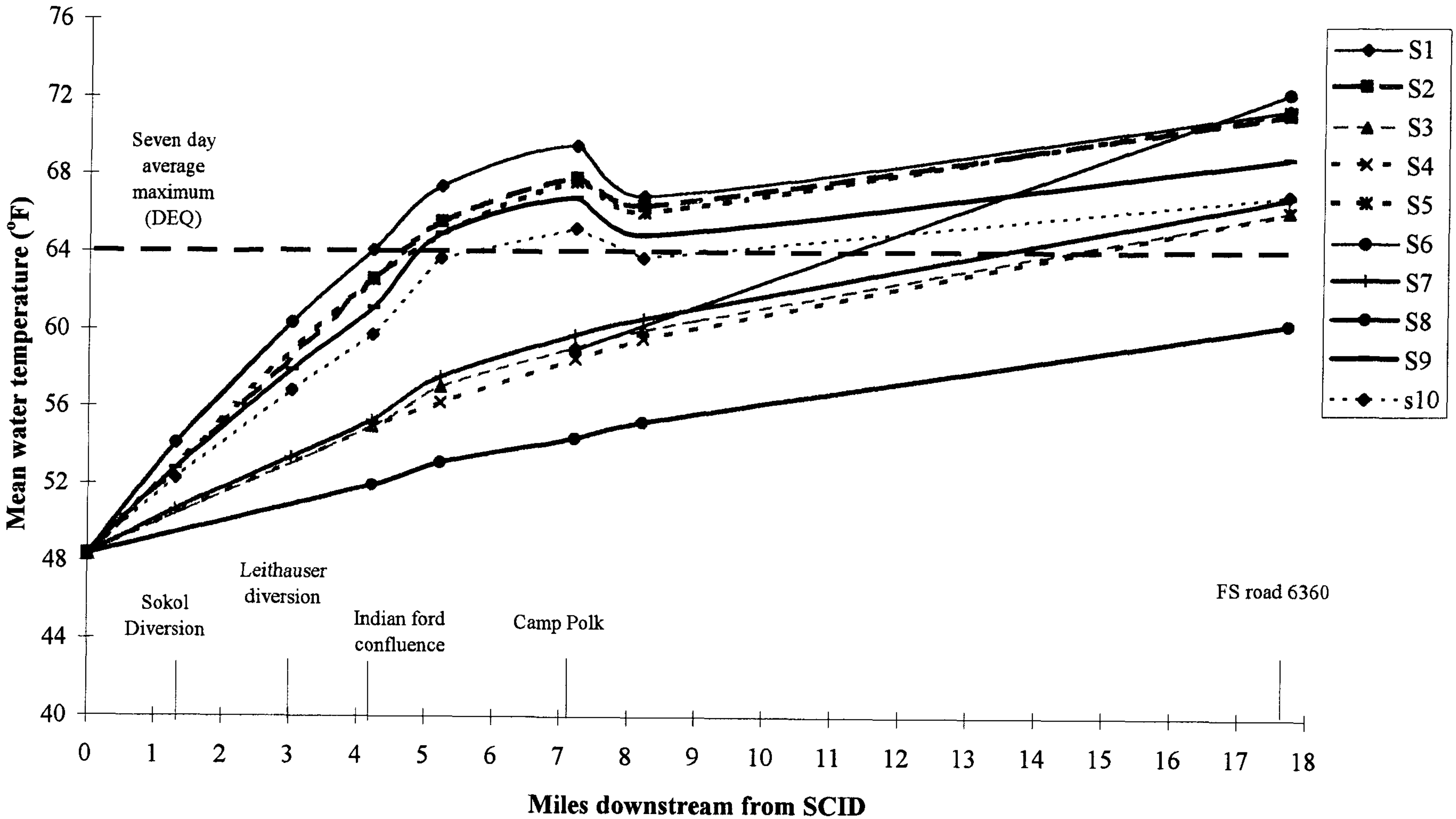

Figure 1. Mean predicted water temperatures along Squaw Creek. Pink line is drought condition prior to instream flow rights (5 cfs at Camp Polk Springs); red lines are average conditions at SCID (12 cfs); green lines are increased instream flow at SCID (40 cfs); blue line is average August discharge with no diversions (92 cfs.) Black lines represent increased shade and narrowed strea width.

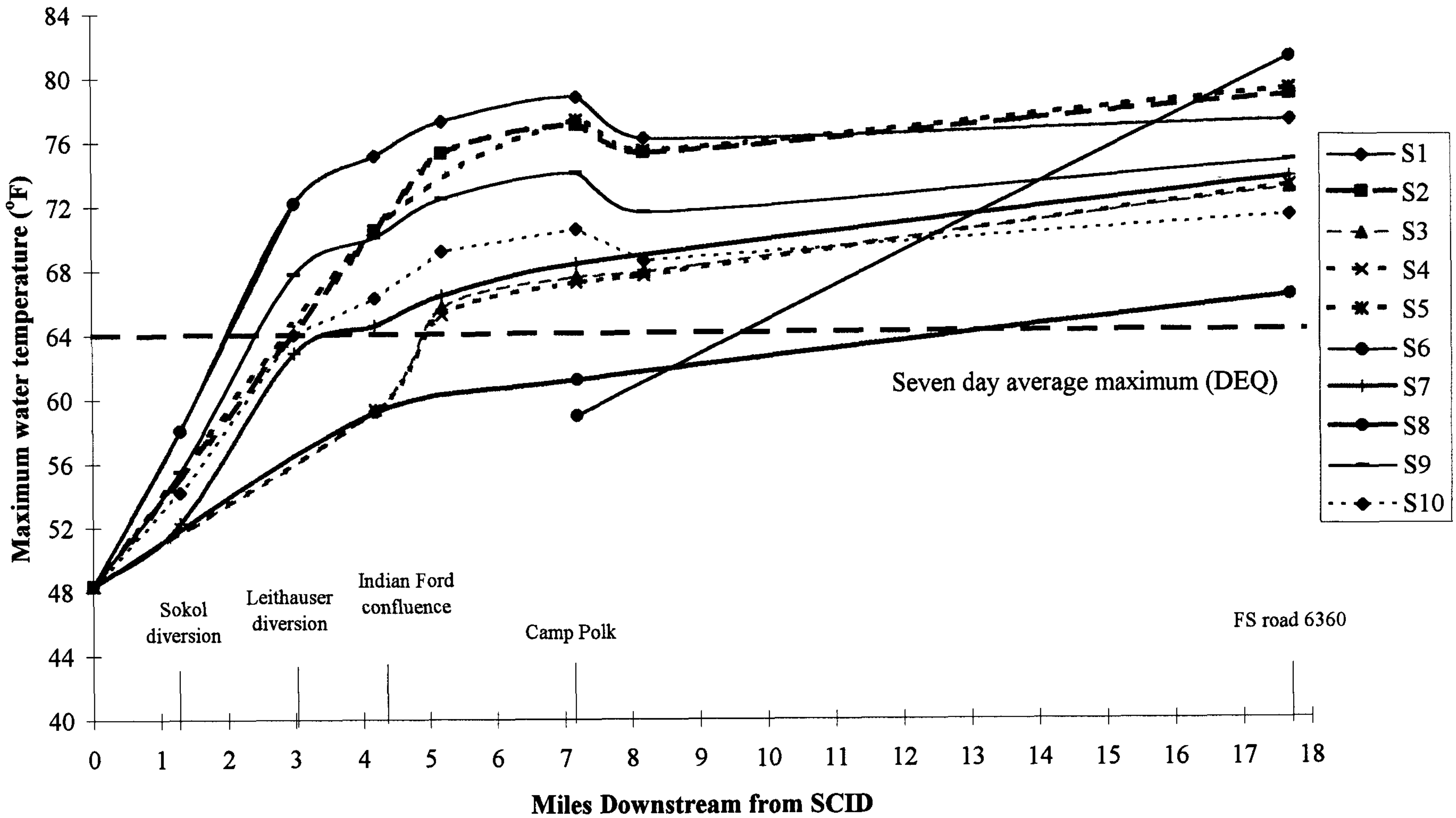

Figure 2. Maximum predicted water temperatures along Squaw Creek. Pink line is drought condition prior to instream flow rights (5 cfs at Camp Polk Springs); red lines are average conditions at SCID (12 cfs); green lines are increased instream flow at SCID (40 cfs); blue line is average August discharge with no diversions (92 cfs.) Black lines represent increased shade and narrowed stream.

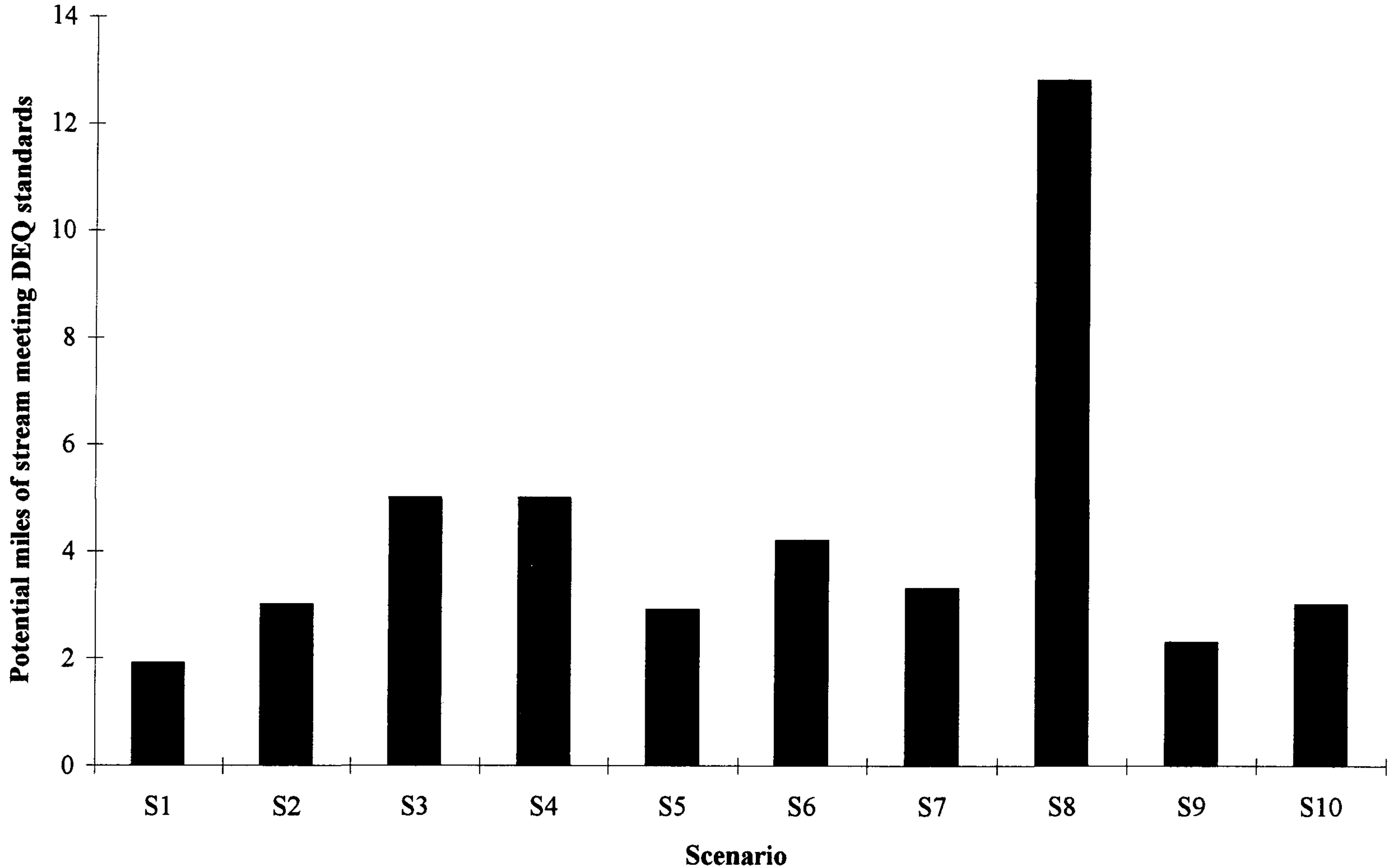

Figure 3. Potential stream miles meeting ODEQ standards for rearing salmonids. Pink bar is drought condition prior to instream flow rights (5 cfs at Camp Polk Springs); red bars are average conditions at SCID (12 cfs); green bars are increased instream flow at SCID (40 cfs); blue bar is average August discharge with no diversions (92 cfs.) Black bar represent increased shade and narrowed stream width.

Data sources:

Segment inflow: 12 cfs average release (OWRD personal communication) through SCID diversion dam.
40 cfs flow calculated from hypothetical water right purchase of McAllister ditch plus 12 cfs average release.
92 cfs an average flow in Squaw Creek during August (USGS gauging data averaged from 1988-1992).

Inflow Temperature: Mean monthly temperature during August 1997 at OWRD gauging station. (48.38°F)

Segment outflow: Inflow - diversions given by OWRD.
McAlister 25.36 cfs
Plainview 31.6 cfs
Lazy Z 7.56 cfs
Edgington 0.68 cfs
SCID 181 cfs
Sokol 3.28 cfs
Smith/Barclay 3.44 cfs
Leithauser 1.12 cfs
Indian Ford Creek 3 cfs (inflow)
Camp Polk Springs 5 cfs (inflow)

Lateral Temperature: Inflow temperature from tribs or springs.
Indian Ford 21°F,
Camp Polk Springs 15°F

Segment Length: Calculated from Burke (1997), Dachtler (1997).

Mannings n: Morisawa (1968). (0.04)

Elevation: U.S. Army Corp of Engineers (1978) stream bed elevations.

Width A - term Calculated from discharges at city park for reach 1- 3. Reaches 4-5 from discharges taken near Camp Polk. Reach 6 from discharges taken at FS road 6360 ford (USFS unpublished data).

Width B-term Calculated from discharges (USFS unpublished data).

Thermal gradient: Bartholow (1996). (1.65)

Air temperature: Average maximum air temperature in August (National Weather Service data from internet). (83°F)

Relative humidity:	Average relative humidity for August from 1990-1997 taken at 1300 hrs (Weather observations from station 352620). (27.25%)
wind speed	Estimate (3 mph) from Mike Carnahan (personal communication)
% possible sun	Estimate (90%) (Default number from program)
Solar radiation	Calculated from sssolar for each reach
Daylight Length	Calculated from sssolar for each reach
Segment shading	Averaged from Burke (1997) for each reach.
Ground Temperature:	Average yearly air temperature (NWS 1998). (51^{o}F)

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APPENDIX R-1

RECOMMENDATIONS TABLE

Recommendation	USFS or Coop Action	Trend	Legal Require Y or N	Law or Standard and Guideline	Priority H, M, L	Feasibility H, M, L	Describe Desired Outcome	Monitoring Actions
Implement harvest treatments that maximize the time period between harvest entries	USFS	8	Y	Deschutes LRMP: SL-1 to SL-6 and Appendix 14 Region 6 Soil Quality Standards FSM 2520	H	H	A minimum of 20 years between harvest entries	LRMP Forest Implementation and Effectiveness Soil Monitoring
Reduce post harvest entries by treating stands as much as possible with the commercial timber harvest rather than post harvest	USFS	8	N	Deschutes LRMP: SL-1 to SL-6 and Appendix 14 Region 6 Soil Quality Standards FSM 2520	H	H	Less post harvest fuel treatments that impact soils	LRMP Forest Implementation and Effectiveness Soil Monitoring
Consider using prescribed fire to treat activity fuels rather than mechanical fuel treatments that increase soil compaction and displacement	USFS	8	N	Deschutes LRMP: SL-1 to SL-6 and Appendix 14 Region 6 Soil Quality Standards FSM 2520	H	H	Less detrimental soil impacts caused by post harvest fuel treatments	LRMP Forest Implementation and Effectiveness Soil Monitoring
Where possible, integrate less impactive harvest systems such as cable or helicopter into a portion of some timber sales	USFS	8	N	Deschutes LMRP Appendix 14, Objective 5, Sensitive Soils	H	H	Avoidance of detrimental soil impacts	LRMP Forest Implementation and Effectiveness Soil Monitoring

Recommendation	USFS or Coop Action	Trend	Legal Require Y or N	Law or Standard and Guideline	Priority H, M, L	Feasibility H, M, L	Describe Desired Outcome	Monitoring Actions
Remove berms that restrict flood spreading along lower reaches of Squaw Creek	Coop	4 5	N	State of Oregon Clean Water Act through application of Best Management Practices (BMP's) Deschutes LRMP W-1 through W-7 NWFP – ACS objectives	M	Moderate to low significance in sub-watershed Moderate level of complexity	Energy dispersal of water during high flows which will help to maintain bank stability and limit stream down cutting Increased scouring of historic floodplains allowing regeneration of native vegetation adapted to this process (i.e. cottonwood regeneration)	Stream Survey – Percent of Stable Banks versus Unstable Banks
Squaw Creek – Complete 303(d) Management Plan, recommending flows and funding sources Explore options to trade surface water rights for ground water rights Explore options to trade effluent for surface water rights	Coop Coop Coop	1 2 3	Y N N	Clean Water Act Organic Act Clean Water Act Organic Act Clean Water Act	H	High significance in sub-watershed High level of complexity	Increase flows during summer months resulting in connecting Squaw Creek to flows down stream. Improved fish and aquatic habitat Opportunity to establish riparian vegetation along stream due to moisture provided by summer flows	Water Quality Monitoring of Temperature, Dissolved Oxygen, and Flow
Reintroduce chinook salmon and steelhead into Squaw Creek watershed	Coop	23	N	NWP – ACS Objectives	H	L	Complete assemblage of native fish	Monitor success of fish populations
Enforce fish screening of diversion – Squaw Creek	Coop	23	Y	State Law	M	Moderate significance Low complexity	Prevent loss of fish when diverted flows are stopped	ODFW Cooperative Fish Salvage Screen Checks

Recommendation	USFS or Coop Action	Trend	Legal Require Y or N	Law or Standard and Guideline	Priority H, M, L	Feasibility H, M, L	Describe Desired Outcome	Monitoring Actions
Promote opportunity for fish passage at Round Butte/Pelton Dam	Coop	23	Y	Federal Power Act Wild and Scenic Act Deschutes NF LMRP	H	High significance High complexity	Anadromous fisheries	Population survey of both anadromous and resident fish
Repair or close bridge ford at 6360 Road	USFS	9	N	State of Oregon Clean Water Act through application of Best Management Practices (BMP's) Deschutes LRMP W-1 through W-7 NWP – ACS Objectives	L	Low significance Low complexity	Reduce sedimentation and other disturbances in stream	Erosion Survey Photo Points
Eliminate the need for Pole Creek diversion and return water to Pole/Squaw Creeks	Coop	1 2 6	N	State of Oregon Clean Water Act through application of Best Management Practices (BMP's) Deschutes LRMP W-1 through W-7 Record of Decision Aquatic Conservation Strategy	M to H	Moderate significance Moderate complexity	Increase flows to Squaw Creek during summer months when flows are needed for fish habitat and maintenance of riparian vegetation	Monitor Temperature and Flows in Squaw Creek

Recommendation	USFS or Coop Action	Trend	Legal Require Y or N	Law or Standard and Guideline	Priority H, M, L	Feasibility H, M, L	Describe Desired Outcome	Monitoring Actions
Assess if additional water would change vegetative composition of Pole Creek meadow and alter water quality of Squaw Creek	Coop	1 2	N	State of Oregon Clean Water Act through application of Best Management Practices (BMP's) Deschutes LRMP W-1 through W-7 NWFP – ACS objectives	M	High significance Moderate complexity	Return of historic soil moisture regimes that provide slower water release over drier summer months and increased riparian type vegetation species	Monitor Temperature and Flows in Squaw Creek Measure existing water table in Pole Creek swamp and determine if its being lowered by ditching, roading, culvert problems, etc.
Rehabilitate dispersed roads, trails, and camps within riparian reserve – Pole Creek, Trout Creek, and Three Creeks area	USFS Coop	2 3 8 23 24	N	State of Oregon Clean Water Act through application of Best Management Practices (BMP's) Deschutes LRMP W-1 through W-7 NWFP – ACS objectives	L – Pole Creek and Trout Creek H – Three Creeks area	**Pole & Trout** -Low significance Low complexity **Three Creeks area-** High significance Moderate complexity	Less impacts from dispersed camping activities in the riparian reserves Reduced erosion, increased fish habitat, and increased aesthetics	Photo Points Establishment of new disturbance Extent of existing disturbance
Provide recommendations for rehabilitation of meadows– Trout Creek and Three Creeks area	USFS Coop	6 22	N	State of Oregon Clean Water Act through application of Best Management Practices (BMP's) Deschutes LRMP W-1 through W-7 NWFP – ACS objectives	M	**Trout** – Moderate significance Low complexity **Three Creek** High significance Moderate complexity	Return of historic soil moisture regimes that provide slower release of water and more hydric soil conditions for wetland plants	Vegetation Plots Photo Points Measure existing water table in Trout Creek swamp and Three Creek meadow and determine if its being lowered by ditching, roads, culvert problems, etc. Coordinate with OSU amphibian research

Recommendation	USFS or Coop Action	Trend	Legal Require Y or N	Law or Standard and Guideline	Priority H, M, L	Feasibility H, M, L	Describe Desired Outcome	Monitoring Actions
Repair dam at Big Three Creek lake or remove dam	Coop	1 2 3	Y	State Dam Safety Standards	H	High significance High complexity	Stable lake level for riparian vegetation to develop which will enhance fish habitat (high level)	Flow and coordination with OSU
Restore flows to maintain or enhance habitat – Squaw Creek and Indian Ford Creek are priority areas	Coop	1 2	N	State of Oregon's Clean Water Act through application of Best Management Practices (BMP's) Deschutes LRMP W-1 through W-7	H	High significance High complexity	Meet DEQ standards	Temperature monitoring Flow monitoring
Repair/eliminate ditches – Melvin, Snow Creek (rehab), and Pole Creek	USFS Coop	1 2 3	N	Record of Decision Aquatic Conservation Strategy Deschutes National Forest LRMP	H-Melvin L – Snow Creek	Melvin – High and Snow Creek Moderate significance Low complexity	Prevention of further soil erosion Reduced snow-melt run-off Move toward historic habitat conditions	Photo Points Road surveys
Maintain Peck's penstemon habitat	Both	1 4 5	N	Conservation strategy for Peck's penstemon	M	L	Restore opportunities for genetic exchange between populations	Effectiveness of restoration activities
Promote seasonal flooding for lichen habitat	Coop	2	N	NWFP	M	H	Meet habitat requirements for S&M species	Monitor S&M populations

Recommendation	USFS or Coop Action	Trend	Legal Require Y or N	Law or Standard and Guideline	Priority H, M, L	Feasibility H, M, L	Describe Desired Outcome	Monitoring Actions
Plant cottonwoods, willow, and aspen to restore natural habitats and increase shade – Squaw Creek and Indian Ford Creek	Coop	2 3	Y	Clean Water Act Deschutes County Ordinance	H	High significance High complexity	Low water temperatures in Indian Ford Creek and Squaw Creek to meet State standards and aquatic species habitat requirements	Temperature monitoring
Look for opportunities to partner with private landowners to restore cottonwood galleries	Coop	2 3	N	Clean Water Act Deschutes County Ordinance	H	H	Low water temperatures in Indian Ford Creek and Squaw Creek to meet State standards and aquatic species habitat requirements Streambank erosion condition	Temperature monitoring

Recommendation	USFS or Coop Action	Trend	Legal Require Y or N	Law or Standard and Guideline	Priority H, M, L	Feasibility H, M, L	Describe Desired Outcome	Monitoring Actions
Promote med/large tree structure for connectivity between reserves and uplands, eagle and osprey habitat, etc	USFS	15	Y	Deschutes National Forest LRMP Northwest Forest Plan – Aquatic Conservation Strategy Objectives	H	M	Meet habitat requirements for riparian associated species and connectivity for late successional species	Monitor habitat use
Promote long term down woody material and dispersal habitat	USFS	15	Y	Deschutes National Forest LRMP Northwest Forest Plan – Aquatic Conservation Strategy Objectives	H	M	Meet habitat requirements for riparian associated species and connectivity for late successional species	Monitor habitat use
Target management on north slopes for goshawks	USFS	15 16	Y	Same as above	M	M	Same as above	Monitor habitat use
Thin small trees in riparian areas, possibly with fire (Pole Creek)	USFS	10 15	N	NWFP – ACS objectives	M	M	Increase size of riparian trees and large wood recruitment to streams	Stream surveys
Manage grazing and other management activities to protect and maintain habitat for mollusks, lichens, and other species	Both	2	Y	Northwest Forest Plan Survey and Manage guidelines	M	M	Protection of survey and manage species	Survey for survey and manage species

Recommendation	USFS or Coop Action	Trend	Legal Require Y or N	Law or Standard and Guideline	Priority H, M, L	Feasibility H, M, L	Describe Desired Outcome	Monitoring Actions
Promote retention of down woody material both instream and adjacent to streams for aquatic species habitat and Caliciales habitat – Trout Creek Swamp	USFS City of Sister s	6	Y	Clean Water Act Deschutes LRMP W-1 through W-7 Record of Decision Aquatic Conservation Strategy Northwest Forest Plan Survey and Manage guidelines	M	Moderate significance Low complexity	Improved stream and reserve habitat	Stream Survey Wood inventory Survey for Survey and Manage species
Protect sensitive wetlands from further damage								
Melvin Springs – keep vehicles out and limit foot traffic	USFS	8 23	Y	Clean Water Act ROD ACS Objectives Deschutes LRMP W-1 thru W-7	L	M	Controlled traffic in spring area	Photo points
Three Creeks area – manage horse use	Coop	2 23	N	ROD ACS Objectives Deschutes LRMP W-1 thru W-7	H	H	Reduced erosion, increased fish habitat, and increased aesthetics	Photo points
Build a log stringer foot bridge at crossing of Squaw Creek along Metolius – Windigo Trail	USFS	23	N	ROD ACS Objectives	H #4	H	Improve public safety for hikers and mountain bikers at crossing of Squaw Creek	Public feedback
Design and build a gravity feed horse tank at Whispering Pines Campground	Both	2 23	N	ROD ACS Objectives Deschutes LRMP RP-36	M #5	H	Eliminate horse watering along Trout Creek and restore vegetation	Site Condition Monitoring
Harden stock watering site at Lava Camp Lake	USFS	2 23 24	N	ROD ACS Objectives Deschutes LRMP RP-36	H #4	H	Eliminate shoreline damage by stock	Site Condition Monitoring

Recommendation	USFS or Coop Action	Trend	Legal Require Y or N	Law or Standard and Guideline	Priority H, M, L	Feasibility H, M, L	Describe Desired Outcome	Monitoring Actions
Avoid fragmentation of riparian corridors that will isolate riparian associated species with limited dispersal capabilities, such as lichens	USFS	1 2 13	N	Northwest Forest Plan	M	H	Preserve existing habitat Increase information on each species	Survey potential habitat and document known sites at the regional level
Protect and enhance Peck's penstemon habitat: Reintroduce fire – Glaze meadow Protect from dispersed camping impacts – Cold Springs campground Long term fix for flooding – Trout Creek Maintain and restore uninterrupted flow regimes and channel integrity Prioritize weed control around Peck's penstemon populations	Both	1 4 5 25	N Yes as it applies to the Clean Water Act	FSM Deschutes National Forest Land Management Resource Plan Conservation Strategy for Peck's Penstemon	H	H	Enhanced vigor and viability of populations. Expand and increase populations. Move toward historic habitat conditions Restore opportunities for genetic exchange between populations	Monitor adjacent burned areas for population expansion. Patrol burned areas for noxious weed invasions. Monitor effectiveness of restoration activities

Recommendation	USFS or Coop Action	Trend	Legal Require Y or N	Law or Standard and Guideline	Priority H, M, L	Feasibility H, M, L	Describe Desired Outcome	Monitoring Actions
Prevent loss of Peck's penstemon in future land exchanges. This may require innovative land protection agreements, such as conservation easements – Deschutes Land Basin and Trust in school land exchange property	Coop	29	Y	FSM Deschutes National Forest Land Management Resource Plan Conservation Strategy for Peck's Penstemon	H	M	Maintain existing populations on exchanged FS lands	Monitor populations
Look for partnerships to protect and enhance Peck's penstemon on private lands with interested landowners	Coop	30	N	Conservation Strategy for Peck's penstemon	M	M	Maintain existing populations on private lands	Collaborate with private land owners to monitor populations
Prevent and control the spread of noxious weeds, especially along FS roads 11, 16 and in Indian Ford and the Sisters urban interface areas	USFS	25	Y	FSM 2080 Integrated Fuels Management Strategy Weed EA	H	M	Prevent new infestations and control spread	Tier to recommendations in the Noxious Weed EA Educate employees in all disciplines to identify noxious weed species.
Maintain and protect Newberry's gentian habitat in the Three Creek s Lake area	USFS	2 6	Y	FSM Deschutes National Forest Land Management Resource Plan	H	H	Protect habitat and populations	Monitor recreational impacts through LAC process

Recommendation	USFS or Coop Action	Trend	Legal Require Y or N	Law or Standard and Guideline	Priority H, M, L	Feasibility H, M, L	Describe Desired Outcome	Monitoring Actions
Lichens - Preserve and enhance Pacific yew, cottonwoods, other hardwoods, dogwood, and others for their value as habitat for survey and manage species – especially Black Butte Swamp, Trout Creek Swamp, Pole Creek, Big Slough	USFS	3 7	Y	Northwest Forest Plan Survey and Manage Guidelines	H	L	Preserve existing habitat. Increase information on each species.	Survey potential habitat and document known sites as needed
Fungi - Maintain and protect habitat for the three S&M component 1, 3 fungi in the Three Creeks Lake area which requires a buffer area of 160 acres	USFS	3 7	Y	Northwest Forest Plan	H	M	Preserve habitat and protect documented sites	Survey potential habitat and document known sites. Buffers of 160 acres must be observed. Assess recreational impacts. Assess the extent of occurrences in the analysis area.
Treat stands to promote desired species composition and tree density.	USFS	15 17 18	Y	Deschutes National Forest LRMP TM-55-67	Moderate	Low	Balance fire/climatic climax species composition and structure depending on management allocations and objectives	Periodic

Recommendation	USFS or Coop Action	Trend	Legal Require Y or N	Law or Standard and Guideline	Priority H, M, L	Feasibility H, M, L	Describe Desired Outcome	Monitoring Actions
Ponderosa Pine PAG--------------- Promote fire climax and a mosaic of fire/climatic climax in specific areas to provide wildlife habitat for a variety of early to late-successional dependent species. Increase med/large tree habitat – around meadows for Great grey owls, north slopes near water for goshawks, for white-headed woodpeckers, and Williamson's sapsucker Introduce fire to reduce dense understories Promote future large snag and down woody material habitat Decrease in juniper densities	USFS	10 11 12 15 16 17 19 20 21	N	Deschutes National Forest LRMP S&G's for Timber Management, Wildlife, and Fire and Fuels	Moderate	High	In urban interface areas, increase acres managed for fire climax and reduce small tree densities and brush component. Urban interface areas in MA-7 - Provide mosaic of fire and climatic climax. Maintain and enhance deer cover and forage while maintaining defensible space. In MA-7 outside of urban interface - Maintain and enhance deer forage and cover with a mosaic of bitterbrush age classes. Maintain a healthy multi-storied canopy. Sustainable stand densities (below UMZ) Species composition primarily PP in most stands Create, improve, and enhance habitat for late successional species Improve connectivity and reduce fragmentation	Vegetation/resource exams

Recommendation	USFS or Coop Action	Trend	Legal Require Y or N	Law or Standard and Guideline	Priority H, M, L	Feasibility H, M, L	Describe Desired Outcome	Monitoring Actions
Mixed Conifer Dry PAG--------- Promote fire climax and climatic climax in specific areas for wildlife habitat. Increase med/large tree habitat – around meadows for GGO's, north slopes near water for goshawks, for white-headed woodpeckers, Williamson's sapsucker, pileated, fisher and marten Decrease white fir densities Introduce fire to reduce dense understories Promote future large snag and down woody material habitat Decrease overall stand densities to below UMZ	USFS	10 11 12 15 17 19 20 21	N	NWFP (1994) – Standards and Guidelines Section 7 Endangered Species Act (ESA) - Provide habitat for T&E species Deschutes National Forest LRMP	Moderate	High	Increase acres of fire climax on south aspects, (45^0 - 310^0) Maintain, enhance, and increase acres of climatic climax in moister ecotones such as riparian bottoms, some north slopes, or other areas with longer than usual fire return intervals, especially in the LSR, NRF, and adjacent to NRF for connectivity, and in riparian areas. Create, improve, and enhance habitat for late-successional and old-growth dependent species. Improve connectivity and reduce fragmentation. (NWFP) Sustainable stand densities below UMZ	Vegetation/resource exams TES surveys

Recommendation	USFS or Coop Action	Trend	Legal Require Y or N	Law or Standard and Guideline	Priority H, M, L	Feasibility H, M, L	Describe Desired Outcome	Monitoring Actions
Mixed Conifer Wet PAG---------- Promote climatic climax for wildlife habitat Increase med/large tree habitat – especially around meadows for GGO's, north slopes near water for goshawks, for white-headed woodpeckers, Williamson's sapsucker, pileated, fisher and marten Decrease white fir densities Introduce fire to reduce dense understories Promote future large snag and down woody material habitat Promote structure within stands Decrease overall stand densities below UMZ	USFS	10 11 12 15 17 19 20 21	Y	Deschutes National Forest LRMP NWFP ESA	High	High	Enhance, maintain, and increase acres of climatic climax in LSR, CHU, NRF, and adjacent to NRF for connectivity. Create, improve, and enhance habitat for spotted owls and other late-successional and old-growth dependent species. Improve connectivity and reduce fragmentation. Provide quality habitat that will increase the number and distribution of late-successional and old-growth species. Move from sustaining to improving habitat and numbers of individuals. Move toward recovery. Sustainable stand densities below UMZ	TES Surveys Vegetation/resource exams

Recommendation	USFS or Coop Action	Trend	Legal Require Y or N	Law or Standard and Guideline	Priority H, M, L	Feasibility H, M, L	Describe Desired Outcome	Monitoring Actions
Lodgepole and High Elevation PAGs -------------- Allow fires to occur naturally to restore habitat for focal species Allow for accumulations of down woody material, especially near riparian areas, to provide lynx and marten habitat Promote large tree structure near riparian areas for marten habitat Stand treatments should be planned carefully to reduce the risk of blowdown	USFS	18 19 20 14	N	Deschutes LRMP NWFP	L	M	Balance of vegetation structure and species composition across the PAGs	Vegetation condition surveys
Re-establish beaver dams and ponds where they occurred historically.	USFS and Coop	1 2 3 6 22	N	Deschutes National Forest LRMP – S & G's for Riparian Areas/Streamside Management Units, and Floodplains	Low	Low	Increase special habitats that have been lost or altered. Increase riparian vegetation and improve habitats for riparian species.	Potential conflicts with downstream water users

Recommendation	USFS or Coop Action	Trend	Legal Require Y or N	Law or Standard and Guideline	Priority H, M, L	Feasibility H, M, L	Describe Desired Outcome	Monitoring Actions
Prepare deer and elk Management Plan for winter and transition ranges incorporating recreational uses	Coop with ODF W	12 16 17 27 28 33	N	IFMS Deschutes National Forest LRMP MA-7, Wildlife S & G's, Fire and Fuels S & G's	High - Need to accomp-lish prior to proposing treatments in these areas	Moderate	Deer and elk Management Strategy that incorporates IFMS which provides managers with planning tools to better balance deer and elk cover and forage needs with sustainable fire climax plant communities and fire proofing areas of urban interface. Section 9 Land Exchange guidance	Ensure consistency with IFMS (Integrated Fuels Management Strategy) Periodic Updates
Prepare an Old-growth Management Plan	USFS	10 15 16 17,18 20 21 28	N	ICBEMP Old-growth allocation (M 15) Metolius Old-growth allocation (M 27)	M	Moderate	Fine tune existing objectives with new science, information, and direction to improve management of old-growth	Periodic Updates
Aspen regeneration - Thin and Prescription burn	USFS	2 3 6 7	N	Deschutes National Forest LRMP TM55-67	Low	High	Enhance viability of aspen stands	Periodic Examinations
Develop a Firewood Management Plan Design firewood cutting units to be small and easily monitored and patrolled	USFS	20 34	N	NWFP Deschutes National Forest LRMP S & G's for Fuelwood, Wildlife, and Fire and Fuels Mgmt. ICBEMP	Moderate	High	Refine objectives of firewood program to ensure objectives of LSR are being met Ensure compliance	Periodic Updates Law Enforcement Officer

Recommendation	USFS or Coop Action	Trend	Legal Require Y or N	Law or Standard and Guideline	Priority H, M, L	Feasibility H, M, L	Describe Desired Outcome	Monitoring Actions
Eagles – Protect nest trees and co-dominants in BEMA and BECA Complete and implement BEMA Plan and associated Fire Management Plans Reduce risk to BEMA by fire and insects by thinning, removing brush, etc.	USFS	2 10 12 15 17 19 20 23 39	Y	Deschutes LRMP NWFP Draft Bald Eagle Management Plan and associated Fire Management Plans	H	M	Stable eagle habitat and future habitat Lowered risk to disturbance Maintained reproductive success	Monitor bald eagle sites Monitor effectiveness of management actions

Recommendation	USFS or Coop Action	Trend	Legal Require Y or N	Law or Standard and Guideline	Priority H, M, L	Feasibility H, M, L	Describe Desired Outcome	Monitoring Actions
Spotted Owls and LSR- increase amount of suitable habitat in home ranges – Promote large tree structure, PP, and DF Improve north-south connection between home ranges Decrease stand densities – reduce white fir understories Reintroduce fire into landscape to reduce risk of large scale disturbances	USFS	10 15 16 17 21	Y	NWFP Standards and Guidelines	H	M	NRF habitat will be maintained or created, understories will be decreased and dominated by PP and DF.	
Dispersal Habitat – Update 11-40 analysis to assess changes where boundaries changed	USFS	19	N	NWFP	H	H	Updated analysis showing where gaps in dispersal habitat occur	Analysis updated as changes and direction occur
Protect and enhance bat habitat – protect cave entrances from disturbance and vandalism	USFS	22	Y	NWFP Deschutes LRMP National Cave Management Act	H	M	Populations of bats, especially Townsends big-eared bats, continue to occupy caves and reproduce successfully. No vandalism of caves	Monitor Sky Line Cave to understand effects to cave dwelling species

Recommendation	USFS or Coop Action	Trend	Legal Require Y or N	Law or Standard and Guideline	Priority H, M, L	Feasibility H, M, L	Describe Desired Outcome	Monitoring Actions
Enhance or maintain meadows – Trout Restore fire to high elevation meadows Promote large tree structure near meadows for Great grey owls Remove encroaching lodgepole Provide nest structures for GGO if large tree structure is absent	USFS	15 17 18 20 22	N	NWFP Deschutes LRMP	M	M	Open meadows free of encroachment	Photo points Survey for great gray owls
Restore Glaze meadow – rehabilitate unneeded trails, close some horse trails, and remove fences Continue habitat restoration in Old Growth area with prescribed fire in both meadow and forest to enhance Peck's penstemon habitat	Coop	22 25 30 12	N	NWFP Deschutes LRMP	M	M	Restore meadow to a more natural condition Degraded sites are rehabilitated	Monitor Peck's penstemon populations
Improve Lower sno-park for fire	USFS	13	N	None	Moderate	High	Improve area around sno-park for crew bedding and	N/A

Recommendation	USFS or Coop Action	Trend	Legal Require Y or N	Law or Standard and Guideline	Priority H, M, L	Feasibility H, M, L	Describe Desired Outcome	Monitoring Actions
camp							camp area	
Develop a fire camp site in Pole Creek/Alder Creek area	USFS	13	N	None	Moderate	High	Have area set in case a large fire camp is needed in this area	N/A
Restore fire into the juniper fringe to restore and protect habitat	Coop	10 12	N	None	M	M	Restore grass understories	N/A
Increase to large scale fuels modification projects, including wilderness	USFS	12 19	N	None	High	High	Reduce loss of resources to wildfires and increase fire fighter and public safety Reduce large fire risk Decrease fire hazard through prescribed burning and mechanical treatment, both short and long term through multi entries based on fire return intervals, etc. (more frequent in pine stands than fir, lodgepole or wilderness)	
Look for opportunities to block up public and private lands. Provide input to City of Sisters regarding zone changes	Coop	28 30 27	N	Deschutes NF Land and Resource Management Plan, page 4-87	M #3	M	Less urban interface, less urban sprawl, and fewer access roads	Provide input to zoning changes and be consistent with the Land and Resource Management Plan Land Adjustment map

Recommendation	USFS or Coop Action	Trend	Legal Require Y or N	Law or Standard and Guideline	Priority H, M, L	Feasibility H, M, L	Describe Desired Outcome	Monitoring Actions
Provide community education on natural ecosystem function. Emphasize an appropriate balance between human uses, resource extraction, and preservation	Coop	2 7 12 15 17 22 33 43	N	Forest Service Direction and Policy	H #2	M	Bring public ownership, support, and consent to restoration efforts	Monitor feedback and public support
Expanded public involvement in planning projects	USFS	20 30 43	N	Northwest Forest Plan Deschutes NF Land and Resource Management Plan	H #1	H	Bring public ownership, support, and consent to restoration efforts	Monitor feedback and public support
Work with City and County to encourage environmentally benign development – limit developments in floodplains and developing more urban interface	Coop	34 35 43	N	Northwest Forest Plan Deschutes LRMP	H	H	Community Support More numbers of people involved than the past Less impacts from development	Public feedback
Encourage community policing of Pits in urban interface areas Work with subdivisions	Coop	34 35 43	N	N/A	H	M	Community support More numbers of peoploe involved than the past Less impacts from use	Monitor use occurring in and adjacent to pits Public feedback

Recommendation	USFS or Coop Action	Trend	Legal Require Y or N	Law or Standard and Guideline	Priority H, M, L	Feasibility H, M, L	Describe Desired Outcome	Monitoring Actions
Prepare a Master Plan/Site Restoration Plan for the Three Creek Recreation complex Protect sensitive habitat and rare endemic species Relocate, improve, and define Tam McArthur trailhead Restore wetlands to Three Creek meadow, Trapper meadow, and Little Three Creek Lake	USFS	2 6 25 32 33 39 42 43 44 46	N	Deschutes National Forest LRMP M11-3, M11-4, M11-38, M11-47 Deschutes LRMP M6-50 NWFP – ACS objectives	H #2 H #4 H	M H CIP $$ 1999 M	Improve site conditions and recreation experience through site hardening, restoration of impacted areas, trail designation, and interpretive programs. Assess Trapper's Cabin's future Eliminate parallel parking along Road 16 near Three Creek Lake Dam Natural flow regimes are re-established Endemic salamander species habitat is protected	Pre- and post monitoring Public surveys Site condition surveys Monitor parking in area Coordinate with OSU amphibian research
Develop partnerships with the City of Sisters, County, and subdivisions to educate and enforce and monitor forest lands in the urban interface areas	Coop	17 22 24 25 27 28 33 34 35 39 40	Y	CFR's regarding dumping, encroachments, and resource damage (CFR 261.11 b, c, d, e) Deschutes National Forest LRMP FF-1	H #3	M	Improve resource condition and visual quality in the urban interface area and maintain natural quality of pine forests	Monitor through annual patrols and work parties Use partners and volunteers as eyes and ears (does this go here)

Recommendation	USFS or Coop Action	Trend	Legal Require Y or N	Law or Standard and Guideline	Priority H, M, L	Feasibility H, M, L	Describe Desired Outcome	Monitoring Actions
Reduce road densities – deer winter range and MCW for wolverine Rehab closed roads – enhance forage for big game Limit motorized access in the urban interface area through road and area closures	USFS	9 22 25 36 37 39 40 42 44	Y	Deschutes NF Land and Resource Management Plan, Road Density S&G's (TS-6, TS-7, TS-12)	M #3	M	Stop proliferation of roads and trails Reduce road densities to 2.5 mi/mi^2 Higher quantity and quality of forage in areas where human/deer conflicts occur	Road density monitoring
Grazing – Evaluate allotments for Squaw Creek, Cache Mtn, and Garrison Butte. Conduct NEPA to determine fate Consider pulling fences from wilderness areas	USFS	31 6 22 25 28	N	Deschutes LRMP	M	M	Close allotments that are non-active Removal of hazards (fence) especially in wilderness Rehabbed sites where grazing may have degraded habitat and soils	NEPA documents Site monitoring
Update Indian Ford Allotment Plan Survey for mollusks	USFS	31 6 22 25 28	Y	NWFP Standards and Guidelines Deschutes National Forest LRMP	H	M	Survey and manage species sites are located and buffered Riparian reserve vegetation is functional	Survey for survey and manage species

Recommendation	USFS or Coop Action	Trend	Legal Require Y or N	Law or Standard and Guideline	Priority H, M, L	Feasibility H, M, L	Describe Desired Outcome	Monitoring Actions
Provide more day use opportunities	USFS	27 29 39	N	Deschutes National Forest LRMP M11-3, M11-4	H #2	M	Disperse users Improve recreation experience Meet ROS Guidelines	Encounter data Public input
Build a tie trail to Whispering Pines Campground from Metolius-Windigo trailhead	USFS	27 29 33 39	N	Deschutes National Forest LRMP TR-11	M #5	H	Provide more riding opportunities from both trailhead and campground	Feedback from OET and users
Add nordic skiing opportunities at Lower Three Creeks sno-park	USFS	27 29 39	N	Deschutes National Forest LRMP TR-15 and TR-17	M #6	H	Improve recreational experience and opportunity at this location	Public feedback and acceptance
Construct interpretive trail at Cold Springs campground	USFS	28 29 39	N	Deschutes National Forest LRMP RP-36 Underline EA	H #4	H	Provide an interpretive opportunity at this location	Public feedback and involvement
Add trail opportunities from Graham Corral campground	USFS	27 29 39	N	Deschutes National Forest LRMP TR-11	M #5	H	Provide 2-3 trail riding opportunities from this location	Public feedback Recreation use monitoring at campground
Meet American Disabilities Act (ADA) requirements in recreational facilities	USFS	27 29 39	Y	American Disabilities Act	H in priorities 4-6	M	Provide accessible facilities throughout the watershed	Site facility inventory
Move toward using prescribed natural fire in wilderness	Both	12 15 16 17 27 41	N	Prescribed Natural Fire Plan	M #7	L	Restore fire to wilderness ecosystem	Monitor progress as described in the Prescribed Natural Fire Plan

Recommendation	USFS or Coop Action	Trend	Legal Require Y or N	Law or Standard and Guideline	Priority H, M, L	Feasibility H, M, L	Describe Desired Outcome	Monitoring Actions
Require stock feeds that are certified as weed free throughout the watershed	USFS	25	N	Weed Management EA	M #7	M	A weed free watershed	Weed survey Pre- and post certification requirement
Manage landscapes for ecological aesthetics. Rehabilitate old clear-cuts by feathering edges	USFS	43	N	EA's	L-M	M	Improve visual quality in forested areas "seen" from towns, highways, view points, etc.	Pre- and post treatment monitoring Public feedback
Expand limited entry areas (LEA's) in wilderness from the Willamette NF to the Deschutes NF (i.e. Expand Obsidian LEA to include Matthieu Lakes). Look for other quota needs	USFS Coop with WIF	41	N	Wilderness Strategy EA Deschutes National Forest LRMP M6-25, M6-27	M #7	M	Bring high use areas into standard physically and socially	Monitor encounter data pre- and post quota
Move Park Meadow Trailhead to Road 16. Connect existing Jeep Road to trailhead. Improve parking at Road 16 and define	USFS	41	N	Deschutes National Forest LRMP M6-26	H #4	M	Decrease road density Protect fragile pumice flats Improve wilderness experience	Monitor use and encounter data and public acceptance
Make minor improvements to Squaw Creek Falls access road and trailhead	USFS	41	N	Deschutes National Forest LRMP M6-50	H #4	H	Improved driving and recreational experience in driving to trailhead	Public feedback

Recommendation	USFS or Coop Action	Trend	Legal Require Y or N	Law or Standard and Guideline	Priority H, M, L	Feasibility H, M, L	Describe Desired Outcome	Monitoring Actions
Plan and construct a sno-park on Highway 242 near the snow gate	USFS and WRAC	41 42	N	Deschutes National Forest LRMP TR-17	M #6	L – Requires EA and App to WRAC and CIP	Provide a well designed sno park and snow plowing in this location	Public feedback Use monitoring
Write a management plan for the historic structure at Lava Camp Lake Campground	USFS	39 45	N	Deschutes National Forest LRMP CR-3, CR-7	H #4	H	Remove or maintain the historic structure. If possible, provide a similar facility away from campground	Public input from winter sports users and organizations
Close and rehabilitate OHV hill climbs and trails at Black Pine Springs campground	USFS	8 33	N	Deschutes National Forest LRMP M8-3, M8-4	M #7	M	Restore native plants and grasses Prevent further erosion	Site condition monitoring
Complete a Wild and Scenic River Plan for Squaw Creek	USFS	39	Y	Deschutes National Forest LRMP Wild and Scenic River Act	H	L Money and resources not available	Comply with legal requirements and provide direction	Accomplishment of Plan
Protect and enhance wilderness Limit unlawful trespass in winter to protect rare and sensitive species Sign wilderness boundary to make more visible Increase Forest Service presence	USFS	41 42	Y	Wilderness Act	H	M	Reduce or eliminate trespass	Number of trespass incidents

Recommendation	USFS or Coop Action	Trend	Legal Require Y or N	Law or Standard and Guideline	Priority H, M, L	Feasibility H, M, L	Describe Desired Outcome	Monitoring Actions
Work with the Confederated Tribes of Warm Springs to meet Federal Trust Obligations on ceded lands	Coop	22 23 26 45	Y	1855 Treaty with Tribes of Middle Oregon	H	H	Increased cooperation and communication	N/A
Identify Heritage resources	USFS	45	Y	National Historic Preservation Act Deschutes NF Land and Resource Management Plan, CR-1, CR-4, CR-5	H	H	Knowledge of where these fragile and non-renewable resources are	Annual review - acres surveyed and sites recorded
Evaluate Heritage resources	USFS	45	Y	Deschutes NF Land and Resource Management Plan, CR-2, CR-4, CR-5	H	H	Knowledge of which resources to protect and which not to	Number of sites evaluated each year
Develop Management Plans for heritage resources being damaged or that can't be avoided	USFS	45	Y	Deschutes NF Land and Resource Management Plan, CR-3, CR-4, CR-5 National Historic Preservation Act 36 CFR 800 36 CFR 61`	H	M	Knowledge of what activities are needed to reduce damage or recover significance for sites at risk	Number of plans in place Number of Natural Register nominations
Rd 11 – Widen Shoulders	USFS	37	Y	MOU – FHWA Public Highway Safety Act	L	M	Make HSA road safer for public use	Number of accidents
Rd 16 – Widen Shoulders	USFS	37	Y	MOU – FHWA Public Highway Safety Act	M	M	Make HSA road safer for public use	Number of accidents
Rd 16 – Reconstruct to Standard and Resurface	USFS	37	Y	MOU – FHWA Public Highway Safety Act	M	M	Make HSA road safer for public use from end of pavement to Three Creek Lake	Number of accidents Traffic Counts
Rd 1514 – Stabilize Surface	USFS	9 37	N	N/A	L	L	Conserve non-renewable resource	Use
Rd 1514-780 – Install culvert and reshape ditchline	USFS	9	N	N/A	H	H	Restore flow to original streambed Reduce sediment	Resource protection

Recommendation	USFS or Coop Action	Trend	Legal Require Y or N	Law or Standard and Guideline	Priority H, M, L	Feasibility H, M, L	Describe Desired Outcome	Monitoring Actions
Rd 1608 – reconstruct, Replace or Abandon	USFS	9 37	N	N/A	H	H	Stop sedimentation for Melvin Ditch diverted flows	Erosion quantity
Rd 1608-900 – Reconstruct, Replace or Abandon	USFS	9 37	N	N/A	H	H		Erosion quantity
Maintain "Other" Roads (Condition Survey)	USFS	9	N	N/A	H	H	Roads allowed to "grow in" or self close without resource damage. Reduce road densities	Percent of completion
Maintain "Secondary" Roads. (Condition Survey)	USFS	9	N	N/A	M	H	Roads allowed to "grow in" or self close without resource damage. Reduce road densities	Percent of completion
Inventory/Conditi on Survey roads acquired in Crown Land Exchange	USFS	9	N	N/A	L	M	Assess additional roads	Percent of completion
Protect impacted areas with area closures to motor vehicles	USFS ODF W	36	N	N/A	M	M	Stop creation of new roads in urban interface Maintain Density (Green Dot type closure recommended may be possible)	Compliance