McCloud Arm Watershed Analysis
May 1998

Shasta-Trinity National Forest

Preface

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

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

1. Characterization of the watershed
2. Identification of issues and key questions
3. Description of current conditions
4. Description of reference conditions
5. Synthesis and interpretation of information
6. Recommendations

This document is guided by two levels of analysis:

- **core topics** - provide a broad, comprehensive understanding of the watershed.

  Core topics are provided in the Federal Guide for Watershed Analysis (8/95) to address basic ecological conditions, processes, and interactions at work in the watershed.

- **issues** - focus the analysis on the main management questions to be addressed.

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

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

Table of Contents

List of Maps

List of Figures

List of Tables

Chapter 1

Characterization of the Watershed

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

The major topics covered in this chapter are:

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

Location

The McCloud Arm Watershed is located along the McCloud Arm of Shasta Lake. The watershed lies about 20 miles north of Redding, California and is located within Shasta County. The entire watershed falls within the boundary of the Shasta Lake Ranger District of the Shasta-Trinity National Forest (see Map 1 - Vicinity Map).

Watershed Setting

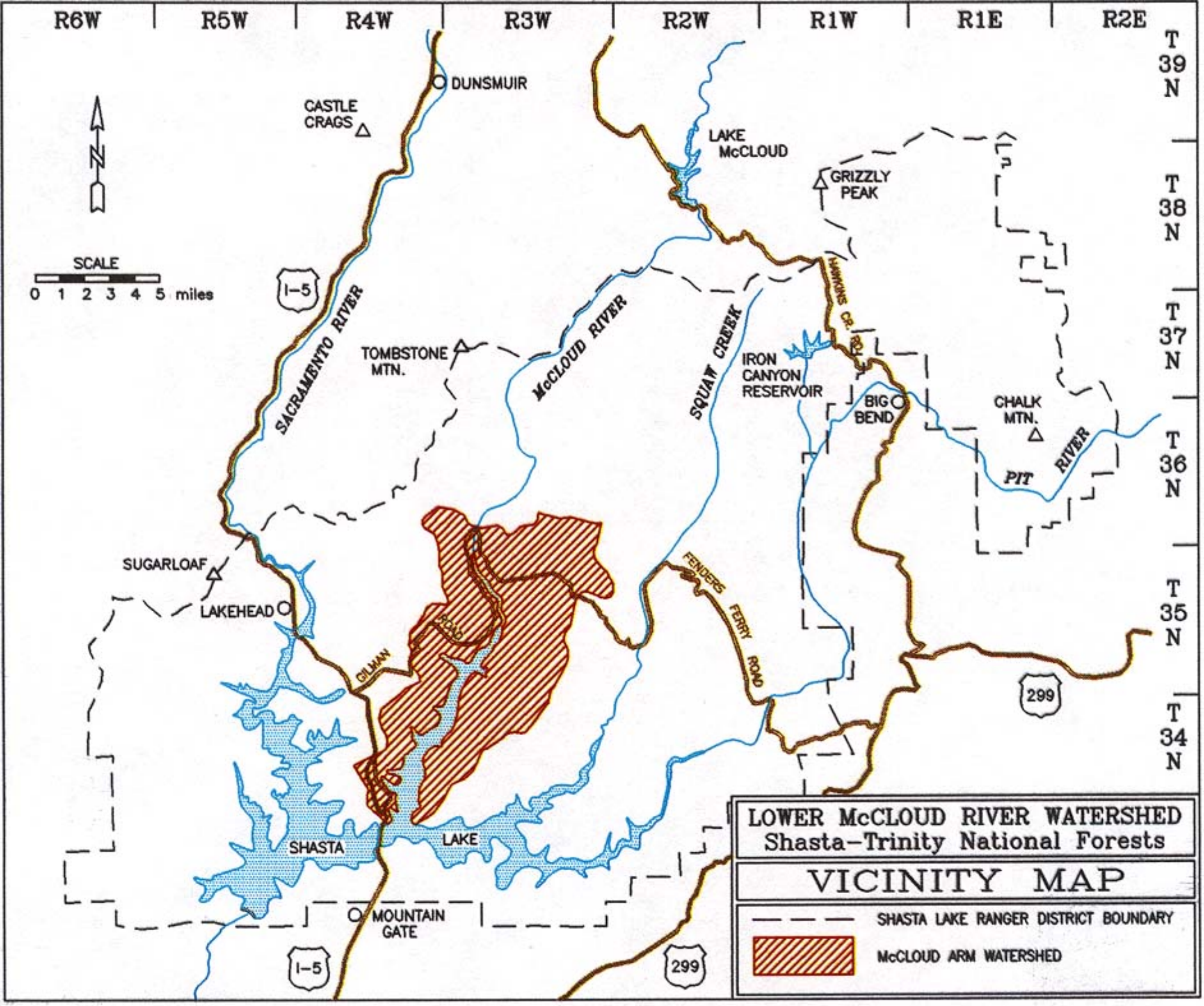
The McCloud Arm Watershed is about 41,248 acres in size, of which 26,817 acres are National Forest. Watershed boundaries used in this analysis include all lands that drain into the McCloud Arm of Shasta Lake downstream from the McCloud Bridge.

The landbase in the McCloud Arm Watershed is summarized as follows:

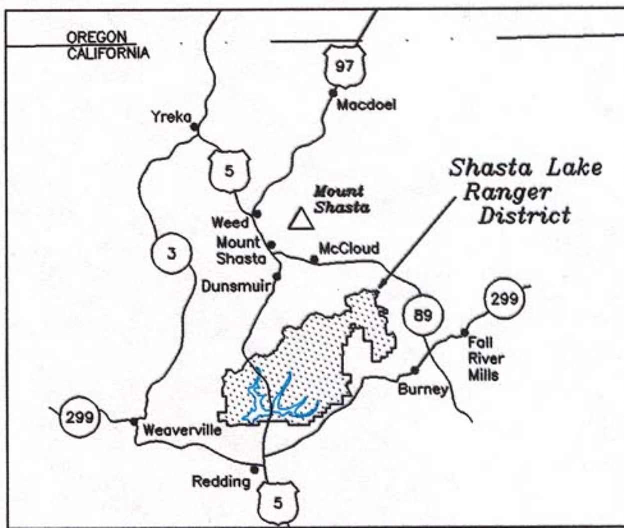
National Forest	26,817	acres	(65%)
Private ownership	9,590	acres	(23%)
Total land area	36,407	acres	(88%)
Total water area *	4,841	acres	(12%)
Total area (land & water)	41,248	acres	(100%)

* McCloud Arm of Shasta Lake only

The arrangement of National Forest and private ownership within the watershed is displayed on Map 2 - Ownership.

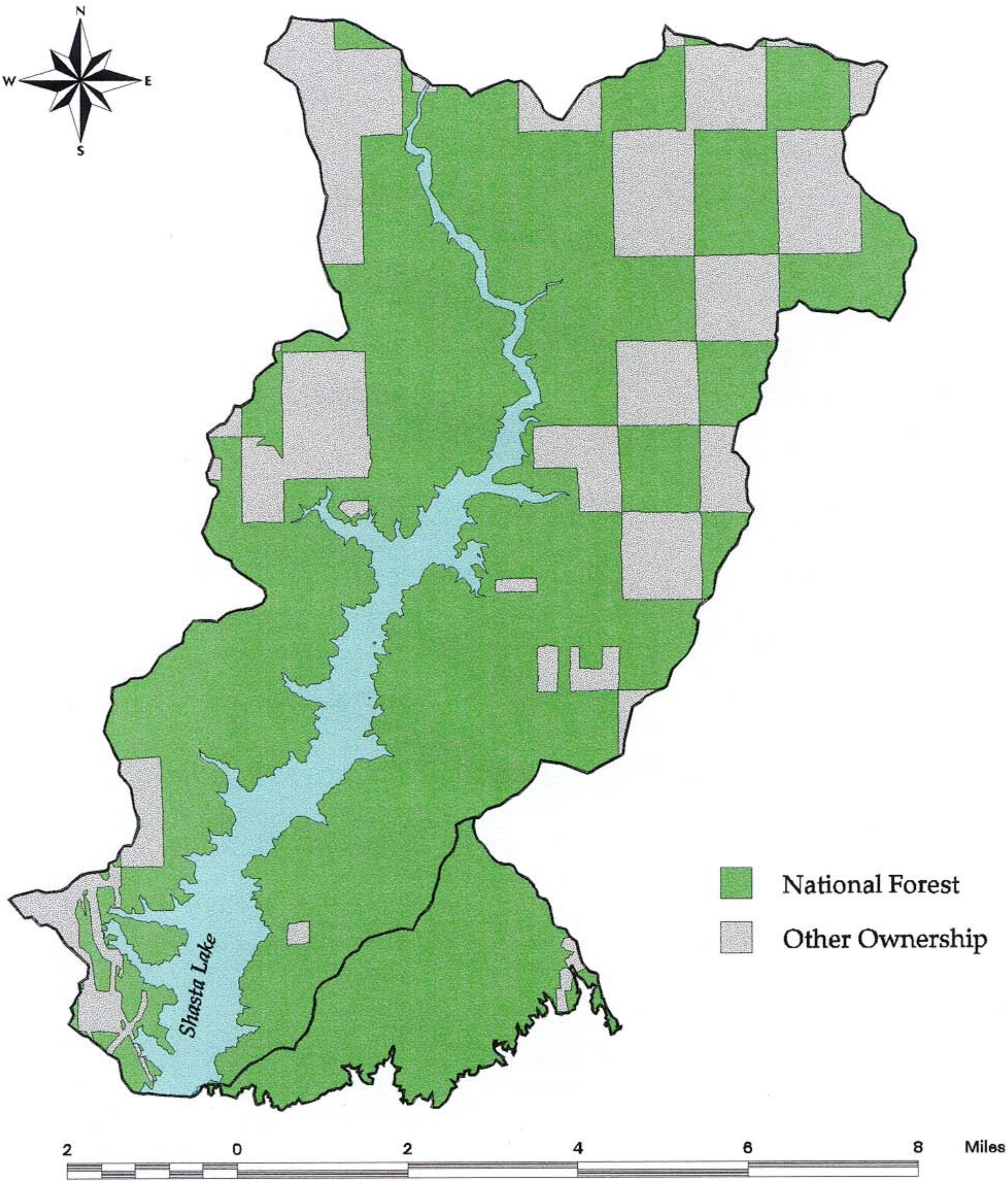


Map 1. Vicinity Map



McCLOUD ARM WATERSHED ANALYSIS

Map 2. Land Ownership



Additional Area Included in this Analysis

During the analysis process for the McCloud Arm Watershed, it was noted that prescribed burning recommendations to improve wildlife habitat would be best implemented if certain areas in the adjacent Squaw Creek Watershed were treated at the same time. Inclusion of these additional areas would take advantage of topographic features for controlling the perimeter of the prescribed burn and would tie proposed treatment areas into previously treated areas. If these additional areas were left to be included in the upcoming Squaw Creek Watershed Analysis, there would be an estimated two-year delay in implementing burning.

This additional area consists of 4,792 acres on the south slopes of Horse Mountain and west of Horse Creek. Named drainages in this area are Azelle Creek, Baxter Creek, Zinc Creek, and Horse Creek. Total acreage for the Squaw Creek Watershed is approximately 64,000 acres.

It was decided to include this additional area in the McCloud Arm Watershed Analysis to allow prescribed burning to be implemented in a more efficient manner. Analysis of this additional area within the Squaw Creek Watershed would focus on the impacts of prescribed burning within Riparian Reserves. In the future, this area would be included in the Squaw Creek Watershed Analysis.

Analysis of this additional area, separate from the rest of the Squaw Creek Watershed, is appropriate because the drainages within the area flow into Shasta Lake rather than into Squaw Creek. Flows and linkages along streams in this area have been isolated and disrupted by the creation of Shasta Lake. There would be no downstream effects and impacts would not tend to extend beyond each drainage.

No changes are proposed to watershed boundaries. Acres within this additional area are kept separate from acres within the McCloud Arm Watershed. For the remainder of this document, this additional area is referred to as the "Squaw Creek Addition".

The landbase in the Squaw Creek Addition to the McCloud Arm Watershed Analysis is summarized as follows:

National Forest	4,637	acres	(97%)
Private ownership	155	acres	(3%)
Total land area	4,792	acres	(100%)
Total water area *	-	acres	-
Total area (land & water)	4,792	acres	(100%)

* Lake surface area is not included in the Squaw Creek Addition.

Relationship to Larger-Scale Settings

Many physical, biological, and human processes or features span areas much larger than a watershed. To appropriately characterize and analyze specific aspects of the watershed, the watershed needs to be placed in its logical setting with respect to these larger scales.

Two larger-scale settings need to be considered when addressing the Lower McCloud River Watershed:

- The McCloud River Basin
- National Recreation Area

The McCloud River Basin

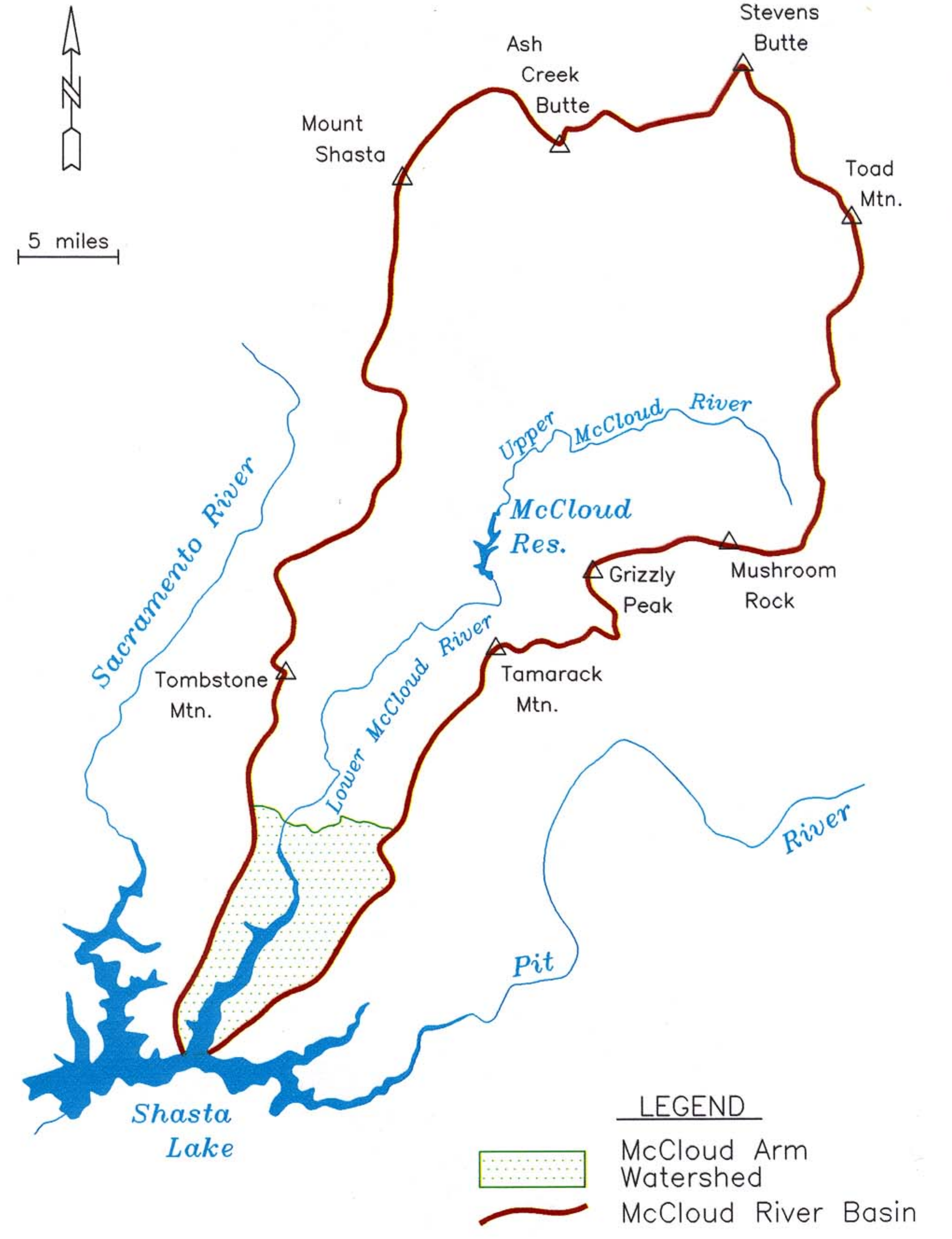
The McCloud River Basin drains an area of roughly 800 square miles. Its headwaters are at Colby Meadows near Bartle. The river flows southwesterly for approximately 50 miles to its terminus at Shasta Lake (see Map 3 - McCloud River Basin).

Physical conditions and land use patterns in the McCloud River Basin are best described by dividing the basin into three sections:

1. The Upper McCloud River (above McCloud Reservoir)
    - Terrain is generally flat to gentle slopes and includes the McCloud Flats.
    - Vegetation consists of mixed-conifer and ponderosa pine forest.
    - Land use is predominantly timber management and grazing with recreation use concentrated along the river.
2. The Lower McCloud River (between McCloud Reservoir and Shasta Lake)
    - Terrain consists of a deep canyon through which the river flows.
    - Vegetation is predominantly mixed-conifer and Douglas-fir forest.
    - Timber management has occurred in the Hawkins Creek drainage and the upper slopes on the east side of the canyon. Most of the remainder of this portion of the river basin remains essentially unroaded.
3. The McCloud Arm of Shasta Lake
    - Terrain consists of a deep canyon through which the river once flowed. This section of the river is now inundated by Shasta Lake.
    - Vegetation is predominantly open conifer stands, gray pine, knobcone pine, and chaparral.
    - High-density recreation use occurs on the lake and its shoreline. Much of the remaining area is rugged, inaccessible, and essentially unroaded.

National Recreation Area

The McCloud Arm Watershed is a portion of the Shasta Unit of the Whiskeytown-Shasta-Trinity National Recreation Area (NRA) which includes 212,000 acres on the Shasta Lake and Weaverville Ranger Districts of the Shasta-Trinity National Forests. The portion of the watershed included within the NRA is displayed on Map 7 as Management Area #8.



Map 3. Relationship of the McCloud Arm Watershed to the McCloud River Basin

Geological & Biological Uniqueness

The limestone formation in the area around Shasta Lake is unique in its development, composition and contribution to economic, and worldwide paleontological significance. For example, the McCloud limestone contains thirty-six species of rugose and tabulate corals, twenty-three of which should form the basis of new species. These fall into sixteen genera, four of which are probably new species.

Because of its very diverse fossil faunas, the area immediately north of Shasta Lake and between its McCloud and Pit Arms is perhaps California's single most important area for paleontological research (Munthe and Hirschfield 1978). Marine invertebrate faunas of Mississippian, Pennsylvanian and Permian age; marine invertebrate and vertebrate faunas of Triassic age; and faunas of Pleistocene age all occur in this small area.

The area immediately northwest of McCloud Bridge has produced several large Mississipian and Pennsylvanian invertebrate faunas. Since this period is poorly represented on the West Coast, these Shasta Lake faunas become all the more important to understanding the late Paleozoic evolution in this part of the country.

The Permian paleontological record in the area north of Shasta Lake is also unique. Only in the Mojave Desert are there comparable California Permian faunas. Research in the Shasta Lake area can provide an understanding into how West Coast invertebrate evolution compares with the rest of the continent.

Shasta Lake limestone formations have provided important Triassic marine invertebrate fauna. Ichthyosaurs of the area have provided virtually everything known about this group's development during the late Triassic period in North America. Several new species and genera have been described based on collections made by J.C. Merriam and others from the University of California in the early 1900s. This work still stands as some of the most important information on ichthyosaurs. In addition to ichthyosaurs, the area has produced the only remains of Thallatosauria ever found in the Western Hemisphere. Ichthyosaurs were the most highly adapted reptiles for an aquatic existence. Thallatosaurs were small aquatic fish-feeding reptiles.

Limestone caves in the Shasta Lake area and tar-pit entrapment at Rancho La Brea in Los Angeles have produced most of what is known about a large part of California in the late Pleistocene. Specifically, Potter and Samwell caves constitute virtually the entire knowledge of late Pleistocene vertebrate life in northern California.

The McCloud limestone also provides habitat for unique cave-adapted vertebrates and invertebrates, and limestone associated biota. Examples of known species unique to limestone formations include:

- Shasta salamander
- Shasta eupatorium (Ageratine shastensis)
- Howell's cliff-maids (Lewisia cotyledon ssp. howellii)
- Shasta snow-wreath (Neviusia cliftonii)

Physical Features

Dominant Physical Features

The dominant physical feature of the watershed is the McCloud Arm of Shasta Lake. Elevations range from 1065 feet above sea level (the spillway elevation of Shasta Lake) to slightly above 4300 feet on Town and Salt Creek Mountains

The only large sub-drainage within the watershed is the Nosoni Creek drainage in the northeast portion. Numerous smaller tributary streams are found throughout the remainder of the watershed. All of these tributary streams drain directly into Shasta Lake.

Dominant features in the watershed are shown on Map 4 - Dominant Physical Features.

Climate

The McCloud Arm Watershed is characterized by hot, dry summers and a mild climate during the remainder of the year. Daytime high temperatures commonly exceed 100° in the summer. Annual precipitation, mostly in the form of rain, varies from 50 to 75 inches depending on local topography. Approximately 85% of this precipitation falls from November 1 through April 30.

Geology, Geomorphology, and Erosion Processes

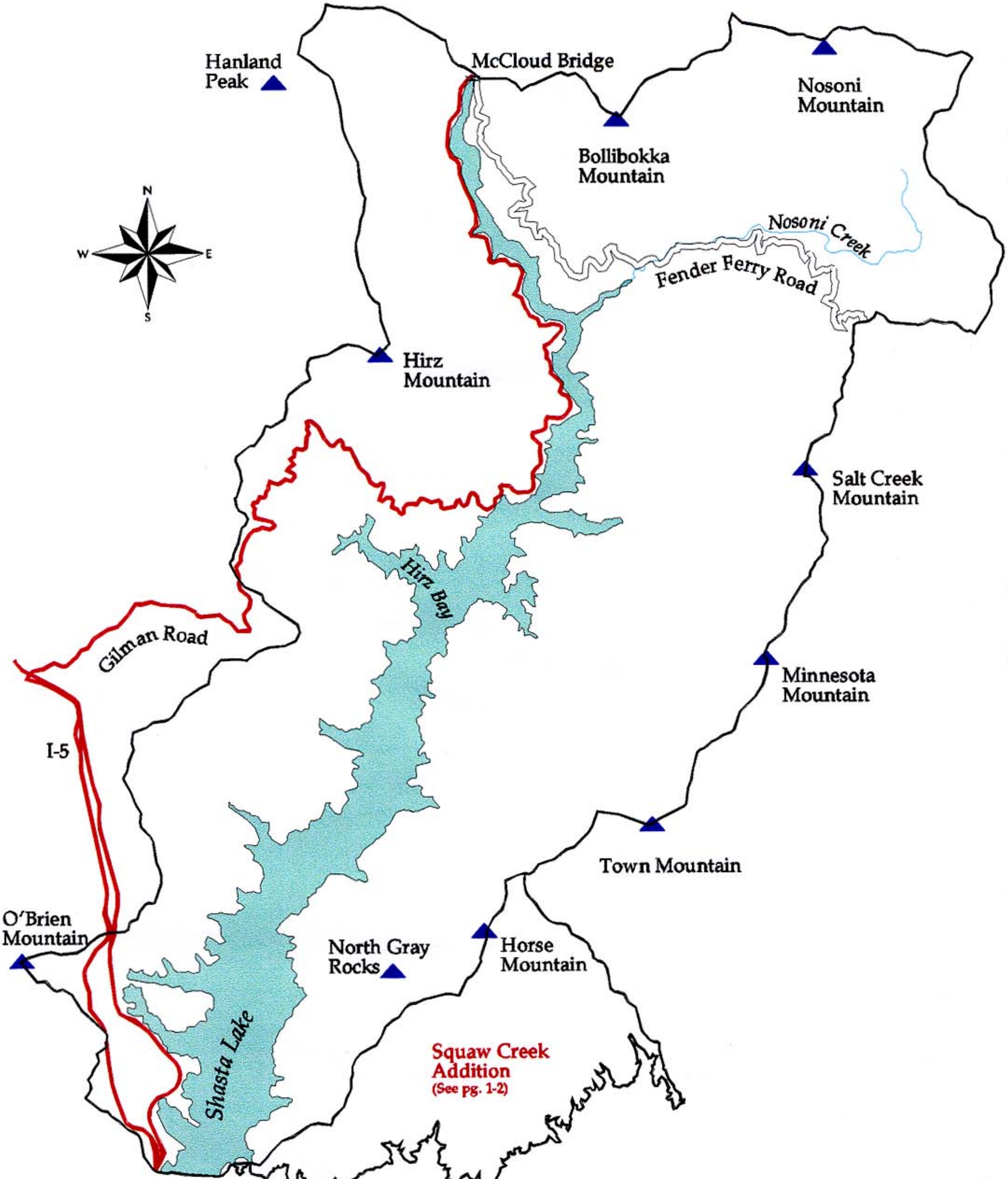
As discussed previously in this chapter, the most unique geologic feature in the McCloud Arm Watershed is the McCloud Limestone formation. Besides containing numerous limestone caverns, the McCloud Limestone formation also provides habitat for many cave-adapted invertebrates and limestone associated biota.

Eighty percent of the analysis area is characterized by active mass wasting processes in the form of debris slides, flows, torrents and colluvial filled hollows. Mass erosion also occurs as dry creep or dry ravel on steep slopes with soils that are high in coarse materials and low in cohesion.

Prescribed burning is the major land-use activity in the watershed that affects erosion. Fire alters the physical, chemical, and biological properties of the soil, which regulate runoff and control erosion. The removal of protective litter by fire on steep slopes encourages dry creep. Information on erosion following prescribed fire in chaparral is limited.

The potential for catastrophic wildfire resulting from large fuel accumulations and its possible effects on mass wasting and erosion processes is a particular concern in this watershed.

McCLOUD ARM WATERSHED ANALYSIS



Map 4. Dominant Physical Features

Hydrology

The dominant hydrologic feature in the watershed is the McCloud Arm of Shasta Lake. The surface area of the lake within the watershed is approximately 4841 acres at full capacity or 12 percent of the total watershed area.

All tributaries to Shasta Lake drain mountainous terrain forested primarily by brushy, understocked hardwood stands and ponderosa pine dominated conifer stands.

Riparian Reserves in the McCloud Arm Watershed consist almost exclusively of stream channels, unstable areas and reservoir buffers. There are no natural lakes, ponds, or wet meadows in the watershed.

Base flows in the McCloud River are completely regulated by the Pit River Hydroelectric Project. Water from the McCloud River is diverted at Lake McCloud and sent through a tunnel to Iron Canyon Reservoir and eventually into the Pit River. Baseflows in all of the sub-watersheds tributary to the McCloud Arm are unregulated.

Peak flow events in the McCloud Arm Watershed occur during the winter months when heavy rains saturate the ground and melt snow at the upper elevations of the watershed.

Stream Channel

The twelve miles of the main channel of the McCloud River within the watershed have been inundated by the formation of Shasta Lake.

The morphology of stream channels in the McCloud Arm Watershed is a reflection of natural geologic and fluvial processes and, in some cases, land-use activities. Channel morphologies throughout the watershed differ because channels have formed in different geologic parent materials.

Upland channels are generally located within unstable terrain throughout the watershed. Geologic analyses indicate that most upland channels have been affected by debris flows and landslide activity that has occurred throughout the Holocene Epoch. Many of the upland channels were formed as a direct consequence of debris flows.

The morphology of channels and the unstable slopes associated with them may be affected by fire suppression, catastrophic fire and prescribed fire. Effective fire suppression over the past 55 years has allowed vegetation to accumulate in the watershed. Increased vegetative cover and a decrease in the return periods of natural fires may be affecting erosion process and sediment delivery to the channel network.

Sediment inflows from the McCloud River and the other tributaries are slowly decreasing the size and storage capacity of Shasta Lake. The process of aggradation in Shasta Lake is believed to be occurring at a very slow rate (NRA Management Guide, 1996). The rate of aggradation in the upper McCloud Arm has been reduced by the McCloud Reservoir which effectively cut off the supply of sediment from Mud Creek (above Lake McCloud) and the entire Upper McCloud River Basin.

Water Quality

The quality of water in the McCloud Arm Watershed is influenced by both natural processes and land-use activities. Beneficial uses dependent on high quality water include fish and aquatic life (including riparian vegetation), drinking water for private residences and recreational facilities along the McCloud Arm, and recreation benefits associated with fishing, boating, swimming and hiking.

The quality of water in Shasta Lake is considered to be very good. The high turnover rate of water in Shasta Lake is the main factor that insures good water quality. Inflows from Shasta Lake's major tributaries continually replenish the lake with fresh, high quality water. The total annual inflow to Shasta Lake is approximately half the total storage capacity of the lake.

The greatest water quality concern in the McCloud Arm is the existing and potential turbidity levels in Shasta Lake. Factors contributing to turbidity include peak flows, shoreline erosion from wave action and water level fluctuations in the reservoir.

Large concentrations of debris provide increased habitat for aquatic organisms but also present a hazard to boaters on the lake. Large concentrations of woody debris that accumulate in the reservoir after large floods, such as the 1997 event, are removed from the reservoir on an annual basis.

Biological Features

Vegetation

Vegetation in the McCloud Arm Watershed is described as a mixture of chaparral, hardwoods, and open conifer stands typical of the transition from foothill to montane conifer vegetation.

Hardwood stands are the most common vegetation type and often contain scattered gray pine and conifers. Hardwoods comprise approximately 44% of the National Forest land base in the watershed or approximately 33% if private ownership is included in the landbase.

Conifer vegetation types also occupy approximately 44% of the National Forest land base in the watershed or approximately 33% of all land (including private ownership). The majority of conifer stands (approx. 94%) have an open, scattered crown canopy of less than 40% cover. These stands are usually interspersed with gray pine, hardwoods and shrubs. Less than 2% of the watershed occurs as late-successional conifer stands. These older conifer stands tend to occur mostly in the Nosoni Creek drainage and on higher terrain around Town Mountain and Minnesota Mountain.

Chaparral vegetation occurs on approximately 10% of the National Forest landbase in the watershed and approximately 7% of all land (including private ownership). Chaparral vegetation occurs as both shrubs (manzanita, buckbrush, etc.) and as shrub-sized hardwoods (black oak, live oak, etc.).

There has been essentially no timber harvest on National Forest land in the watershed.

Copper and iron smelters in use between 1900 and 1920 emitted large volumes of sulfur dioxide that had severe impacts on vegetation in the area around Shasta Lake. No smelters were in operation within the McCloud Arm Watershed; however, vegetation was possibly impacted by drifting emissions from these smelters.

Large fires in the late 1800s destroyed vegetation in much of the area. This was followed by ninety years of fire suppression that have allowed vegetation to develop and fuels to accumulate.

Grazing was widespread in the watershed prior to the formation of Shasta Lake in 1945.

The inundation of a large portion of the watershed by Shasta Lake eliminated approximately 4841 acres (12%) of the landbase in the watershed, including what was probably the most productive forest land along the river terraces.

Species and Habitat

Wildlife species of special concern in the Lower McCloud River Watershed are:

- American Peregrine Falcon
- Bald Eagle
- Northern Spotted Owl
- Shasta Salamander
- Northern Red-Legged Frog
- Northern Goshawk
- Willow Flycatcher
- Pacific Fisher
- American Marten
- Northwestern Pond Turtle
- Black-tailed Deer
- Elk
- Neotropical Migratory Birds

Bat species of special concern include:

- Long-eared Myotis
- Fringed Myotis
- Long-legged Myotis
- Pallid Bat
- Silver-haired Bat
- Townsend's Big-eared Bat
- Yuma Myotis

Rare plant species of special concern are:

- Arnica venosa
- Lewisia cotyledon spp. howellii
- Neviusia cliftonii
- Raillardiopsis scabrida
- Ageratina shastensis (=Eupatorium shastense)

These species are addressed more fully in the main document because of their status. Other species not listed, but still of concern can be found in Table 3-12 of Chapter 3.

Old growth and late-successional forest habitat currently comprises less than 2% of the watershed. The potential for development of additional late-successional habitat in the future is very limited due to climate and soil conditions. The filling of Shasta Lake in the 1940's also removed the most productive forest land in the watershed. As a result, most of the traditional late-successional forest-associated species would not be expected to inhabit this watershed.

The watershed also has limited value in providing for dispersal habitat (forest stands >11"dbh and >40% crown cover). Currently dispersal habitat has been identified in 35%

of the watershed. As with late-successional habitat, climate and soil conditions severely limit the potential of the watershed to provide additional dispersal habitat in the future.

The majority of habitat types in the watershed are found in the early and mid seral stages.

- Hardwood habitat occurs on 11,920 acres (44%).
- Shrub/chaparral habitat occurs on 2,644 acres (10%).
- Open conifer stands occur on 11,337 acres (42%)

There is one historical peregrine falcon eyrie within the watershed near Shasta Lake Caverns. Additional sightings of peregrine falcon have also been recorded in the northernmost part of the watershed, around the McCloud Bridge.

There is one known bald eagle nest location in the watershed at Hirz Bay. There is concern that there is a lack of suitable large ponderosa pine for nest trees around Shasta Lake.

There are no known spotted owl activity centers within the McCloud Arm Watershed nor are nesting spotted owls expected to inhabit the watershed.

Except for the Northwestern pond turtle and Northern red-legged frog, the remaining species of concern listed are expected to exist in isolated areas within the watershed or very sparingly. Shasta salamander occur abundantly in the watersheds to the south of the Lower McCloud River Watershed but are not known to occur within the watershed itself. They are known to occur in isolated areas northwest of the watershed. Black-tailed deer and elk do utilize the watershed, but mostly along the main river or streamcourses in small numbers. Mainly, the watershed is believed to be used as a transition zone between summer range in the north and winter range in the south around Shasta Lake. As with the Shasta salamander, habitat for cave dwelling bats, such as the Townsend’s big-eared bat, is more abundant south of the watershed, near Shasta Lake, and becomes less abundant the further north in the watershed, based on the number of known caves found by local caving groups and the Forest Service.

For the Northwestern pond turtle, Northern red-legged frog, willow flycatcher and other riparian associated species, the McCloud River and its major tributaries provide habitat. Though surveys have occurred, only the willow flycatcher has been detected. Outside the watershed, though, many other aquatic and riparian associated species have been detected. This is expected to be a function of survey effort and not the quality of the habitat within the watershed.

Human Uses

Shasta Lake received approximately 2,368,600 recreation visitor days of use in 1994. The popularity of the lake as a focal point for recreation is due to its climate and easy access from large population centers. Recreation and tourism generated by Shasta Lake also provide significant income and employment in the Redding area.

The southwest corner of the watershed provides transportation and utility corridors for Interstate Highway 5, a major railroad, and a powerline.

The local transportation system within the watershed totals approximately 97 miles (private and National Forest) and is displayed on Map 5 - Transportation System. Current road density is approximately 1.5 miles of road per square mile of land, but is highly variable with highest densities occurring in areas of high recreation and residential use and very low densities on the east side of the McCloud Arm.

Numerous homes are located on both private and National Forest land within the watershed.

Native American religious and cultural sites are located along the McCloud Arm. Ethnographic information is available for 49 Wintu village sites, all of which are now inundated or partly inundated by Shasta Lake. Many of these have been recorded as archaeological sites, either prior to the completion of the dam or during extensive drawdown periods.

Mining was common in the Shasta Lake area from the 1880s until the 1940s. No significant mining has occurred in the McCloud Arm Watershed since 1945.

Land Allocations and Management Direction

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

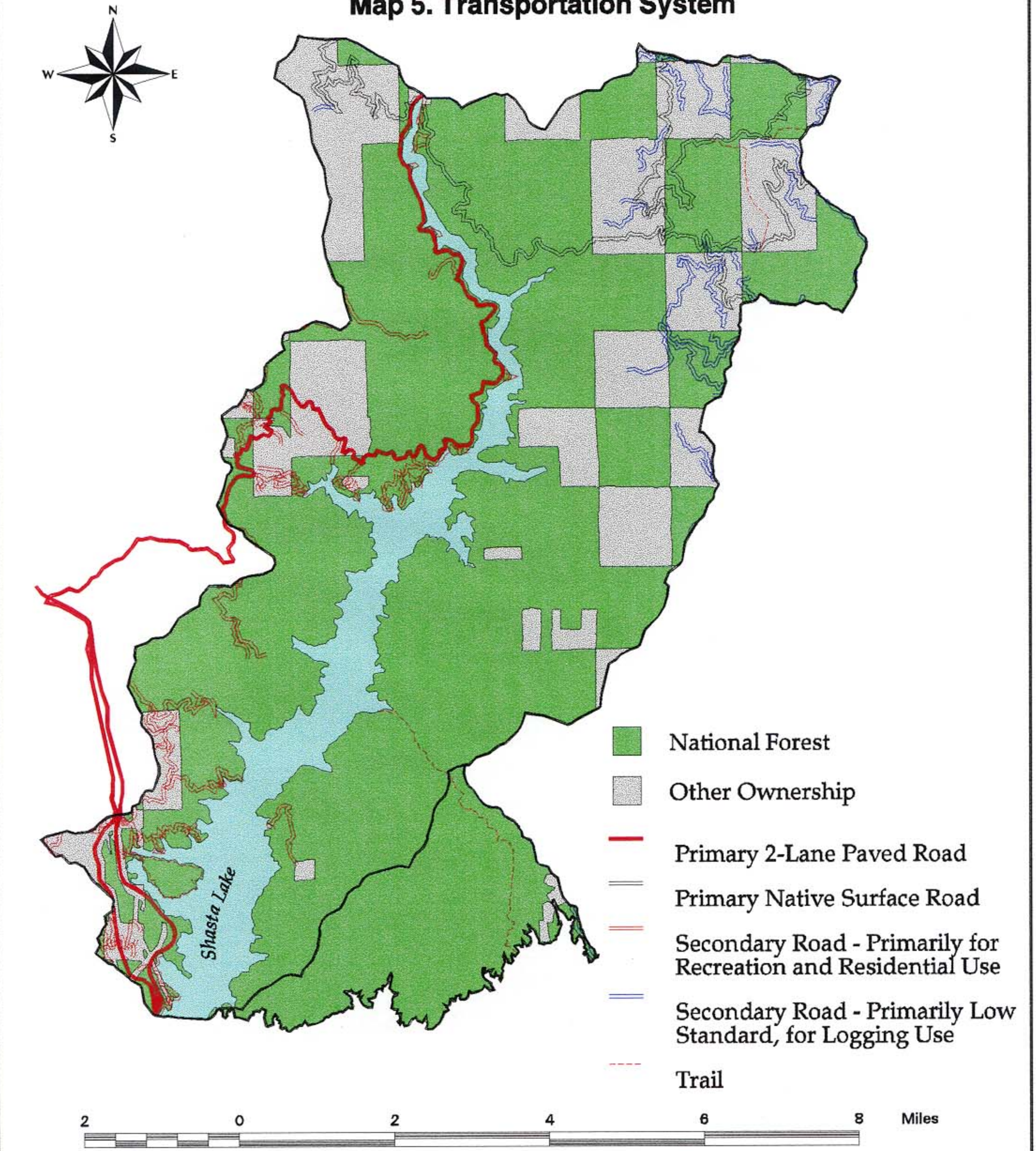
The ROD identifies four land allocations within the McCloud Arm analysis area:

- Late-Successional Reserves (LSR)

  Late-Successional Reserves are areas that have been established to protect and enhance conditions of late-successional and old-growth forest ecosystems and to insure the support of related species, including the northern spotted owl (LMP 4-37).

McCLOUD ARM WATERSHED ANALYSIS

Map 5. Transportation System



- Riparian Reserves

  Riparian Reserves provide an area along streams, wetlands, ponds, lakes, and unstable and potentially unstable areas where riparian-dependent resources receive primary emphasis. Riparian Reserves are important to the terrestrial ecosystems as well, serving, for example, as dispersal habitat for certain terrestrial species (ROD A-5).

- Administratively Withdrawn Areas

  Administratively Withdrawn Areas are identified in current Forest and District Plans or draft plan preferred alternatives and include recreation and visual areas, back country, and other areas where management emphasis precludes scheduled timber harvest (ROD A-4).

- Matrix

  The Matrix consists of those federal lands outside the three categories of designated areas listed above (ROD A-5). The Matrix are lands on which most timber harvest will occur and where standards and guidelines are in place to assure for appropriate conservation of ecosystems as well as provide habitat for rare and lesser known species (ROD B-10).

These land allocations are displayed on Map 6 and acreages are summarized in Table 1-1.

In addition to the four land allocations identified in the ROD, the LMP identifies eight Management Prescriptions in the McCloud Arm analysis area (see Map 7 - Management Areas and Prescriptions). These are:

- II - Limited Roaded Motorized Recreation (LMP 4-46)
  - semi-primitive motorized recreation in poorly roaded areas.
- III - Roaded Recreation (LMP 4-64)
  - recreation associated with developed roads and developed camp sites.
- IV - Roaded, High Density Recreation (LMP 4-48) *
  - high density recreation such as developed campgrounds and marinas.
- VI - Wildlife Habitat Management (LMP 4-66)
  - habitat management for early and mid-seral dependent wildlife species.
- VII - Late-Successional Reserves (LMP 4-43)
  - special management for Threatened and Endangered (T&E) species.
- IX - Riparian Management (LMP 4-59) *
  - protection, maintenance, and enhancement of riparian areas.
- X - Special Area Management (LMP 4-49)
  - protection of geologic Special Interest Area at Samwel Cave.
- XI - Heritage Resource Management (LMP 4-50) *
  - protection of areas of archaeological and historical value.

* unmapped - occurs as minor inclusions within other prescriptions

These management prescriptions are displayed on Map 7 and acreages are summarized in Table 1-1. Management prescriptions are also described in detail in Appendix B.

Supplemental management direction for specific units of land is provided in the LMP under Management Area Direction (LMP - Chapter 4 - Section G). The LMP identifies two Management Areas in the McCloud Arm analysis area (see Map 7):

- National Recreation Area - Shasta Unit (#8) (LMP 4-111)
- Nosoni (#12) (LMP 4-129)

Supplemental management direction for these areas is described in Appendix B.

Table 1-1: Acreage summary by land allocation and management prescription within the McCloud Arm Watershed Analysis area. Only National Forest land acres (not including lake surface) are displayed.

Land Allocation or Management Prescription		McCloud Arm Watershed Only		Squaw Creek Addition Only		Entire Analysis Area	
		acres	%	acres	%	acres	%
Late-Successional Reserves							
VII	Late-Successional Reserve	1226	4.6	0	0.0	1226	3.9
	Total - Late-Successional Reserve	1226	4.6	0	0.0	126	3.9
Administratively Withdrawn Areas							
II	Limited Roaded Motorized Recreation	3219	12.0	2176	46.9	5395	17.2
IV	Roaded, High Density Recreation	*	*	*	*	*	*
X	Special Area Management (Samwel Cave)	139	0.5	0	0.0	139	0.4
XI	Heritage Resource Management	*	*	*	*	*	*
	Total - Administratively Withdrawn	3358	12.5	2176	46.9	5534	17.6
Matrix							
III	Roaded Recreation	16224	60.5	2461	53.1	18685	59.4
VI	Wildlife Habitat Management	6009	22.4	0	0.0	6009	19.1
	Total - Matrix	22233	82.9	2461	53.1	24694	78.5
Total - All National Forest Land		26817	100	4637	100	31454	100
Riparian Reserves **							
IX	Riparian Management	8490	31.6	1183	25.5	9673	30.6

* This prescription occurs as minor unmapped inclusions within other prescriptions. Actual acreage in the watershed is small and is not displayed in this table.

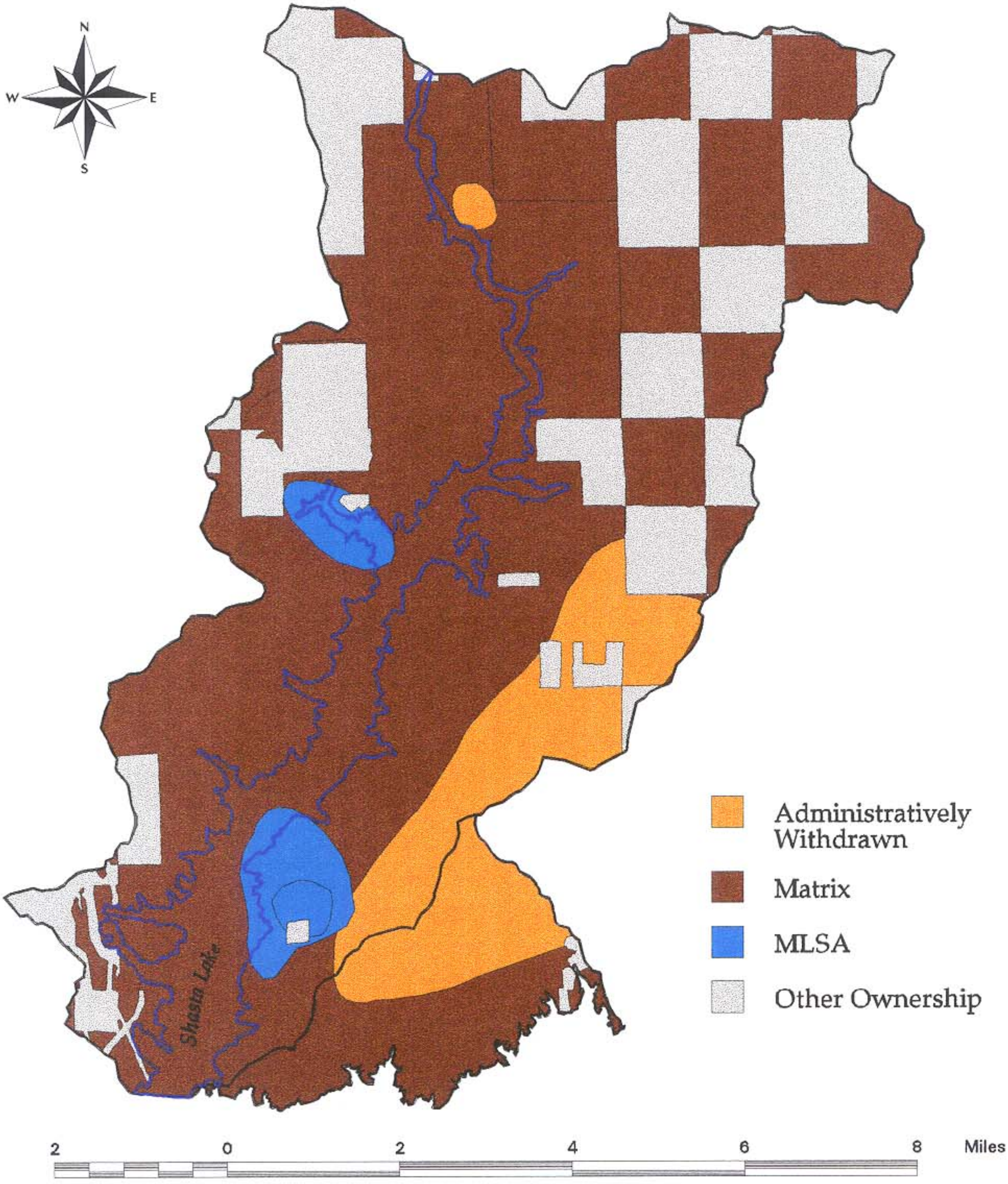
** Riparian Reserves occur as inclusions within other management prescriptions and are listed separately to avoid “double-counting” acres. Acres shown here represent National Forest land acres only. An additional 4,841 acres of lake surface are also part of the Riparian Reserves.

National Recreation Area

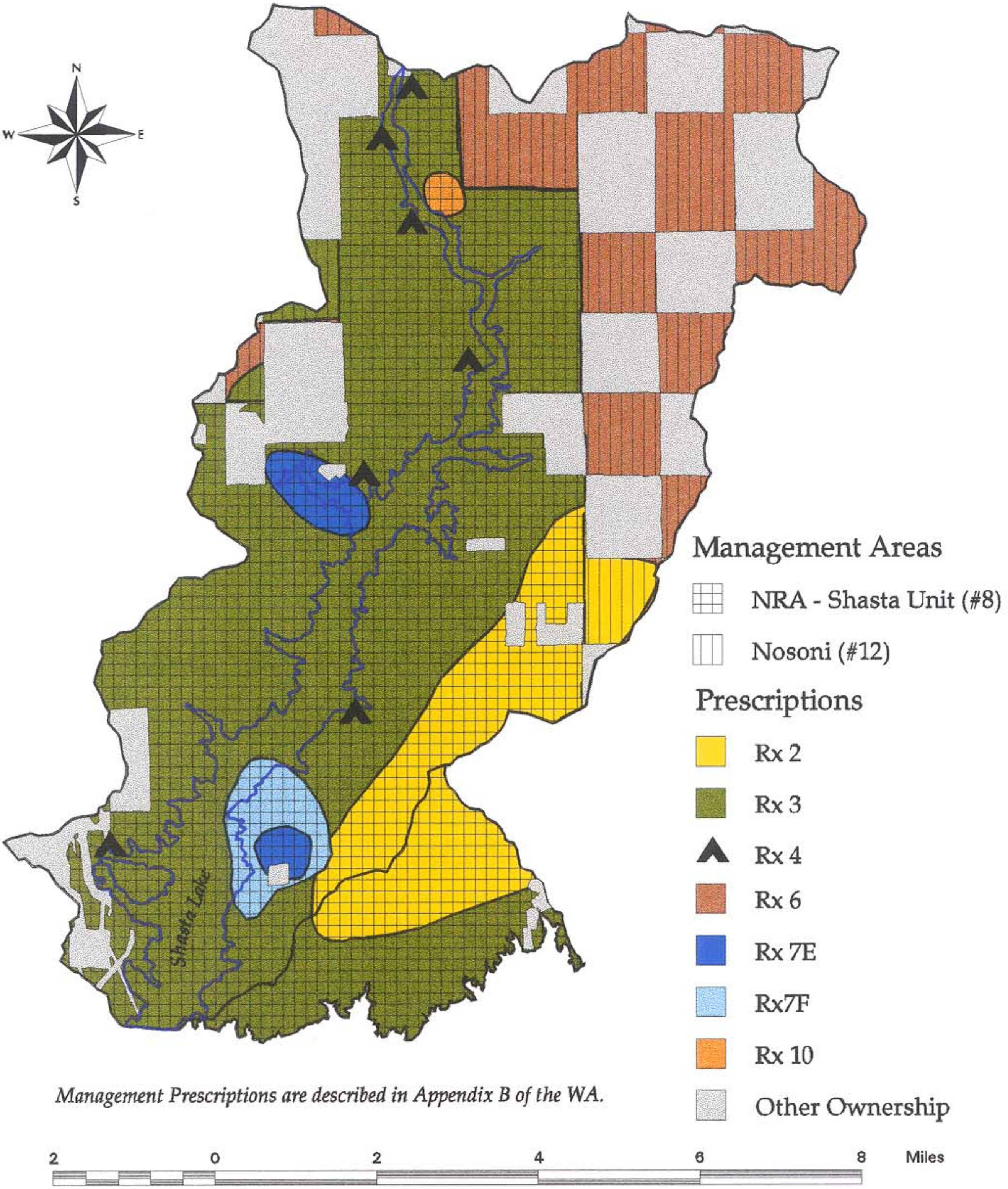
Additional management direction for the National Recreation Area (NRA) is provided in the *Management Guide for the Shasta and Trinity Units of the Whiskeytown-Shasta-Trinity National Recreation Area* (4/96). This management guide integrates past decisions that are pertinent for managing the NRA with standards, guidelines and management prescriptions incorporated from the LMP. It is an analysis of direction in the LMP, a summary of existing conditions, and a strategy on management recommendations, opportunities, and mitigation measures that will be used to implement the LMP.

McCLOUD ARM WATERSHED ANALYSIS

Map 6. Land Allocations



McCLOUD ARM WATERSHED ANALYSIS



Map 7. Management Areas and Prescriptions

Any proposed projects or activities within the NRA will require analysis of potential impacts and appropriate documentation in compliance with the National Environmental Policy Act.

Chapter 2
Issues and Key Questions

The purpose of this chapter is to focus the analysis on the key elements of the ecosystem that are most relevant to the management questions and objectives, human values, or resource conditions in the watershed.

This document is guided by two levels of analysis:

- **core topics** - provide a broad, comprehensive understanding of the watershed.

  Core topics are provided in the Federal Guide for Watershed Analysis (8/95) to address basic ecological conditions, processes, and interactions at work in the watershed. Core topics to be addressed are:

  - Erosion Processes
  - Hydrology
  - Stream Channel
  - Water Quality
  - Vegetation
  - Species and Habitats
  - Human Uses
- **issues** - focus the analysis on the main management questions to be addressed.

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

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

The major issues identified in this analysis are:

- Forest Health
- Fire Management
- Mass Wasting
- Recreation Use Management
- Cave Management

Forest Health

Healthy forest conditions are essential to maintaining the various values for which this watershed is being managed. Forest health problems in the McCloud Arm Watershed have been grouped into the following categories:

- Wildlife Habitat
  - There has been a loss of suitable nest trees around Shasta Lake for bald eagles and osprey. There is also a concern that replacement nest trees are not available in adequate numbers to provide for future needs.
  - There is a threat of habitat loss in the watershed due to stand replacing wildfire.
  - Dense vegetation is a barrier to wildlife movement and is resulting in underutilization of the watershed.
- Recreation
  - There has been a deterioration of conditions in campgrounds and resorts due to:
    - high stocking levels.
    - lack of replacement reproduction.
    - gradual loss of shade by continuous removal of hazard trees.
  - There has been a decline in native vegetation for shade and screening.
  - Recreation use and construction has impacted vegetation through disturbance and soil compaction.
  - Visual quality in the watershed is threatened by the potential for catastrophic wildfire and high levels of mortality.
- Forest stand conditions
  - Knobcone pine stands in the watershed are deteriorating due to aging and insect activity. Fire exclusion has allowed fuels to accumulate to undesirable levels.

Key Questions:

Step 3 - Current Conditions

- What types of wildlife habitat currently occur in the watershed?
- What is the condition of the various types of habitat?
- What habitat conditions are favored by bald eagles and osprey?
- What is the present condition of vegetation in high use recreation areas?
- What vegetation types in the watershed are experiencing high levels of mortality or have a high potential for loss to wildfire due to high fuel loads?

Step 4 - Reference Conditions

- What is the historic distribution and condition of vegetation and wildlife habitat in the watershed?
- What past disturbances and processes have influenced the development of vegetation and wildlife habitat in this watershed?
- What has been the past condition of vegetation in high use recreation areas?

Step 5 - Interpretation

- What is the future trend for vegetation and wildlife habitat in the watershed?
- What is the desired distribution and condition of various types of wildlife habitat in the watershed?
- What can be done to reach and maintain this desired distribution and condition of wildlife habitat?
- What is the trend for vegetation conditions in campgrounds and other high use recreation areas in the watershed?
- What factors are influencing vegetation conditions in campgrounds and other high use recreation areas?

Fire Management

Wildfire concerns in the McCloud Arm Watershed have been categorized into the following three groups:

- ♦ Public Safety
  The possibility of wildfire in the watershed is a concern due to heavy recreation use, the presence of homes, and the interstate highway.
- ♦ Fire Exclusion
  Fire exclusion and increasingly effective fire suppression for the last 100 years have allowed fuels to accumulate and for stand structures to develop fuel ladders.
- ♦ Fire Suppression
  Much of the watershed is remote and inaccessible. Access for fire suppression is difficult.

Key Questions:

Step 3 - Current Conditions

- What is the current fire regime in the watershed?
- What is the potential for catastrophic wildfire in the watershed?
- What resources in the watershed are currently at risk of loss or damage to catastrophic wildfire?
- What are the air quality conditions that are of concern in the watershed?

Step 4 - Reference Conditions

- What was the past fire regime for the watershed?

Step 5 - Interpretation

- Under current management, what are the future trends for fire in the watershed?
- What is the desired role of fire in the watershed?
- How can fire be incorporated as an ecological process?
- What measures need to be taken to ensure adequate fire protection in the watershed.

Mass Wasting

Eighty percent of the analysis area is characterized by active mass wasting processes in the form of debris slides, flows, torrents and colluvial filled hollows. Field reconnaissance and aerial photos dating back to 1944 indicate that such features have been common in the analysis area and are especially prevalent surrounding inner gorges.

The catastrophic effects of uncontrolled fires on soil and mass wasting have been observed frequently following wildfire. At this time, no understanding of the cumulative effects of such within the analysis area can be gathered since no monitoring has occurred over the years. However, few investigators disagree with the idea that burning (especially when intensive) increases erosion on many sites.

Although mass wasting is usually covered under the "Erosion Processes" core topic, the analysis team decided to elevate it to an issue to focus on the effect of fire (both wildfire and prescribed burning) on forest soils. This knowledge provides a basis for developing guides to the effective use of prescribed fire and for determining the situations where wildfires can be minimized or prevented by using prescribed fires.

Key Questions:

Step 3 - Current Conditions

- What are the dominant mass wasting processes in the analysis area?

Step 4 - Reference Conditions

- What has been the extent of mass wasting in the past?
- What are the anticipated effects of prescribed burning on mass wasting processes?

Step 5 - Interpretation

- What are the tradeoffs of several light or moderate controlled burns compared to no treatment?
- What are the tradeoffs between prescribed burning and other means of vegetation manipulation?
- What measures can be taken to reduce the risk of mass wasting following controlled burning?

Recreation Use Management

High use recreation areas frequently conflict with other resources and values. In the McCloud Arm Watershed, two potential sources of conflict have been identified:

- wildlife disturbance - specifically disturbance to eagles nests
- riparian areas - impacts to riparian vegetation by boat ramps, trails, etc.

There is also a need to compare existing facilities with anticipated future demands.

Key Questions:

Step 3 - Current Conditions

- What resources and values in the watershed are compatible with recreation use?
- What resources and values in the watershed are in conflict with recreation use?
- Are existing recreation facilities in the watershed adequate to meet current demand?

Step 4 - Reference Conditions

- What conflicts have existed in the past between recreation use and other resources and values?

Step 5 - Interpretation

- What measures need to be taken to protect other resources and values from recreation use?
- What is the trend for recreation use in the watershed and are existing facilities adequate to meet future demands?

Cave Management

Caves are common in the limestone geological formations around the McCloud Arm of Shasta Lake and several of these caves have been nominated to the Shasta-Trinity National Forests significant caves list. Caves are being addressed as an issue in this watershed in response to several letters that were received from caving groups during public scoping. Cave protection is provided under the Federal Cave Resource Protection Act of 1988.

Caves are fragile ecosystems which provide a unique habitat for certain animal species including the Shasta salamander and Townsends long-eared bat. There is a concern that certain management activities, especially prescribed burning, can have a detrimental affect on the cave environment.

Key Questions:

Step 3 - Current Conditions

- What is the distribution and location of caves in the watershed?
- Which caves are significant and require special protection?
- What are the risks to caves in this watershed?

Step 4 - Reference Conditions

- What conditions have affected caves in the past?

Step 5 - Interpretation

- How can caves be managed in this watershed?
- What protection measures need to be taken?
- What management activities are compatible with caves? Which are not?
- What are monitoring needs?

Chapter 3
Current Conditions

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

Physical Features

Geology, Geomorphology, and Erosion Processes

Geology

The McCloud Arm Analysis Area is located within the Eastern Klamath Belt of the Klamath Mountains Geologic Province. The rocks which comprise this region were formed as part of extensive Paleozoic and Mesozoic island arc systems.

The geologic formations which comprise the watershed are from oldest to youngest: the Bragdon, Baird, McCloud Limestone, Dekkas, Nosoni, Bully Hill, and the Pit. The formations are exposed in a north-south trend generally paralleling the course of the McCloud River (see Map 8). Additionally, various unconsolidated deposits in the-form of landslide debris, terrace and alluvial fan deposits, and colluvium are found extensively throughout the area.

The paleontological significance of limestone formations in the watershed and their importance for cave-adapted and limestone associated biota have been discussed previously in Chapter 1 (pg. 1-3)

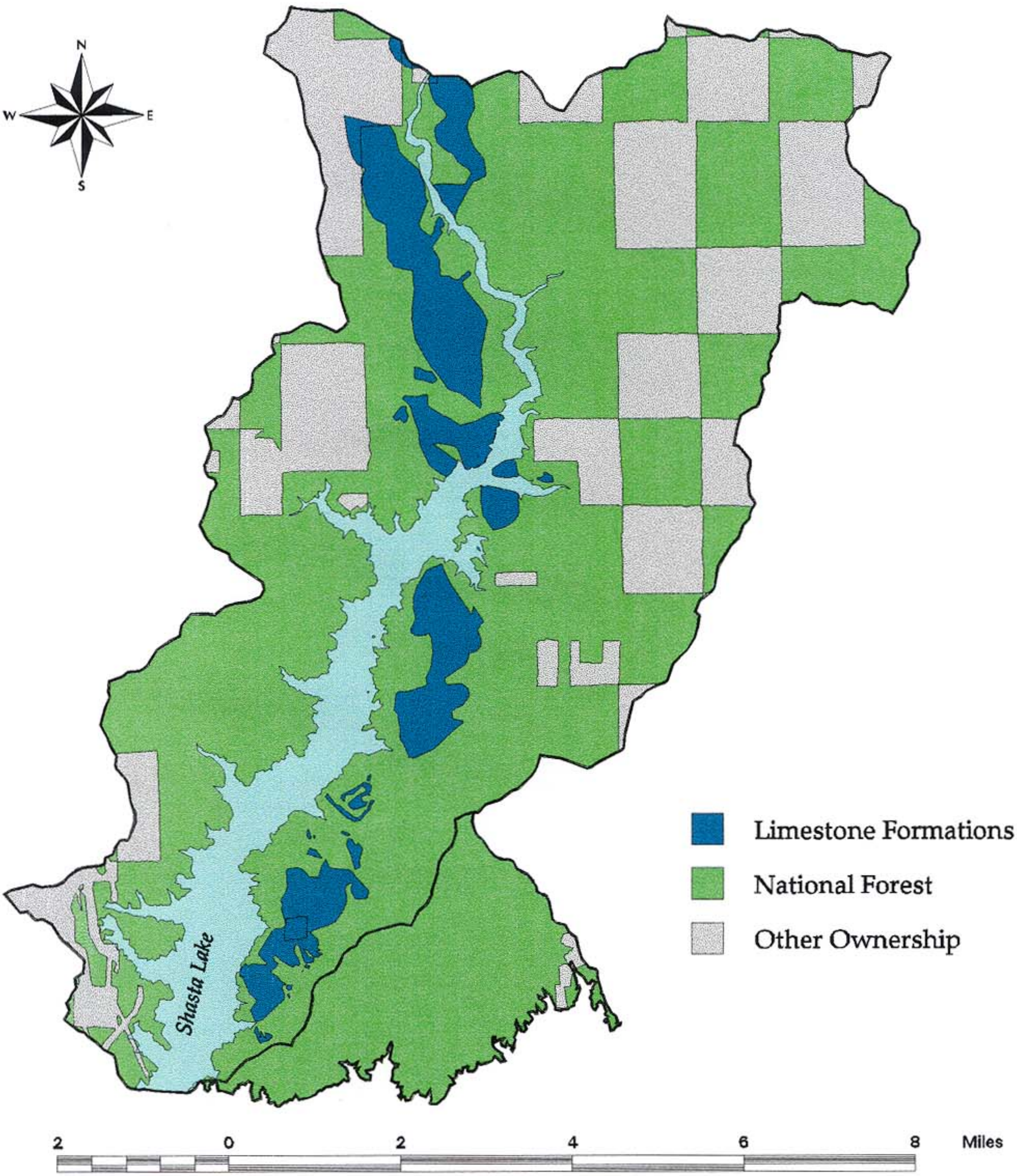
The area has also been important economically contributing such products as zinc, copper, gold, silver, limestone, and crushed stone (see mining section).

Geomorphology/Mass Wasting

Eighty percent of the analysis area is characterized by active mass wasting in the form of debris slides, flows, torrents and colluvial filled hollows (see Map 9). Current and 1944 vintage aerial photo and field reconnaissance indicates that these are ubiquitous across the landscape and especially prevalent surrounding inner gorge terrain. Shallow linear depressions oriented up and down slope represent old landslide scars or surface erosion channels and identify concentrated surface and subsurface flow. Soil pedestals were also observed on bare ground.

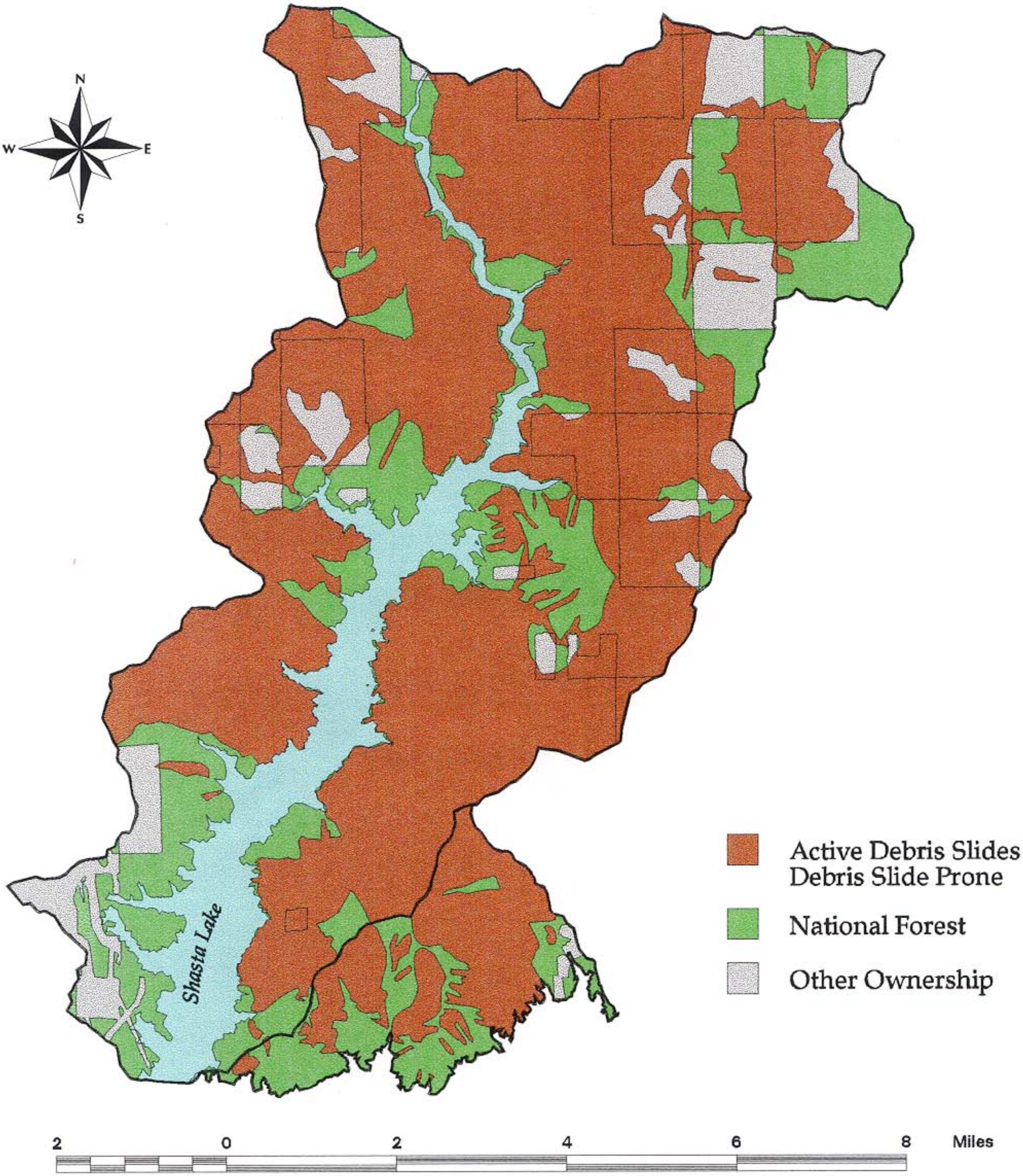
Debris slides tend to be shallow and in this area have slide planes generally no more than a few feet in depth. Debris flows and torrents are a rapid movement of water-charged soil and rock down high gradient streams. These are generally initiated during extreme discharge events by a streamside debris avalanche which enters a flowing channel and entrains organic debris and sediment through scouring as it moves down channel. When momentum is lost, or a significant obstruction is encountered, flow material is deposited. Debris deposits are encountered throughout the analysis area. At the mouth of Azelle

McCLOUD ARM WATERSHED ANALYSIS



Map 8. Limestone Formations

McCLOUD ARM WATERSHED ANALYSIS



Map 9. Slope Stability Hazards

Creek for instance a debris fan estimated at 112,000 cubic yards was deposited as a result of the January, 1997 storm event.

Shallow, linear depressions ("swales" or "colluvial hollows") on the hillslopes are common features and form common points of origin for debris avalanches, flows and torrents. Such depressions are created by the weathering of bedrock along zones of weakness. Subsequent and recurring slope processes result in periodic stripping and infilling of these depressions. Converging flows of groundwater into these depressions during periods of storm precipitation or rapid snowmelt cause the buildup of temporary perched water tables. Later generation of pore-water pressures in the in-fillings of the depressions reduces the strength of the material and greatly increases the instability of the site.

Deep gullies and V-notch drainages (inner gorges) which dissect the slope frequently serve as collectors of debris material from adjacent hillslopes. They also tend to have very steep, unstable side slopes with frequent rockslides and small debris avalanches that dump additional soil, rock and organic debris directly into these confined channels. If the quantities of debris are large enough, or if flows are too small to mobilize debris initially, temporary debris dams may develop. During major storms, these dams may fail, producing large volume, high velocity debris torrents. Torrents may also be produced during high-flow periods by the mobilization of stored channel materials. In general, debris torrent activity can be expected to be highest in local areas of increased gully density.

The gradient of the channel will control the rate at which landslide debris is transported and the dominance of erosion or deposition processes during a particular flow event. Scouring and mobilization of debris in and adjacent to the channel can be expected to occur where channel gradients are above 18 percent. Major velocity reductions and significant deposition of materials should occur when channel gradients drop below 12 to 16 percent.

Effects of Fire

It is important to understand the effects of fire on forest soils. This knowledge provides a basis for developing guides to the effective use of prescribed fire and for determining the situations where wildfires can be minimized or prevented by using prescribed fires.

The catastrophic effects of uncontrolled fires on the soil and mass wasting have been observed frequently following wildfires. There is a need for evaluating those situations where fire effects are less dramatic than during wildfires so the tradeoffs between prescribed burning and/or other means of vegetation manipulation can be compared. For example, burning volatilizes nitrogen, an essential element for plant growth; however, the loss of some nitrogen by burning might become a more acceptable alternative than large soil losses occurring after the use of heavy mechanical equipment. Likewise, several light or moderately controlled burns possibly have less impact on the soil than a single severe wildfire that may result from a large fuel accumulation.

Fire destroys soil organic matter, or residues that eventually become soil organic matter. The amount and location of the organic matter lost depends on the fire intensity (rate of heat release per unit of ground surface; proportional to flame height and rate of spread). Burning the surface organic matter removes or decreases the protective forest floor, volatilizes large amounts of nitrogen and smaller amounts of other elements, and transforms less volatile elements to soluble mineral forms that are more easily absorbed by plants or are lost by leaching. Heating the underlying soil layers also alters the physical, chemical, and biological properties of the soil dependent upon soil organic matter.

These general relationships would lead one to believe the effects of burning are predictable; however, to the contrary, the effects reported in the literature are highly variable. These variations are attributed to fire intensity, temperature, vegetation type and amount, soil type and moisture, and other speculative factors.

About eighty percent of the analysis area has been burned at one time or another this century. At this time no understanding of the cumulative effects of such can be gathered since no monitoring has occurred over the years. But few investigators disagree with the idea that burning (especially when intensive) increases erosion on many sites. In the pine regions of the Sierras for instance, erosion was 2 to 239 times as great on burned areas (Haig 1938).

The importance of forest floors in regulating runoff and controlling erosion was investigated by Lowdermilk (1930). He concluded: (1) forest litter greatly reduced runoff, especially in finer textured soils; (2) destruction of litter and exposure of bare soil greatly increased soil erosion and reduced the water absorption rate; (3) sealing of pores by particles in runoff caused marked differences in infiltration between bare and litter covered soils; and (4) water absorption capacity of litter is insignificant in comparison with its role in protecting maximum percolating capacity of soils.

Only a limited amount of information is available on erosion following prescribed burning in chaparral (Debano and Conrad, 1976). These studies indicate slope is important. The first year after a prescribed burn, 2.6 times more surface erosion occurred on the 50 percent slope than on the 20 percent slope. on the 50 percent slope about 35 times as much erosion occurred on the burned areas as on the similar unburned site. Chaparral in Arizona was strip burned. Erosion was greatest an steep slopes adjacent to main channels; however, lightly burned areas retaining 70 percent or more litter residue eroded but little, while areas with less than 60 percent litter remaining eroded moderately during periods of high precipitation. Other studies (Wright et al. 1976) show that vegetation does not develop as rapidly or uniformly on steep slopes (>37 percent) after burning as on moderately steep slopes (8-20 percent).

Mass movement events in California chaparral are most commonly manifested as debris flows or torrents. The debris bulking ratio (ratio of volume of debris to volume of water) has been shown to increase from 2 to 15 times following some fires (Rowe et al. 1954, Sinclair and Hamilton 1955). Increased debris bulking ratio, coupled with increased storm runoff, is the principal cause of disastrous debris flows that occur in southern California for instance.

Another form of mass erosion termed dry creep or dry ravel occurs on steep slopes with soils that are high in coarse materials and low in cohesion. Removal of protective litter by fire allows the soil particles to easily move downslope under the influence of gravity. In western Oregon, dry creep following logging and slash burning ranged from 0.008 to 1.34 cubic meters per hectare for a 2-year period following disturbance severe enough to bare 55 percent of the soil (Mersereau and Dyrness, 1972). No dry creep was observed on nearby undisturbed slopes. Similar results were reported for the San Gabriel Mountains in southern California. Krammes (1963) measured annual dry creep averaging from 0.03 to 0.47 metric tons per hectare. By the end of the third year after the fire, dry creep was reduced to a range of 0.004 to 2.06 metric tons per hectare, presumably in response to regrowth of vegetation.

Thusly slope, fire intensity, time of year, frequency of burning (i.e., rapidity of vegetation recovery) should be considered when projecting effects for making fire management plans.

Hydrology

The McCloud Arm Watershed drains an area of 64.4 square miles between the inlet of the McCloud River and the confluence of the McCloud Arm with the Pit River Arm of Shasta Lake. The Squaw Creek Addition (see page 1-2) covers an additional 6.4 square miles drained by Azelle and Horse Creeks (on the Pit River Arm). All data presented in this section has been compiled for both the McCloud Arm Watershed and the Squaw Creek Addition unless stated otherwise.

The dominant physical feature in the McCloud Arm Watershed is the McCloud Arm of Shasta Lake. The surface area of the lake within the watershed is approximately 4841 acres or 12 percent of the total watershed area. All tributaries to Shasta Lake drain mountainous terrain forested primarily by brushy, understocked hardwood stands and ponderosa pine dominated conifer stands. In addition to the runoff originating in the watershed, the McCloud Arm also receives runoff from the McCloud River Basin. The total area drained by the McCloud River at its confluence with the Pit River Arm is approximately 675 square miles. The McCloud Arm Watershed accounts for approximately 10 percent of the total basin area.

The climate of the watershed is characterized by hot, dry summers and cool, wet winters. Annual precipitation averages approximately 65 inches with the majority of precipitation occurring between November and April. The majority of the precipitation falls as rain below 4500 feet. Snow occasionally blankets the watershed but rarely accumulates below an elevation of 4000 feet.

The McCloud Arm Watershed is drained by a dendritic channel network. Nosoni Creek is the largest tributary to the McCloud Arm. The remainder of the watershed consists of smaller tributaries to the McCloud and Pit River Arms including Campbell, Dekkas, Greens, Azelle, Ycotti and Keluche Creeks. The drainage density of the watershed is approximately 5.7 miles of stream per square mile. Drainage densities are relatively uniform throughout the watershed.

Riparian Reserves in the McCloud Arm Watershed consist almost exclusively of stream channels, unstable areas and reservoir buffers. Together these Riparian Reserves account for 31.6 percent of the total public land base in the watershed. In the Squaw Creek Addition, approximately 25.5 percent of the public land base is in Riparian Reserves. In addition to the hydrologic features mentioned above, groundwater pools also occur in the limestone caves throughout the watershed. Wetlands, wet meadows and natural lakes are almost completely absent from the watershed. The watershed contains approximately 54 miles of perennial streams, 99 miles of intermittent streams and 250 miles of ephemeral streams (see Map 10). Ephemeral streams differ from intermittent streams in that they flow only in response to high intensity precipitation events or rapid snowmelt. The reaches of the McCloud River and its tributaries that are submerged beneath Shasta Lake below the spillway elevation were not included in the above calculations.

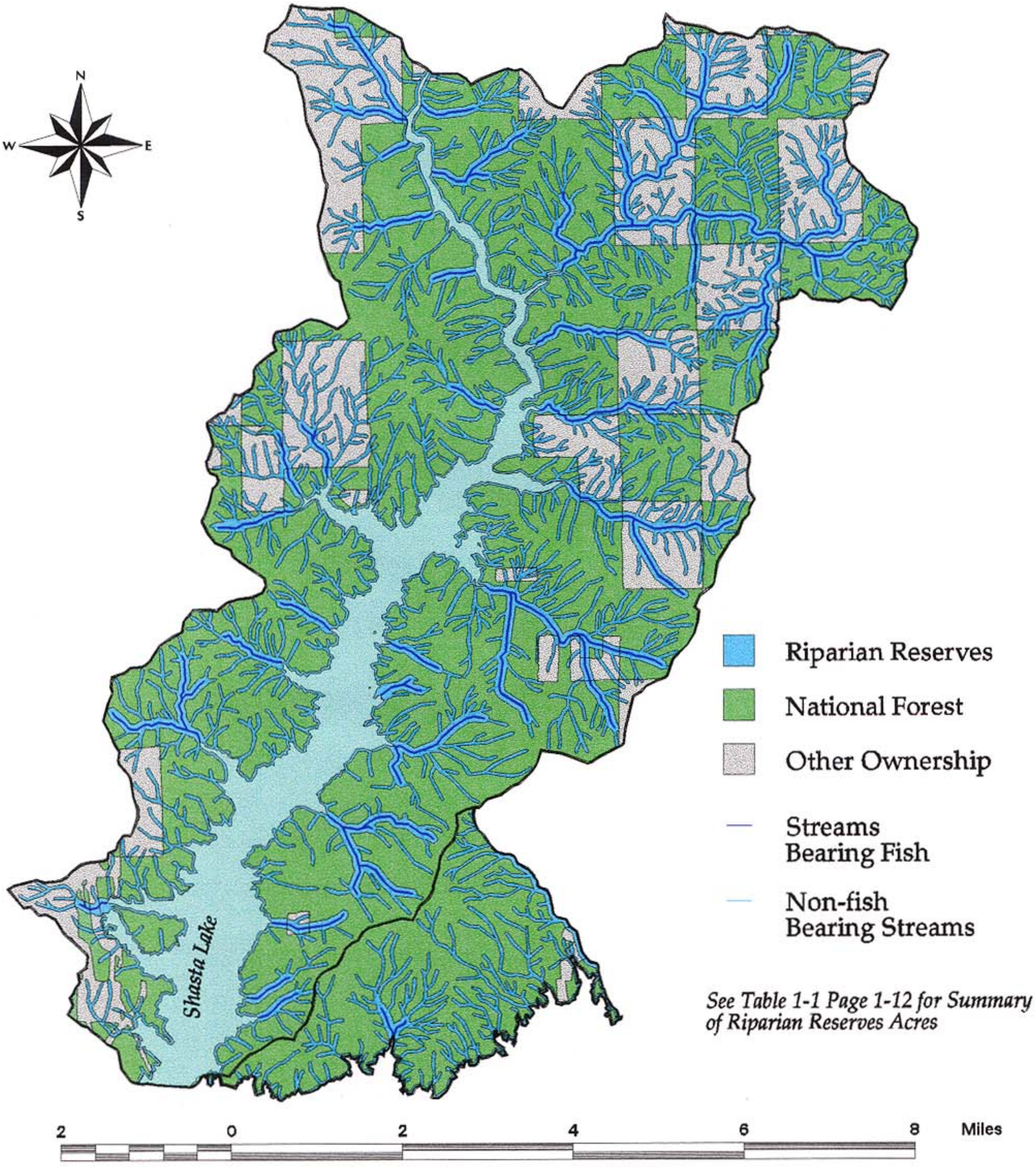
No streamflow records are known to exist for tributaries in the McCloud River in the McCloud Arm. Due to the lack of available information the following content is speculative. It is possible that baseflows in streams with similar drainage areas may vary significantly due to differences in geologic parent materials throughout the watershed. Groundwater storage and releases in the limestone areas may differ significantly from releases in other geologic formations.

An abundance of streamflow data is available for the McCloud River above Shasta Lake due to the need to monitor instream flows in the McCloud River below the McCloud Reservoir Diversion. Because the McCloud River is now beneath Shasta Lake, data on peak and base flows are not presented. Peak and base flows for the McCloud River above Shasta Lake have been addressed in the Lower McCloud River Watershed Analysis (Lower McCloud River Watershed Analysis, 1997). Refer to this analysis for more information on peak and base flows for the McCloud River.

Base flows in the McCloud River are completely regulated by the Pit River Hydroelectric Project. Baseflows in all of the sub-watersheds tributary to the McCloud Arm are unregulated. The majority of precipitation falling in the watershed falls as rain and is quickly fed into the channel network resulting in larger, flashier flow events in the winter and steadily declining flows throughout the summer.

Peak flow events in the McCloud Arm Watershed occur during the winter months when heavy rains saturate the ground and melt snow at the upper elevations of the watershed. A large disparity exists between peak flow runoff in the Upper McCloud Basin (Mount Shasta-McCloud Flats) and the Lower McCloud Basin (Lower Squaw Valley Creek, Lower McCloud and McCloud Arm Watersheds) (see Table 3-1). The McCloud Arm, lower Squaw Valley Creek and Lower McCloud Watersheds supply over four times more runoff to the McCloud River than is supplied by the entire Upper McCloud River Basin. The disproportionate amount of runoff per unit area reflects the difference in groundwater storage between the Lower McCloud River Basin and the Upper McCloud River Basin.

McCLOUD ARM WATERSHED ANALYSIS



Map 10. Riparian Reserve

Table 3-1: Predicted peak flows for the McCloud River.

	Flow (cfs) recurring at 2-100 year recurrence intervals					
Area	**2**	**5**	**10**	**25**	**50**	**100**
McCloud River near McCloud *	2440	4530	6350	9220	11800	14800
McCloud River at Baird *	13600	23800	32000	44100	54300	65600

* Data from Waananen and Crippen, 1977.

Peak and baseflows in the McCloud Arm Watershed could be affected by land-use activities occurring in the heavily roaded portions of the watershed. Natural processes and land-use activities that decrease vegetative cover generally result in increased peak and base flows. High density road networks also may be increasing flood peaks by intercepting groundwater flow and quickly routing storm runoff to the channel network. Areas in the McCloud Arm Watershed where peak and base flows may have been affected by land-use activities include drainages located within the Interstate 5 corridor in the southwest comer of the watershed and heavily roaded areas around Hirz Bay and in the Nosoni Creek drainage.

Groundwater withdrawals supply water to several recreation facilities in the watershed including Lake View Marina, Holiday Harbor, Antlers Resort, USFS boat dock facilities in Turntable Bay, Camloops organizational camp (Campbell Creek) and Shasta Caverns. Forest Service campgrounds on the west side of the McCloud Arm obtain groundwater from three horizontal wells that serve all of the campgrounds. Water uses associated with the I-5 transportation corridor are outside the scope of this analysis and were not inventoried.

Stream Channel Morphologies

The morphology of stream channels in the McCloud Arm Watershed is a reflection of natural geologic and fluvial processes and, in some cases, land-use activities. Channel morphologies in the watershed differ because the channels have formed in different geologic parent materials. Very little information about channel types is available for the McCloud Arm area. Due to the focused nature of this watershed analysis, and the scarcity of available information, stream channel types have been extrapolated from the Lower McCloud Watershed Analysis. Stream channels in the McCloud Arm Watershed are believed to be similar to the channel types described in Table 3-2.

Most of the channel types described are located within unstable or potentially unstable terrain. The upland channels (swale, colluvial, and bedrock) serve as source areas for sediment and are commonly associated with debris flow features. Upland channels are most vulnerable to land-use impacts due to their abundance and the steep topography in which they are found.

Table 3-2: Montgomery and Buffington channel classes found in the McCloud Arm Watershed (Montgomery and Buffington, 1993).

Reach Class	Slope	Reach Type	Description
Swale	Variable	Source	Occur in close proximity to ridgetops, above colluvial and bedrock channels. Do not contain channel features. Contain no evidence of annual scour. Substrate at center of swale dominated by woody debris and soil. Swales located in unstable areas serve as source areas for debris flows. Do not contain riparian vegetation unless associated with springs.
Colluvial	S>.20	Source	Occur in close proximity to ridgetops. Beginning of colluvial channel denotes point of channel initiation. Upper reaches of colluvial channels ephemeral and lower reaches have intermittent streamflow on an annual basis. Channel substrate consists largely of hillslope colluvium deposited by gravitational forces rather than alluvial processes.
Bedrock	Variable	Transport	Occur in close proximity to ridgetops but can also occur at lower elevations. Identical to colluvial channel type with the exception that the dominant substrate is bedrock. Colluvial channels may be converted to bedrock channels following debris flow events. Bedrock reaches may also occur in larger, low gradient channels. Many channels have been scoured to bedrock as a result of the high flows that have occurred over the past several years.
Cascade	.30>S>.10	Transport	High gradient channels occurring on steep mid-slopes throughout the watershed. Flow can be perennial or intermittent. Channel substrates are dominated by boulders and stones in larger , high gradient channels and cobbles and gravels in lower gradient channels.
Step-Pool	.10>S>.03	Transport	Occur in mid to lower elevations within well developed canyons and inner gorges. Flow regime is generally perennial. Channel substrates are dominated by boulders, stones and cobbles. Comprise the majority of larger tributaries to the McCloud River.
Plane-Bed	.03>S>.01	Response	Diverse channel type found in the McCloud River and portions of its major tributaries. Low gradient, perennial channels. Substrate composition is variable. Lack defined bedform patterns such as point bars and pools. No plane-bed channels have been observed in the watershed as of 9/97.
Pool-Riffle	.02>S.001	Response	Comprises majority of McCloud River above watershed but may not occur in the McCloud Arm. Pool-riffle channels may occur in the lower reaches of larger streams such as Nosoni Creek. Flow regime is always perennial. Substrate types generally consist primarily of stones and boulders in riffle reaches and cobbles and gravels in pool reaches. Bedrock outcrops are common. Channel canopy cover is generally less than other channel types due to size of bankfill channel.

Upland and cascade channels are generally located within unstable terrain throughout the watershed. Geologic analyses indicate that most upland channels have been affected by debris flows and landslide activity that has occurred throughout the Holocene Epoch. Many of the upland channels were formed as a direct consequence of debris flows.

The morphology of these channels and the unstable slopes associated with them may be affected by fire suppression, catastrophic fire and prescribed fire. Effective fire suppression over the past 55 years has resulted in a decrease in wildfire throughout the Shasta National Forest. Effective fire suppression has allowed vegetation to accumulate in the watershed. Increased vegetative cover and a decrease in the return periods of natural fires may be affecting erosion process and sediment delivery to the channel network (see Erosion Processes).

Very little channel reconnaissance has occurred in the McCloud Arm Watershed due to its remoteness, inaccessibility, and lack of recent land management activities. A field visit to the Azelle Creek drainage in September, 1997 revealed that the larger channels were relatively free of debris and fine sediments, and that the channel network in the Azelle Creek drainage was capable of transporting large quantities of bedload and fine sediments during high flows. Many reaches of Azelle Creek were scoured to bedrock as a result of the 1997 New Year’s Day Flood. Due to the large amount of annual precipitation (~65 inches) that falls in the watershed, it is likely that other channels probably responded similarly to Azelle Creek. If this is the case, then much of the sediment being delivered to the channel network is being flushed through the channels to Shasta Lake. Large deposits of aggraded sediments at the mouth of Azelle Creek are indicative of the ability of stream channels in the McCloud Arm to transport large volumes of sediment.

Sediment inflows from the McCloud River and the other tributaries are slowly decreasing the size and storage capacity of Shasta Lake. The process of aggradation in Shasta Lake is believed to be occurring at a very slow rate (NRA Management Guide, 1996). This may be true in the deeper portions of the lake where the large area of dead storage prevents aggradation from taking place, however aggradation is occurring in the tributary arms to the lake. The rate of aggradation in the upper McCloud Arm has been reduced by the McCloud Reservoir which effectively cut off the supply of sediment from Mud Creek and the entire Upper McCloud River Basin.

Water Quality

The quality of water in the McCloud Arm Watershed is influenced by both natural processes and land-use activities. Beneficial uses dependent on high quality water include fish and aquatic life (including riparian vegetation), drinking water for private residences and recreational facilities along the McCloud Arm, and recreation benefits associated with fishing, boating, swimming and hiking. Due to the absence of natural lakes and wetlands, almost all water quality concerns in the McCloud Arm Watershed pertain to stream channels and Shasta Lake.

Few water quality concerns have been identified for the majority of the tributaries to the McCloud Arm Watershed. Water quality concerns for the McCloud River above Shasta Lake are addressed in the Lower McCloud River Watershed Analysis (Lower McCloud River Watershed Analysis, 1997). Water quality concerns for many of the tributaries are similar to those discussed in the Lower McCloud River Watershed Analysis.

Sedimentation from the reservoir banks and roads is the leading water quality concern. In the case of the McCloud Arm Watershed, water quality concerns are focused along the I-5 corridor, the western lake perimeter and the Nosoni road system.

The quality of water in Shasta Lake is considered to be very good. Water quality in the lake is monitored by the Central Regional Water Quality Control Board ("Board"). The Board monitors coliform bacteria levels and sets waste discharge requirements for all marinas on Shasta Lake. No water quality parameters have been found to be outside of acceptable levels since monitoring began. Water quality concerns associated with nutrient inputs and bacteria are not significant in the McCloud Arm. Nutrient inputs to the lake are minimal because very little agriculture occurs in the McCloud River Basin. With respect to bacteria, the NRA Management Guide states that:

> "Any concern that bacterial contamination in Shasta Lake is becoming too great for body contact or domestic use following light treatment is largely unfounded. The dilution of localized contaminants by billions of gallons of water and direct exposure to the sun, virtually preclude serious threats to public health. The only potentially critical areas are those coves with poor water exchange where contaminants are not diluted quickly" (NRA Management Guide, 1996).

Areas within the McCloud Arm Watershed where marinas are located and where poor water exchange may take place include Holiday Harbor, Turntable Bay and Lakeview Marina. Sampling of coliform bacteria around Shasta Lake marinas indicates that bacteria levels are steadily increasing around the marinas; however, they are still within basin plan -limits for recreational use (NRA Management Guide, 1996).

According to the Management Guide for the Whiskeytown-Shasta-Trinity National Recreation Area, water quality concerns associated with sedimentation, nutrients, and bacteria are minor compared to turbidity and chemical-spill concerns (NRA Management Guide, 1996). With the possible exception of the extreme southwest corner of the watershed, chemical-spills occurring within the I-5 corridor are not likely to influence water quality in the McCloud Am of Shasta Lake.

The greatest water quality concern in the McCloud Arm is the existing and potential turbidity levels in Shasta Lake. Habitat conditions for aquatic species, visual quality and other recreation values are seriously impaired during periods of high turbidity when large volumes of sediment are suspended in the lake (NRA Management Guide, 1996). Factors contributing to turbidity include peak flows, shoreline erosion from wave action and water level fluctuations in the reservoir. The fine-textured clays which line much of the reservoir perimeter are the source of most of the turbidity occurring during drawdown periods.

In addition to increasing turbidity, peak flows occurring during the winter months also transport large quantities of woody debris into the McCloud Arm. The large concentrations of debris provide increased habitat for aquatic organisms but also present a hazard to boaters on the lake. Large concentrations of woody debris that accumulate in the reservoir after large floods, such as the 1997 event, are removed from the reservoir on an annual basis.

One of the reasons that water quality in Shasta Lake remains very good is that most of the water in the lake is transported through the reservoir to the Sacramento River annually. Inflows from Shasta Lake’s major tributaries (McCloud, Pit and Sacramento Rivers and Squaw Creek) continually replenish the lake with fresh, high quality water. The total annual inflow to Shasta Lake is approximately half as large as the total storage capacity of the lake (NRA Management Guide, 1996). This high turnover rate insures that water quality remains very good. Water quality monitoring in Shasta Lake continues to be a concern due to the large number of recreationists that visit the lake each summer.

Biological Features

Vegetation

Overview

The vegetation types seen in the McCloud Arm Watershed today are the result of an active fire history around the turn of the century, climate, soils, geology, and human activities.

The youthful appearance of the vegetation can be directly attributed to three major causes:

- Fire

  Two stand replacing fires (1872 and 1898) destroyed most of the vegetation in the area.

- Mining

  Copper and iron smelters in use in adjacent watersheds toward the end of the 1800's to 1920, emitted large volumes of sulfur dioxide which may have impacted vegetation in the McCloud Arm Watershed also.

- Shasta Dam

  Vegetation below the high water line of the lake was removed.

Most oaks and conifers are in the early mature (30-60 years) and mid-mature (60-120 years) seral stages. Old growth is only seen in the form of remnant ponderosa pines along the edge of the lake and a few scattered Douglas-fir and sugar pines on the ridgetops. Large snags for wildlife are rare. The lack of old growth ponderosa pines and large snags makes eagle habitat marginal. Hopefully, as the vegetation matures, eagle habitat will improve.

Major vegetation types are:

- Mixed conifer
- Mixed conifer - ponderosa pine
- Mixed conifer - Douglas-fir
- Gray pine
- Knobcone pine
- Black oak
- Canyon live oak
- Chaparral
- Shrub size oaks

A true mixed conifer type is rare in the watershed. Knobcone pine is found throughout the area, mostly as a component of the mixed conifer - ponderosa pine type.

General Vegetation Type Descriptions

Mixed conifer

True mixed conifer stands cover less than 1% of the watershed and are found north of Salt Creek Mountain. Species making up this type are Douglas-fir, sugar pine, ponderosa pine and incense-cedar. Black oak and canyon live oak are important associates of this type.

Mixed conifer - ponderosa pine

This type covers approximately 30% of the landscape. Ponderosa pine is the dominant species. Other components are gray pine and knobcone pine. Douglas-fir and sugar pine can be found occasionally. Canopy closure is generally between 20% and 40%. Black oak and canyon live oak are also important associates of this type.

Mixed conifer - Douglas-fir

Douglas-fir is the major component of this type which covers approximately 10% of the landscape, mostly appearing in drainages and on north slopes. Other components of this type are ponderosa pine, sugar pine and a few incense-cedars. Black oak and canyon live oak are also important associates.

Gray pine

The current database (LMP90) shows less than 1% of the watershed occupied by the gray pine vegetation type (see Table 3-3a). However, casual observation of the landscape makes it obvious that gray pine occurs commonly throughout most of the watershed and is a major component of other vegetation types. Based on aerial photo interpretation and field visits, it is estimated that closer to 30% of the watershed is occupied by vegetation types in which gray pine is a significant component. Gray pine is common as a component of the conifer vegetation type (Table 3-3), espcially the mixed conifer - ponderosa pine type. It also occurs throughout most of the mid seral stage (Table 3-4).

Where gray pine occurs as a major component of a stand, canopy closure is generally 10% to 20%, but does reach as high as 50%. Higher canopy closure is found near limestone outcrops. There is usually a dense layer of black oak or canyon live oak in the mid-story. Sticky whiteleaf manzanita and poison-oak are important shrub associates.

Knobcone pine

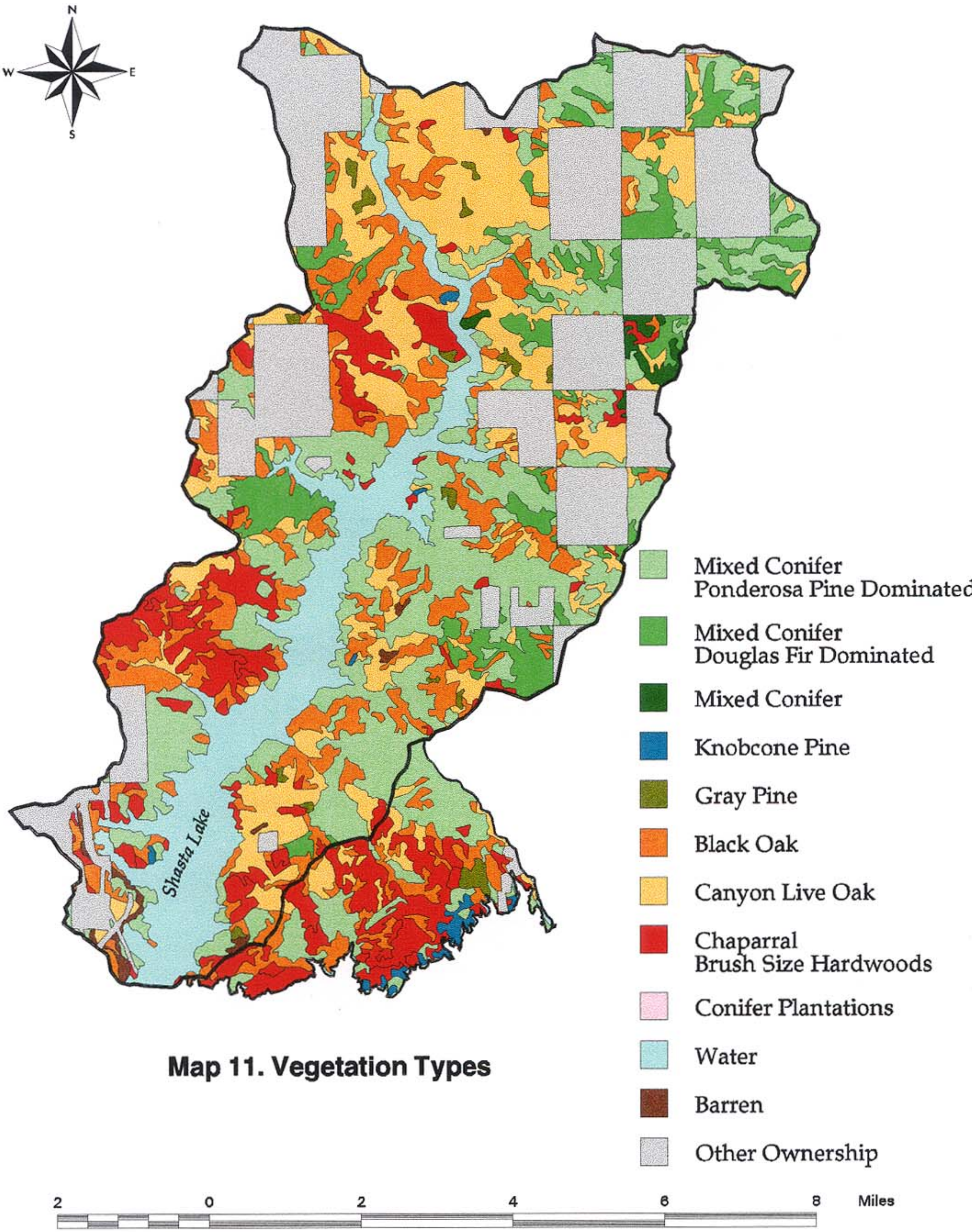
Few stands of pure knobcone pine occur in the analysis area (less than 1% of the area - see Table 3-3). It is most often seen as a component of the mixed conifer - ponderosa pine type. Pure stands of knobcone pine are most noticable along the lakeshore in the Squaw Creek Addition to the analysis area (see Map 11).

Knobcone pine is a species of closed-cone pine which needs fire to regenerate. It also is a short-lived species. Knobcone pine has become decadent in the absence of fire, and much of it is beginning to fall down and become a fire hazard. Most of the decadent knobcone pine stands occur along the lakeshore where boaters and recreationists present a risk of fire starts. Fire in such areas could be a major threat to bald eagle habitat which is already in short supply.

Black oak / canyon live oak

Stands of tree-sized oaks cover approximately 44% of the landbase in the analysis area (Table 3-3). Canopy closure can be as high as 85% with a fairly open understory. Poison-oak is an important shrub associate. Douglas-fir is occurring in the regeneration layer where canopy cover is the highest. Ponderosa pine, gray pine and sugar pine can be found regenerating in the more open patches.

McCLOUD ARM WATERSHED ANALYSIS



Map 11. Vegetation Types

Chaparral / shrub-sized hardwoods

This category covers approximately 10% of the McCloud Arm Watershed. However, it occupies almost 40% of the Squaw Creek Addition where soil conditions and south aspects are more conducive to this vegetation type. The chaparral type is made up of sticky whiteleaf manzanita, buckbrush, Brewer’s oak, poison-oak, and deerbrush. Unless these areas have been burned in the last 40 years, they are generally very decadent and thick. These thickets are still used by animals such as birds and mice, but are useless to deer and other large animals. They are also a potential fire hazard.

Shrub-sized oaks include black oak and canyon live oak which are less than 15 feet tall. These can also be very thick and difficult for larger animals to travel trough.

Shrubs provide food and cover for many forms of wildlife. They regenerate readily after fire, producing fresh young shoots which are very nutritious and palatable.

This document uses the following size and density codes to describe timber stands and wildlife habitat in conifer forest:

Size Class Codes

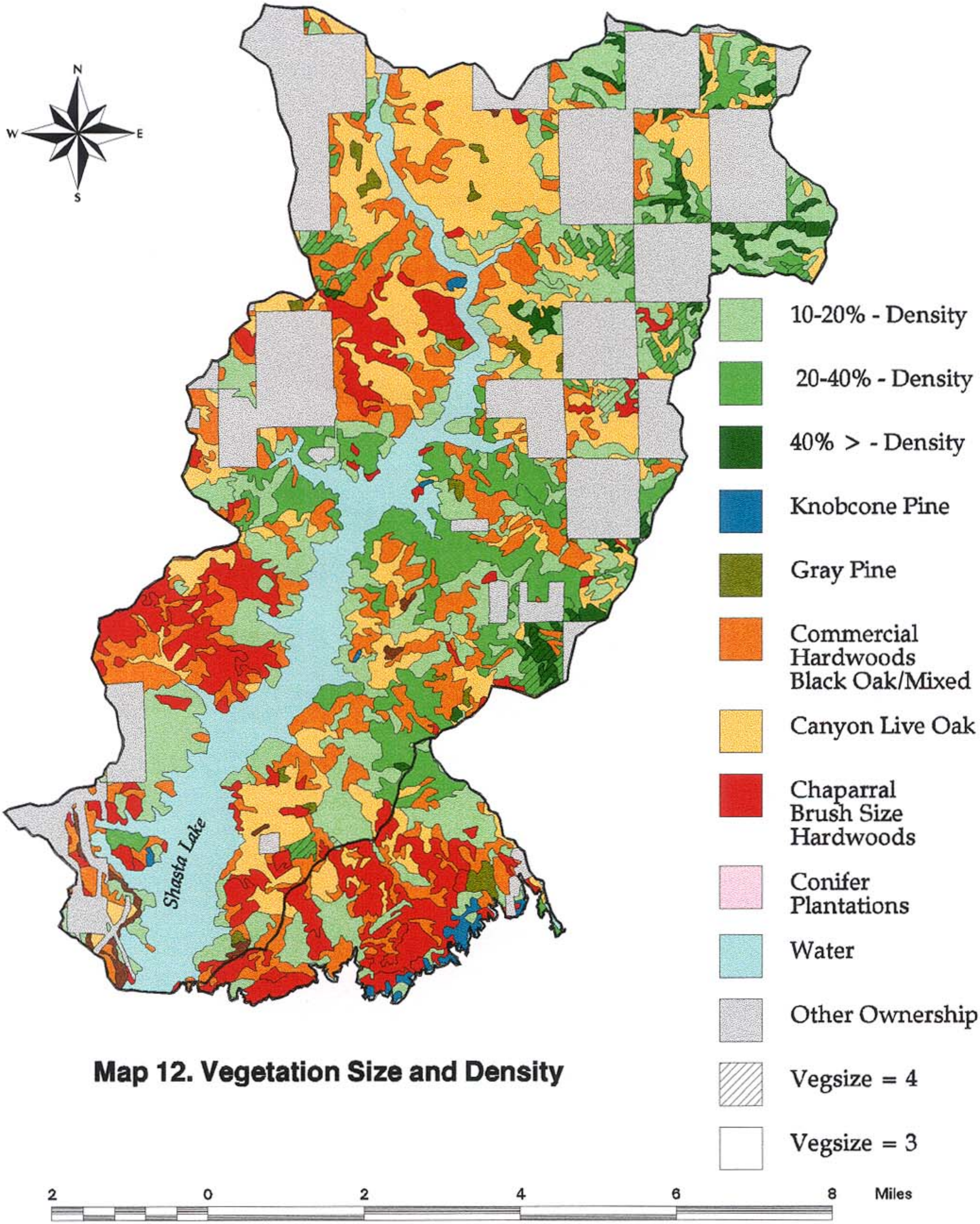
Size Code	Size Class	Crown Diameter	Approx. DBH
1	Seedling		<6”
2	Sapling	<12 ft.	6”-11”
3	Pole/Small Tree	12-24 ft.	11”-24”
4	Medium/Large Tree	>24 ft.	>24”

Density Class Codes

Size Code	Stocking	Canopy Condition	Canopy Closure
P	Poor	Sparse/Open	10-40%
G	Good	Moderate/Dense.	40-100%

For example: 3G would indicate a stand with 12-24' crown diameters and 40-100% crown cover.

McCLOUD ARM WATERSHED ANALYSIS



Map 12. Vegetation Size and Density

Table 3-3a: Summary of vegetation types in the McCloud Arm Watershed only.

Vegetation type	acres (NF land)	% of NF land only	% of all land (pvt. + NF)	% of entire watershed (all land + lake)
Conifer	11,776	43.9	32.7	28.5
Gray pine	242	0.9	0.7	0.6
Knobcone pine	45	0.2	0.1	0.1
Hardwood	11,920	44.4	33.1	28.9
Shrub	2,644	9.9	7.3	6.4
Plantation	3	0.0	0.0	0.0
Barren (rock)	70	0.3	0.2	0.2
Urban developed	118	0.4	0.3	0.3
TOTALS	26,817	100.0	74.4	65.0

Table 3-3b: Summary of vegetation types in the Squaw Creek Addition to the analysis.

Vegetation type	acres (NF land)	% of NF land only	% of all land (pvt. + NF)	% of entire watershed (all land + lake)
Conifer	1,298	28.0	27.1	27.1
Gray pine	75	1.6	1.6	1.6
Knobcone pine	337	7.3	7.0	7.0
Hardwood	1,099	23.7	22.9	22.9
Shrub	1,826	39.4	38.1	38.1
Plantation	0	0.0	0.0	0.0
Barren (rock)	2	0.0	0.0	0.0
Urban developed	0	0.0	0.0	0.0
TOTALS	4,637	100.0	96.8	96.8

Table 3-3c: Summary of vegetation types in the entire analysis area (McCloud Arm Watershed plus the Squaw Creek addition to the analysis area).

Vegetation type	acres (NF land)	% of NF land only	% of all land (pvt. + NF)	% of entire watershed (all land + lake)
Conifer	13,074	41.6	32.0	28.4
Gray pine	317	1.0	0.8	0.7
Knobcone pine	383	1.2	0.9	0.8
Hardwood	13,019	41.4	31.9	28.3
Shrub	4,470	14.2	10.9	9.7
Plantation	3	0.0	0.0	0.0
Barren (rock)	72	0.2	0.2	0.2
Urban developed	118	0.4	0.3	0.3
TOTALS	31,454	100.0	77.0	68.3

Table 3-4a: Summary of seral stages in the McCloud Arm Watershed only.

Seral stage	Strata	Acres (NF land)	% of NF land only	% of all land (pvt. + NF)	% of entire watershed (all land + lake)
Late seral	4G	476	1.8	1.3	1.2
Mature	3G	250	0.9	0.7	0.6
Mid seral	3P,4P,NC, KPX	11,337	42.3	31.5	27.5
Early seral	1,2	3	0.0	0.0	0.0
Hardwood	HCO,HN C	11,920	44.4	33.1	28.9
Shrub/chaparral	SX	2,644	9.9	7.3	6.4
Barren (rock)	NB	70	0.3	0.2	0.2
Urban developed	ND	118	0.4	0.3	0.3
TOTALS		26,817	100.0	74.4	65.0

Table 3-4b: Summary of seral stages in the Squaw Creek addition to the analysis area

Seral stage	Strata	acres (NF land)	% of NF land only	% of all land (pvt. + NF)	% of entire watershed (all land + lake)
Late seral	4G	0	0.0	0.0	0.0
Mature	3G	0	0.0	0.0	0.0
Mid seral	3P,4P,NC, KPX	1,710	36.9	35.7	35.7
Early seral	1,2	0	0.0	0.0	0.0
Hardwood	HCO,HN C	1,099	23.7	22.9	22.9
Shrub/chaparral	SX	1,826	39.4	38.1	38.1
Barren (rock)	NB	2	0.0	0.0	0.0
Urban developed	ND	0	0.0	0.0	0.0
TOTALS		4,637	100.0	96.8	96.8

Table 3-4c: Summary of seral stages in the entire analysis area (McCloud Arm Watershed plus the Squaw Creek addition to the analysis area).

Seral stage	Strata	Acres (NF land)	% of NF land only	% of all land (pvt. + NF)	% of entire watershed (all land + lake)
Late seral	4G	476	1.5	1.2	1.0
Mature	3G	250	0.8	0.6	0.5
Mid seral	3P,4P,NC, KPX	13,047	41.5	31.9	28.3
Early seral	1,2	3	0.0	0.0	0.0
Hardwood	HCO,HN C	13,018	41.4	31.9	28.3
Shrub/chaparral	SX	4,470	14.2	10.9	9.7
Barren (rock)	NB	72	0.2	0.2	0.2
Urban developed	ND	118	0.4	0.3	0.3
TOTALS		31,454	100.0	77.0	68.3

Role of Fire

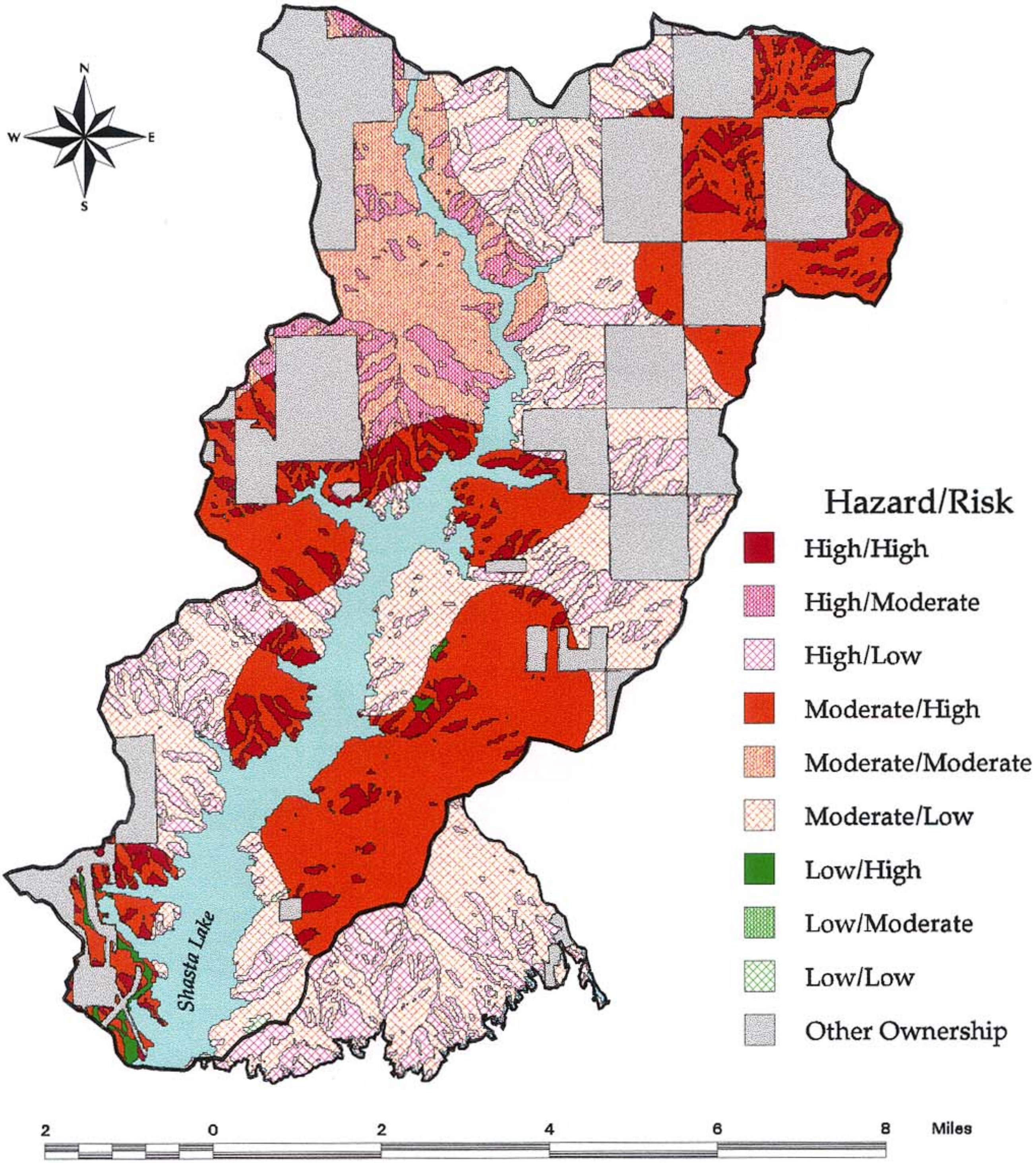
The Southern Cascades Province is characteristic of a short return interval, low intensity surface fire regime. The mixed conifer series is the most common series found throughout the McCloud Arm Watershed which includes ponderosa pine at the drier ends of the mixed conifer zones. Mixed conifer and ponderosa pine series as well are both characteristic of short interval fire adapted fire regimes. Pine sites may have shorter intervals of disturbance (5-15 years) due to drier site conditions and extended burn seasons while higher elevations and transitions zones to mixed conifer stands may experience longer intervals (5-30 years) due to climatic variables. Within the lower elevation, and thus drier sites, fire regimes have experienced a change from frequent low intensity surface fires to that of infrequent high intensity stand replacement fires. Correspondingly, higher elevation moist sites within the same fire regime have changed from infrequent low to moderate intensity surface fires to infrequent low, moderate and high intensity stand replacement fires. Black oak and white oak found in much of the watershed have also evolved under a fire regime of low to moderate intensity surface fires at short intervals.

Hazard and Risk from Wildfire

Fire behavior is a function of fuels, weather and topography. The fuels leg of this triangle relates directly to standing vegetation as well as down and dead surface fuels. Initiation of crown fire behavior is a function of surface fire line intensity and variables of the tree crown layer. Where forest structure effects fire behavior, fire behavior, as well, effects forest structure as discussed previously. This resulting effect from fire absence in the McCloud Arm Watershed is most apparent in standing live fuels that develop dense fire ladders from the surface to live tree canopies. Analysis of stand structure data within the watershed indicates that 55% of the existing National Forest stands are likely to generate or allow crown fire behavior given fire intensity levels expected from characteristic fuel models assigned. Residual surface fuel loads of dead and live fuels are indicators of predictable fire intensity levels. Tree density, measured as "Crown Bulk Density" (CBD) is indicative of crown fire potential given surface fire intensity levels. Live standing brush coupled with high CBD above 0.10 kg/m^3 are the major high risk factors within the fuel profile. Approximately 65% of the watershed is in a fuel model that predicts flame heights of 4-8 feet under typical summer conditions. The historical probability of an ignition start from lightning is "high” at 2.2 lightning fires per decade per 1000 acres for the watershed overall. This combination of CBD over 0.10 kg/m^3, predicted 4-8 ft flame heights, and high probability of ignition puts the McCloud Arm Watershed at high potential for catastrophic wildfire.

Areas within the watershed at higher risk to catastrophic fire are those that posses all the critical characteristics of fuel, weather and topography that contribute to crown fire or stand replacement fire behavior.

McCLOUD ARM WATERSHED ANALYSIS



Map 13. Fuel Hazard Risk

Table 3-5: Critical fire features in the McCloud Arm Watershed.

Land Base Description	Critical Fire Features	
	High Risk	Moderate Risk
Fuels		
Fuel model 6	FL = 8 ft.+ / CBD = 0.10+	
Fuel models 9,10,10/6		FL = 4-8 ft. / CBD = 0.10+
Weather		
Season	July - September	June, October
Topography		
High elevation	High lightning occurrence	
Mid elevation		Mod.-High fire occurrence
Slope		
0-35%		Moderate rate of spread
35%+	High rate of spread	
Aspect		
south/west	High rate of spread	
north/east		Low - mod. rate of spread

FL = flame length CBD = crown bulk density in kg/m^3

The McCloud Arm watershed has 17,500 acres that are considered at "High" risk to produce catastrophic fire behavior. The fire effects on vegetative resources within these high risk areas will likely be replacement in nature.

Fire analysis can identify the fire susceptibility of a watershed in terms of risk and hazard (see Map 13). Risk applies to the probability of an ignition occurring. Hazard identifies the availability of fuels to sustain a fire. Where high risk coincides with high hazard, the probability of catastrophic fire is more likely. Taking these variables into account, the McCloud Arm Watershed is characterized as follows:

Table 3-6: Fire susceptibility in the McCloud Arm Watershed.

Combined rating of risk/hazard	% coverage of National Forest land	Total acres
High	27%	7,240
Moderate	35%	9,385
Low	38%	10,190

Fire Suppression

- Road access for suppression purposes is very limited on the most of the east side of the watershed. Many areas are accessible only from boat where no roads exist. Air attack is often the only option for quick initial attack.
- Urban Interface issues are currently a large suppression concern as well as the development of future resort and home sites within the watershed. Public safety is at higher risk where combinations of adjacent hazardous vegetation, increased risk of human fire starts, and difficult access is apparent.

- Pre-Attack Planning is very limited within the watershed as it is throughout the entire region. This lack of preplanning can hinder effective fire suppression in high risk critical areas such as the urban interface.

Air Quality

Air quality is currently under the authority and monitored by the Shasta County Air Pollution Control Board. Air quality impacts from prescribed burning, as well as from wildfire, can detract considerably from a quality recreation experience.

Species and Habitat

Documentation from sightings, nest locations and habitat/distribution models (Timossi, 1993) have indicated 218 species of wildlife (11 amphibians, 135 birds, 46 mammals and 18 reptiles) are associated with the habitat and elevations characteristic of the McCloud Arm Watershed (Appendix C). This watershed analysis will emphasize the following groups of species:

- Federally listed endangered
- Threatened or proposed species
- Forest Service sensitive species
- Other species of concern including:
    - survey and manage species
    - protection buffers
    - high profile species:
        - neotropical migratory birds
        - McCloud Flats Deer Herd
        - elk
    - fisheries

These species of concern are discussed more in depth in the section 'Species of Concern' found later in this chapter.

Late Successional (Old Growth/Mature) Habitat

Eleven late-successional associated wildlife species are believed to occur within the McCloud Arm Watershed including: great blue heron, hairy woodpecker, varied thrush, solitary vireo, hermit warbler, and hoary bat, to name a few (also see Appendix C). Less than two percent of the entire watershed is comprised of late successional habitat. Late-successional forest occurs in very small isolated patches in the watershed or as relic components in younger stands (i.e., single old growth trees which have survived fire). When Shasta Dam was constructed in the 1940's and the reservoir area was logged, the highest productivity forest land was harvested and flooded by creation of the lake. What it left was the ridgetops and lake.

As a result, one would not expect most of the more traditional late-successional forest-associated Species of Federal concern to inhabit this watershed such as: Northern goshawk, Northern spotted owl, American marten, and Pacific fisher (see "Species of Concern" section). The silver-haired bat, a species of Federal concern is expected to be present within the watershed.

Generally, the habitat these late-successional-associated species are keying into includes late-seral multi-storied forested habitats with over 70% canopy cover. Northern spotted owls require large (>24" dbh) snags or broken top trees for nesting. Pacific fisher and American marten require large (>20" diameter) dead and down woody material for denning. This habitat is generally lacking in this watershed.

Most of the late-successional species require dispersal habitat between areas of late-successional habitat. Generally, dispersal habitat is mid to late-seral forested habitats with 40% or greater canopy closure. Riparian reserves containing riparian or forested habitat are also important dispersal corridors. Dispersal habitat is generally limited in the watershed with only two percent of the conifer-dominated acreage on National Forest lands supporting crown closures greater than 40%. Most dispersal habitat in this watershed would be provided in the tree-form hardwood types; however, it is generally believed that the Shasta Lake region does not support breeding spotted owls, but rather that spotted owls may move across the landscape in this watershed.

Old Growth Habitat (Suitable Nesting/Roosting Habitat for the Northern Spotted Owl)

Currently, there is less than 500 acres (approx. 2%) of late-successional/old growth habitat (4G veg types) and it is doubtful if any of this habitat would provide suitable nesting/roosting habitat due to small patch size and the isolated nature of the patches.

Most of this habitat occurs along Nosoni and Campbell Creeks and neighboring tributaries. It is believed that the lack of connectivity is natural rather than man-caused since little timber harvest activity has occurred in this watershed.

Potential Late-Successional/Old Growth Habitat (Foraging Habitat for the Northern Spotted Owl)

There is very little potential late-successional habitat. There are over 11,000 acres of young to mature forests with less than 40% canopy closure (3P veg type). Most of this habitat is inherently open and will probably never become suitable nesting/roosting habitat. A small percentage of this habitat, occurring on northerly slopes and associated with some drainages may become suitable nesting/roosting habitat if allowed to grow without wildfire, disease, or human manipulation.

Little of the potential conifer-dominated younger forested habitat provides for the connectivity between the old growth patches. Most is too open to function as dispersal habitat.

Dispersal Habitat

Dispersal habitat was quantitatively analyzed using 11-40 (>11" dbh, 40% canopy) for the watershed, not for 1/4 township. Currently 35% of the watershed provides for dispersal habitat. This figure does not meet the USFWS dispersal recommendation of 50% for the landscape (Thomas et al., 1990). This is expected, however, since much of the habitat within the watershed is open forest, rocky, and not capable of producing dispersal habitat. Also, this general area is not classified as suitable for nesting/roosting owls according to the USFWS. Use by owls is not expected except for occasional movement across the landscape (P. Dietrich, pers. comm.).

Early-Mid Seral or Multi Guild species

Within the watershed, approximately ninety-four (94) species of chaparral, shrub, grassland and open habitat-associated wildlife species could occur (Timossi, 1991; Appendix C). Of these, nine are species of concern and seven games animals, including mule deer, elk, turkey, black bear, California quail, bobcat and band-tailed pigeon. Species of Federal concern include the pallid bat, long-eared myotis, and Townsend's big-eared bat, all which utilize the habitat for foraging, and the Northwestern pond turtle, which uses upland habitat in association with streams. Viability of these species is expected to be provided through special management direction for riparian areas, downed logs, snags, old-growth species, green-tree retention, hardwood retention, seral stage diversity management, forest health, management plans for special land allocations and deer management plans.

Hardwood Habitats

Almost 12,000 acres, or approximately 38% of the watershed is classified as hardwood habitat dominated by black oak or canyon live oak. After field verification of database maps (LMP93), it appears that almost 50% of the hardwood vegetation types are actually relatively open habitat dominated by gray pine, mixed hardwoods and shrubs, grasses and forbs. Approximately 25% of the watershed is hardwood habitat dominated by tree-form black oak and canyon live oak. Within the watershed, 13 wildlife species are associated with hardwood habitat including: great egret, Cooper’s hawk, band-tailed pigeon, acorn woodpecker, downy woodpecker, ash-throated flycatcher, plain titmouse, white-breasted nuthatch, two species of vireos, house sparrow, western gray squirrel and wild pig. It is also felt that the black-tailed deer, turkey, elk and black bear should also be added to this list. Oaks provide abundant acorn mast, young leaves and habitat for insects which several species of wildlife feed upon. Cooper’s hawks nest in oak woodlands and feed upon birds inhabiting this habitat.

Aquatic Ecosystems - Aquatic and Riparian Dependent Wildlife Species

Seventy-nine (79) species of aquatic and/or riparian dependent wildlife species are believed to occur within the McCloud Arm Watershed (Appendix C). The presence of the McCloud Arm of Shasta Lake (approx. 4841 acres) and several riparian systems within the watershed boundary provides abundant diverse aquatic and riparian habitat for many species. Species of Federal concern include the foothill yellow-legged frog, Northern red-legged frog, bald eagle, willow flycatcher, and Northwestern pond turtle (see Species of Concern section). Habitat requirements vary from deep non-vegetated open water of the lake to intermittent standing water with varied amounts of vegetation and vegetation type to permanent, cool water, with instream cover and surrounding dense riparian vegetation. Management of Riparian Reserves through the Aquatic Conservation Strategy is expected to provide for or minimize impacts to species listed in the aquatic and riparian guilds. Western pond turtles and bald eagles may be the exception as they can utilize upland habitat for nesting which may fall outside of the Riparian Reserves.

Aquatic Ecosystems - Fisheries

There are approximately 39.2 miles of fish bearing streams (measured from the full lake level) within the analysis area. The largest and most significant of these streams from a fisheries viewpoint are Nosoni and Campbell Creeks. The other streams are of varying importance to fish with the smaller streams providing fish habitat only within the lower reaches. Some of the smaller streams, as well as the upper portion of the larger streams, are intermittent and only provide fish habitat on a seasonal basis. Table 3-7 is a list of fish bearing streams as well as miles of suitable habitat.

Table 3-7: Fish bearing streams and miles of suitable fish habitat within the McCloud Arm Watershed.

Stream	**Fish Habitat** (miles)		**Stream**	**Fish Habitat** (miles)
Nosoni Creek	9.4		Potter Creek	0.6
Dooles Creek	1.4		Ycotti Creek	2.0
Mathles Creek	2.0		Keluche Creek	0.8
Dekkas Creek	2.6		Hirz Creek	2.0
Campbell Creek	6.4		Moore Creek	0.6
Greens Creek	2.6		Ellery Creek	0.8
Curl Creek	3.4		Kabyai Creek	1.7
Marble Creek	0.6		Jennings Creek	0.5
Horse Creek	1.8			

Fish bearing streams are also displayed on Map 9 - Riparian Reserves.

The larger streams within the analysis area generally provide good fish habitat. These streams are in dynamic equilibrium with respect to flow, bedload, and the delivery of large wood. This has resulted in the formation and maintenance of habitat features, such as pools and runs, that are critical to the production of trout. Many of these streams also provide spawning habitat for adfluvial trout runs from the lake. The smaller tributaries in general are also functioning well, but are limited for fish habitat because of their small size and steep gradients.

Rainbow trout are the dominant fish species within the streams. Most of these are resident fish; however, during the spring, rainbow trout from the lake do move into the streams to spawn. Other fish species believed to occur within the lower reaches of the streams include: brown trout, smallmouth bass, Sacramento sucker, Sacramento squawfish, and riffle sculpin. The presence of these species within these streams has not been documented, but they are known to inhabit the general area. The presence of these other species is a result of the lake and their abundance decreases rapidly with upstream distance.

Shasta Lake is a two-story impoundment and provides habitat for both warmwater and coldwater fishes. Habitat for coldwater fish species within the lake is considered good; however, habitat for warmwater fish species is limited by the lack of cover, steep-sided banks, and water level fluctuations. Fish species within the lake are varied and abundant. Species known to inhabit the lake include: rainbow trout, brown trout, chinook salmon, largemouth bass, spotted bass, smallmouth bass, black crappie, bluegill, carp, Sacramento sucker, Sacramento squawfish, riffle sculpin, black fish, hardhead minnow, white sturgeon, channel squawfish, threadfin shad, white catfish, brown bullhead, golden shiner and green sunfish. The basses and trout are the species most frequently caught by anglers. Even though there is some natural reproduction, the coldwater fish populations within the lake are largely maintained through Annual stocking by the California Department of Fish and Game. The warmwater fish populations are self-perpetuating.

Habitat Elements (Snags, Dead/Down, Caves, Building and Bridges)

Snags

Twenty-six (26) wildlife species believed to occur within the McCloud Arm Watershed are dependent on snags for nesting, roosting or denning (see Appendix C). They make up 12% of all the wildlife species within the watershed. Five of the snag dependent wildlife species are woodpeckers, but none are primary excavators, those species which create cavities. Four of the snag dependent wildlife species are bark cavity dwellers, three of which are "survey and manage" bat species. Though other wildlife species not considered snag dependent will also utilize snags, those which are snag dependent are mentioned because their needs are used to assess the snag densities needed across the landscape. See Appendix D for description of habitat needs for Snag Cavity Dwellers and Bark Cavity Dwellers.

Suggested snag and recruitment densities displayed in Table 3-8. These figures are based on the habitat and the cavity dependent species which are associated with them.

Table 3-8: Suggested snag densities for the McCloud Arm Watershed.

Habitat	**Snags/acre**	**Recruitment/acre**
Douglas-fir	1.5	4.5
Hardwoods	2.5	7.5
Riparian habitat	3.0	9.0
Mixed conifer	4.0	12.0
Ponderosa pine	4.0	12.0

Based on ocular estimates, snag densities within the watershed are relatively low and do not meet suggested snag densities (N. Hutchins and R. Posey, pers. comm.). Some factors which may influence snag density are poor site and fires at the turn of the century which has resulted in a relatively young forest over much of the watershed. Smelting in the early 1900's which killed many trees may also have been a factor. In general, most areas which are located in poor growing conditions are expected to be less than the suggested snag densities. Since this area has not been harvested for the most part, past timber harvest is been a factor.

Dead/Down

Eleven species of wildlife are dead/down wood dependent species (see Appendix C). None of the species are Federally listed. Many other species, though not considered dependent, do utilize dead/down wood, like small mammals, amphibians, woodpeckers, and bear. Unlike snags densities, suggested dead/down densities are based on the needs of dependent and 'non-dependent' species, mainly those species of high profile. These dead/down densities are expected to meet the needs of most, if not all other wildlife species which utilize dead/down. For a description of dead/down requirements for dependent species see Appendix D.

Dead and down densities within the watershed are unknown. Two sources of dead/down data, Ecological Unit Inventory (EUI) and fuel loading, were not used because EUI data was not collected and fuel loading has not been calculated in this watershed.

Using snag levels as an indicator for dead/down material, expectations of where dead/down levels meet the needs of dependent species would follow the same pattern for snags. Areas where poor growing conditions exist are expected to have less than the recommended levels of dead/down material.

Caves/Mines/Bridges/Buildings

Twelve wildlife species are known to utilize caves, mines, bridges or buildings for roosting, nesting, or denning. Of these the Shasta salamander, long-legged myotis, long-eared myotis, fringed myotis, pallid bat, and Townsend's big-eared bat are of Federal concern (see Appendix C) Information regarding caves within the watershed is extensive since many of the caves are associated with limestone formations. The Shasta Area Grotto has done extensive exploration of the limestone country around Shasta Lake and they have data on file. Many discovered caves are significant to wildlife, archaeology and scientists. Cave locations are retained within Forest and Grotto files as they are sensitive data.

Although there has been extensive mining in the area during this period, most activity occurred as placer and surface mining and there are no known adits in the watershed.

The following tables summarize bridges and buildings in the watershed that may be utilized by wildlife.

Table 3-9: Bridges which may be utilized by wildlife. (pers communication, W. Stephas 3/97, Engineer, Shasta-Trinity NF, Supervisor’s Office):

Bridge location	**Type of Bridge**	**Surveyed?**
McCloud Bridge (Road 34N17 over McCloud River)	Metal span	No
Pit River Bridge (Interstate 5 over Shasta Lake)	Metal span	No

Table 3-10: Buildings which may be utilized by wildlife.

Building location	**Type of Building**	**Surveyed?**
Hirz Mountain Lookout	Lookout	No
Hirz Bay Cabin	Cabin	No

Current Habitat Conditions

Habitat conditions based on the current database (LMP90) vegetation layer and exiting Biological Evaluations and Assessments, can only be grossly determined. Approximately 82% of the watershed is in open habitats (11,050 acres), dominated by conifers and hardwoods, chaparral/shrub dominated habitat (1,644 acres), gray pine habitat (6,242 acres) and pure hardwood habitat (6,000 acres). These habitats occupy the bulk of the watershed and are present due to past activities, fire or smelting, poor or rocky soils and/or aspect. Assessing areas or early or late seral habitat was not possible because the baseline vegetation layer contains no seral stages for these habitats. With the suppression of fire over the last 50 years, the chaparral habitats are expected to be reaching, if not currently in, a late seral condition. Areas of early seral habitat may occur within disturbed areas, such as recent fire. Hardwood habitat is expected to have understory growth of seedlings and shrubs. The extent of these developing habitats, though, is unknown. No grasslands and very little streamside habitat was identified. Most herbaceous vegetation is expected to occur within the understory of open canopied (<50%) conifer and hardwood forested habitats where shrub encroachment has not occurred.

Species benefiting from the late seral conditions of the chaparral habitat would be those which require large patches of undisturbed habitat, much like the needs of forest interior species. Berry production within these stands would benefit many species able to forage there. These late seral chaparral habitats also provide important thermal and escape cover for birds and larger mammals. Smaller mammals benefit from the lower growing shrubs. Detrimental effects to wildlife species would include the loss of foraging habitat for browsers as senescent chaparral is not palatable. Herbaceous forage is also lost as the chaparral overgrows open, early seral habitat.

Developing hardwood habitats can also reduce the amount of herbaceous forage usually found in the understory, through shading out of the herbaceous forage or through competition from seedling and shrubs. In addition, acorn production may be hindered due to competition of resources by seedlings and shrubs in the understory. This herbaceous forage and acorn production is important to many wildlife species, especially game species such as squirrels, turkey, bear, elk, and deer.

Wildlife Species of Concern

American Peregrine Falcon

Status: Federally Endangered, State Endangered

Presence in watershed:

There is one historical eyrie within the watershed. This eyrie is located near Shasta Lake Caverns and was occupied until 1994-95. It is thought that this pair of falcons has moved further back into the limestone formations since peregrine falcons are still observed foraging on the McCloud Arm. Additional recorded sightings of peregrine falcon have occurred in the northernmost part of the watershed, around the McCloud Bridge (pers. communication with N. Hutchins 1997, Wildlife Biologist, Shasta-Trinity NF, Shasta Lake RD). As indicated in the table below (Table 3-11), the site has a high potential for a peregrine eyrie. Observations are still being conducted to determine if an eyrie does exist in this area.

Landscape overview:

The nearest peregrine falcon eyrie is Pit 6, located 5 miles east of the watershed, along the Pit River.

Survey extents:

Observations are being conducted around the McCloud Bridge to determine if an eyrie exists. Another site at High Mountain may also have an eyrie (T. Hesseldenz 1997, pers. communication). Current monitoring to confirm the eyrie's existence has not been conducted.

Habitat description: vertical cliff habitat with large potholes or ledges.

Habitat condition:

The watershed has great potential for presence due to the abundance of limestone formations and cliffs.

9 sites have been identified as possible locations for peregrine eyries (Boyce & White, 1979) Some have very low potential whereas others have higher potential. This data is only informational as the potential rating has been questioned since predictions have not always matched known outcomes. Without current evaluation of these cliff sites, though, each is assumed to have potential for use by peregrines. The following table identifies each location, potential rating, and whether surveys were conducted.

Table 3-11: Possible eyrie locations, potential, and survey information for peregrine falcon.

Location	**T**	**R**	**Sec.**	**Potential**	**Surveyed**
Hat Mountain	36N	3W	34	Possible	Helicopter only
Grizzly Peak	36N	1W	21	No rating	None
High Mountain	36N	4W	12	No rating	None
Bolliboka Mountain	36N	3W	33	Unsuit./Potential	Helicopter only
McCloud Bridge	36N	3W	32	Highly suspected	Helicopter & ground visit
Nawtawaket Mountain	36N	3W	17	No rating	None
White Rock	36N	3W	2	No rating	None
McKenzie Mountain	36N	2W	28	Possible	Helicopter only
Van Sicklin Butte	36N	2W	3&4	No rating	None

* For further information see Boyce and White 1979.

Highly suspected = suitable habitat with signs of peregrine activity
Possible = suitable habitat, no signs of activity
Potential = unsuitable habitat with enhancement potential
Unsuitable = unsuitable habitat without enhancement potential
No rating = cliffs not helicopter surveyed for potential; low priority sites

Bald Eagle

Status: Federally Threatened

Presence in watershed:

There is one known nest location in the watershed at Hirz Bay.

Landscape overview:

The nearest nest site located on National Forest land is located 3 miles east at Iron Canyon Reservoir. Eagles are also reported to occur at Lake McCloud (CNDDB, 1996), along the northern border of the watershed. Both sets of eagles are expected to utilize the watershed for foraging. How much the watershed is contributing to either pair is unknown.

Survey extents:

No official surveys have been conducted for eagles in the watershed.

Habitat description: large ponderosa pine trees near lakes or large streams.

Habitat condition:

The level of occurrence for potential nest trees along the McCloud River is not known.

Spotted Owl

Status: Federally Threatened

Presence in watershed:

There are no known spotted owl activity centers within this watershed nor are nesting spotted owls expected to inhabit the watershed.

Landscape overview:

Two additional ACs (#109 & #212) lie outside the watershed, but within 1.3 miles of the boundary. These owls may be using habitat within the watershed (i.e. within their own home range).

Survey extents:

None of this watershed has been surveyed to protocol since the USFWS made the determination that the Shasta Lake area does not provide suitable habitat for the spotted owl.

Habitat description: mature conifer forests with dense, multi-layered canopies.

Habitat condition: suitable and potential habitat is lacking in this watershed.

Shasta Salamander

Status: Forest Service Sensitive

Presence in watershed:

Salamanders have been seen only in the southern portion of the watershed, near the McCloud River Bridge.

Landscape overview:

In the adjacent McCloud Arm, Squaw Creek and Lower Squaw Valley Creek watersheds salamanders are present, though the sighting occurrences are less abundant the further north one travels. This is expected to be a function of the abundance of suitable habitat; less limestone rock exposed, and higher elevations (>3000') where exposure does occur.

Survey extents:

Systematic surveys for the Shasta salamander have occurred in the most southern part of the watershed.

Habitat description:

cool, moist microclimate around limestone caves or outcrops below 3000 feet elevation.

Habitat condition:

Several limestone outcroppings do occur within the watershed (see Peregrine potential eyrie sites), but these are usually located above 3000', are drier sites and not forested. Caves are also present which may have salamander populations, though past exploration has not detected their presence (see 'Habitat Elements' discussion for Caves). Other sites may occur, but could not be detected at this level of analysis using aerial photos, geological maps and soils maps. Their existence will be determined at the project level.

Northern Red-legged Frog

Status: Forest Service Sensitive

Presence in watershed:

No sightings of this species have been reported within the area

Landscape overview:

Red-legged frogs have been found in streams within the adjacent Shasta Lake associated watershed (Bogener and Brouha, 1979).

Survey extents:

While systematic surveys specific to the northern red-legged frog have not been conducted within the watershed, personnel responsible for past stream and wetland surveys looked for this species.

Habitat description:

cool, deep, still to slow moving water such as lakes, ponds, or slow streams.

Habitat condition:

Red-legged frog habitat may occur in the alluvial uplands if pools are present. Between the pool-riffle and the step-pool reach types, the pool-riffle would have a higher probability of providing suitable habitat as slow moving pools with riparian vegetation and instream vegetation could occur.

Northern Goshawk

Status:

Forest Service Sensitive, Federal Species of Concern, California Species of Concern

Presence in watershed:

Landscape overview:

Survey Extents:

Habitat description: late seral, conifer forests near early seral openings.

Habitat condition:

Willow Flycatcher

Status: FS Sensitive, California Endangered

Presence in watershed:

Landscape overview:

Survey Extents:

Habitat description: large clumps of willow separated by openings

Habitat condition:

Pacific Fisher

Status:

Forest Service Sensitive, Federal Species of Concern, California Species of Concern

Presence in watershed:

Landscape overview:

Survey extents:

Habitat description: large areas of mature, dense forest below 6000 feet.

Habitat condition:

American Marten

Status: Forest Service Sensitive, California Species of Concern

Presence in watershed:

Landscape overview:

Survey extents:

Habitat description: mature mixed conifer forest types under 4000 feet.

Habitat condition:

Northwestern Pond Turtle

Status: Forest Service Sensitive

Presence in watershed:

Landscape overview:

Survey extents:

Habitat description: deep still water with sunny banks.

Habitat condition:

BATS

Eleven bat species may occur within this watershed.

Five of these are Survey and Manage species:

- long-eared myotis
- fringed myotis
- long-legged myotis
- pallid bat
- silver-haired bat

Two of these are Federal Species of Concern:

- Yuma myotis
- Townsend's big-eared bat

Some of these bats require caves, mines, abandoned wooden bridges and buildings for roosting sites, others require snags, still others utilize both types of roost sites. Foraging areas vary from shrub, chaparral and open fields to streams, lakes and or meadows; essentially, anywhere insects can be found, though some bats do favor particular insects.

There are no confirmed sightings of any bat species in the watershed; however, suitable habitat exists (See Appendix D and 'Habitat Elements' discussion for suitable habitat descriptions). Special habitat needs, though, for the Survey and Manage species expect to be met through snag management, Riparian Reserves, and survey and manage management guidelines. The remaining four species of bats are also expected to be provided for through the above mentioned management.

Neotropical Migratory Birds

Eighty-three (83) neotropical migratory birds (NTMBs) are suspected to occur within the watershed (see Appendix C). Examples include:

- riparian guild - Cooper's hawk, sharp-shinned hawk, yellow warbler, yellow-breasted chat
- open-shrub guild - green-tailed towhee, golden eagle, prairie falcon
- open-grass guild - killdeer
- late seral guild - brown creeper, flammulated owl, varied thrush

There are no known sightings of NTMB species within the McCloud Arm Watershed, but suitable habitat exists throughout the watershed.

These species require breeding habitat and migration corridors. Because of alteration to breeding habitat and increased exposure to predation and parasitism many of these populations have undergone significant declines. Habitat preservation and restoration is the backbone of maintaining current populations of NTMBs. Following proper management of breeding habitat, exposure to predation and parasitism is expected to become reduced.

The general Forests standards and guidelines state that habitat is to be managed for NTMBs to maintain viable population levels. Management of Riparian Reserves, fragmented forested habitat, hardwoods, old-growth and late seral habitat, diverse seral stages, visual quality, protection buffers, snags, dispersal habitat, and special lands will help preserve breeding habitat for NTMBs. Deer herd management is also expected to improve the habitat of NTMBs as well as residents which are dependent upon shrub habitats. The creation of edges is beneficial to most of these species. Also of importance is the proximity of water and the size of shrub patches. A preliminary attempt at determining the size of patches needed was conducted (USDA, 1994), but only information about territory size was found. Deer management which maintains large 40+ acre patches of shrub habitat (mostly late seral) is expected to be most beneficial at this time.

Game Species

Black-tailed Deer

Elk

Table 3-12: Other wildlife species of concern in the McCloud Arm Watershed.

Species	Status				Managed through:				Sightings?
	S&M	FSC	CSC	CT	LS	RR	Deer	Snag	
long-legged myotis	●	●			●	●		●	
fringed myotis	●	●			●	●		●	
long-eared myotis	●	●			●	●		●	
pallid bat	●		●		●	●	●	●	
silvered-haired bat	●				●	●		●	
Townsend's big-eared bat		●	●		●	●			
Yuma myotis		●			●	●	●	●	
wolverine		●		●	●	●		●	
osprey			●			●		●	
sharp-shinned hawk			●		●	●			
Cooper's hawk			●		●	●			
golden eagle			●		●	●			
merlin			●		●	●			
California quail			●			●	●		
black swift			●			●			
Vaux's swift			●			●		●	
purple marten			●			●		●	
yellow warbler			●			●			
yellow-breasted chat			●			●			

Status:

S&M	Survey and Manage Species (LMP)
FSC	Federal species of concern (in most cases replaced category 1, 2 species)
CSC	California Species of Special Concern
CT	California Threatened

Managed through:

LS	Late-Successional Reserve guidelines
RR	Riparian Reserve guidelines
Deer	deer herd management guidelines
Snag	snag guidelines

Human Uses

Overview

The entire McCloud Arm Watershed is located within the Whiskeytown-Shasta-Trinity National Recreation Area (NRA). The NRA was established by Congress on November 8, 1965 by Public Law 89-336. The goals of the NRA legislation, as expressed in the law, were "...to provide, in a manner coordinated with other purposes of the Central Valley Project, for the public outdoor recreation use and enjoyment of the Whiskeytown, Shasta, Clair Engle, and Lewiston reservoirs and surrounding lands...by present and future generations and the conservation of scenic, scientific, historic, and other values contributing to public enjoyment of such lands and waters..."

The management and activities that take place within the McCloud Arm Watershed influence individuals and groups of people living in the watershed, the local area, as well as those who come from elsewhere to use Shasta Lake as a destination recreation area. The following are some of the more obvious and significant (in terms of the number of benefiting people) uses of the watershed:

- speed boaters
- houseboat users
- water-skiers
- commercial permittees (resorts, marinas, and caverns)
- anglers
- recreational camping
- personal watercraft users
- homeowners (private and FS recreation residences)
- Native American cultural and religious activities
- spelunkers
- picnickers and sightseers

Heritage Resources

The McCloud Arm Watershed at historic contact was inhabited by the McCloud Wintu, and their descendants, formalized as the Wintu Tribe of Shasta, retains an active interest in the protection of prehistoric sites as well as an ongoing spiritual interest in a number of sites. The most important of these sites are:

- Salt Creek Mountain
- a small waterfall on an unnamed tributary to Nosoni Creek
- Samwell Cave and several smaller caves on the north side of Hirz Mountain
- the McCloud Bridge Campground.

One subgroup of the Wintu has a Special Use Permit for conducting ceremonies and for collecting medicinal plants on National Forest land within the McCloud Arm Watershed.

Seventy-two prehistoric and historic archaeological sites have been formally recorded within the McCloud Arm Watershed. Archaeological reconnaissance has been most intensive within the pool area of Shasta Lake, both prior to the completion of the dam and during drought years. Sixty recorded sites lie beneath the maximum level of the lake, 56 of them prehistoric middens, some with historic components as well, and four historic sites. A number of these sites lie within the annual drawdown area of 60 to 100 feet below maximum lake level and are subject to extensive erosion and vandalism as well as damage by lake access roads and camping activities.

With the exception of campground areas, roads, and trails, very limited archaeological reconnaissance has been conducted on the slopes above the lake. Nine prehistoric and three historic sites have been recorded, five of them located within campgrounds or lakeshore trails. Three of these sites, Samwell Cave, Potter Creek Cave, and Hirz Mountain Lookout, have been nominated or found eligible fro the National Register of Historic Places.

Residential Use

Residences on private land are interspersed throughout the McCloud Arm Watershed. Two concentrations of private residences occur at:

- the west side of the McCloud Arm from the Pit River north to Ycotti Creek
- the upper slopes of the Hirz Bay drainage

Recreation residence tracts are located on National Forest land around the inlet at Campbell Creek on the east side of the McCloud Arm of Shasta Lake. Forest Service policy is to manage these tracts and residences for individual recreation use and to keep them as much as possible in their natural state. Improvements are minimal, within established guidelines, and structures must blend into the natural environment.

Recreation Facilities

Recreation facilities in the McCloud Arm Watershed are summarized below. Detailed descriptions of these facilities can be found in Appendix G - Recreation Facilities.

Commercial Services

Within the McCloud Arm Watershed, full service resort/marina facilities at Holiday Harbor and Lakeview. Shasta Caverns is also located on the McCloud Arm.

All three of these commercial businesses are operated under a special use permit issued by the Forest Service.

<u>Government Services</u>

The following tables summarize government services on the McCloud Arm of Shasta Lake.

Table 3-14: Day use picnic areas on the McCloud Arm of Shasta Lake.

Site	Picnic Units	Services/Features
Bailey Cove	8	toilet, drinking water, boat ramp, camping
Dekkas Rock	4	toilet, drinking water

Table 3-13: Campground facilities on the McCloud Arm of Shasta Lake.

Site	Camping Units	Services/Features
Bailey Cove	8	toilet, drinking water, boat ramp, picnic area
Greens Creek	11	toilet, boat access only
Hirz Bay	48	toilet, drinking water, boat ramp
Hirz Bay Group	2	toilet, drinking water, group camp
Dekkas Rock Group	1	toilet, drinking water, group camp
Moore Creek	12	toilet, drinking water
Ellery Creek	19	toilet, drinking water
Pine Point	14	toilet, drinking water
McCloud Bridge	20	toilet, drinking water

Table 3-15: Boat ramps on the McCloud Arm of Shasta Lake.

Site	Services/Features
Bailey Cove	toilet, drinking water, picnic area, camping
Hirz Bay	toilet, drinking water, camping

Hirz Bay has three ramps. Boats are also launched from the old highway when the ramp at Hirz Bay is out of the water.

There are four recreation trails in the area:

- Bailey Cove Trail
- Green Creek Trail
- Hirz Bay Trail
- Samwel Cave Trail

Transportation System

The southwest corner of the watershed provides transportation and utility corridors for Interstate Highway 5, a major railroad, and a powerline.

The local transportation system within the watershed totals approximately 97 miles (private and National Forest) and is displayed on Map 5 - Transportation System. Current road density is approximately 1.5 miles of road per square mile of land, but is highly variable. Three distinct areas can be described according to road densities and standards:

- Nosoni Creek and the north part of the watershed.

  Roads densities in this area are very high. Roads are generally low standard logging roads built to support timber harvest activities on private land. Most roads are unsurfaced.

- West side of the McCloud Arm.

  Roads in this area are mostly residential and recreation-based. Densities are moderate and most roads are surfaced with better width and alignment than in other parts of the watershed.

- East side of the McCloud Arm.

  This part of the watershed has a primitive, unroaded character and poor access with only occasional low standard ridgetop jeep and foot trails due to the steep, rugged, and isolated terrain. Road densities in this area are extremely low.

Chapter 4
Reference Conditions

The purpose of this chapter is to explain how ecological conditions have changed over time as a result of human influence and natural disturbances. A reference is developed for later comparison with the current conditions over the period that the system evolved and with key management objectives.

This chapter begins with a historic overview which summarizes the natural processes and land-use activities in the watershed. The remainder of the chapter follows the six core topics that have been presented previously.

The major headings in this chapter are:

- Historic Overview
- Physical Features
- Biological Features
- Human Uses

Discussions under the headings of physical features, biological features, and human uses are grouped into the following time periods:

- pre-1850
  This is a period before significant Anglo-American influences. The ecosystem was functioning under essentially natural conditions at this time.
- 1850-1945
  This is a period during which human influences began to affect natural processes in the watershed.
- 1945-present
  This is a period of major human influence on the watershed. It begins in 1945 with the completion of Shasta Dam

Historic Overview

This historic overview lists key dates and events related to the land-use activities and natural process in the watershed. A narrative history is also included in Appendix E.

Land-Use Activities

Fire Suppression

Fire suppression in the McCloud Arm Watershed began with establishment of the National Forest in 1905 and progressed through three eras:

- 1905-20 - horse/mule fire suppression
- 1920-45 - mechanized fire trucks
- 1945-present - aircraft, retardant planes, and helicopters

Each era represents increased effectiveness in suppressing fires.

Timber Harvest

- Mid 1970s - logging occurs on private land in the Salt Creek Mountain area.
- Early 1980s - logging occurs on private land in Nosoni Creek drainage.
- No significant logging has occurred on National Forest land in the watershed.

Road Construction

- 1871 - California-Oregon Trail, a toll road, is routed up the west side of the McCloud River and up Bailey Creek where it crosses into the Sacramento River drainage.
- 1916 - California-Oregon Trail is modernized by the State of California as the Pacific Highway (later called Highway 99).
- 1930's - CCCs construct Fender Ferry Road.
- 1945 - Interstate 5 and Southern Pacific Railroad line are relocated as Shasta Lake fills.
- 1957 - Gilman Road is completed.
- Mid 1970s - road construction on Salt Creek Mountain for access to private logging.
- Early 1980s - road construction in Nosoni Creek drainage for access to private logging.

Reservoirs/Diversion

- 1945 - construction of Shasta Dam is completed
  - Shasta Lake inundates a large portion (12%) of the watershed and 12 miles of the McCloud River.
  - passage of anadromous fish is blocked
  - wildlife migration is affected
- 1965 - construction of dam at Lake McCloud is completed
  - water in the Lower McCloud River is diverted to Iron Canyon Reservoir.
  - base flows and peak flows on the McCloud Arm are affected.
  - suspended sediments from Mud Creek reduced.

Grazing

- late-1800s - several ranches were located along terraces of the McCloud River.
- controlled grazing begins in 1905 with establishment of the National Forest.
- 1917-1919 - records indicate significant grazing occurring along the McCloud River and in Campbell, Dekkas, Mathles, and Nosoni Creek drainages.
- 1937 - land use map of the McCloud River area shows grazing as the most widespread activity in the watershed.
- grazing in the watershed ends shortly after the filling of Shasta Lake in 1945.

Mining

- 1853 - first gold mine in the area is started near Town Creek. Early gold prospecting was largely unsuccessful and probably had little impact on the watershed.

- 1862 - gold found in surface rock near Copper City (near Zinc Creek) starts a rush for gold and silver.
- 1907-19 - fumes from an experimental smelter at Herault (now under Shasta Lake) may have impacted vegetation in the Azelle Creek area.
- 1907-26 - Shasta Iron Mine in operation but cumulative impacts are unknown.
- 1907-28 - smelter fumes from Bully Hill mining operation killed vegetation in the area of Town Creek (just east of the analysis area) and may also have had some impacts to the watershed.
- 1942-44 - Shasta Iron Mine in operation again. Operations appear to have been more intensive during this period.
- 1945 - no significant mining has occurred in the watershed since the filling of Shasta Lake.

Recreation

- 1871 - first road access into watershed by construction of the California-Oregon Trail.
- 1896 - Central Pacific Railroad is granted odd-numbered sections within the watershed under the Pacific Railroad Acts of 1862 and 1864. Much of this land was later sold for small ranches and homesites.
- 1945 - Shasta Lake formed and quickly becomes an important recreational attraction.
- 1948 - Public Law 449 transfers administrative responsibility for managing the shoreline of Shasta Lake from the Park Service to the Shasta National Forest.
- 1955 - campgrounds are established at Bailey Cove, Green Creeks, Curl Creek, Jennings Creek, and McCloud Bridge. Commercial boat docks are established at Bailey Cove and Hirz Bay. Other commercial enterprises follow shortly at Lakeview Resort and Marina and at Shasta Caverns.
- 1957 - Gilman Road provides access to the upper end of the McCloud Arm.
- 1965 - the National Recreation Area is created by Congress with its primary goal of public outdoor recreation.
- 1965 - campgrounds are established at Hirz Bay, Dekkas Rock, Ellery Creek, Hirz Bay, Moore Creek, and Pine Point.

Natural Processes

Wildfires

Reports of wildfires in the watershed are found in old records and newspaper accounts. Known major fires include:

- 1872 - 150,000 acre fire from North Fk of the Pit River to Chatterdown Ck.
- 1898 - another large fire similar to the 1872 burn.
- 1921 - 150 acre fire north of Minnesota Mountain
- 1924 - 1000 acre fir west of Minnesota Mountain
- 1924 - 4600 acre fire Minnesota Mountain north to Nosoni Mountain
- 1929 - 500 acre fire west of Bully Hill
- 1930 - 250 acre and 400 acre fires on Salt Creek Mountain
- 1931 - 480 acre fire on Town Mountain
- 1932 - 50 acre fire west of Bully Hill

- 1935 - 2100 acre fire west of Horse Mountain
- 1939 - 4600 acre fire on Horse Mountain
- 1942 - 200 acre fire in Greens Creek
- 1954 - 200 acre fire in Dekkas Creek

Eruptions/Mudflows

Mount Shasta has erupted 13 times in the last 10,000 years. Repeated eruptions and mudflows affect water quality and channel morphology. The last major mudflow occurred on Mud Creek in 1924. Sediment from this mudflow entered the McCloud River and was observed entering San Francisco Bay.

Peak Flows

Peak flows greater than 20,000 cfs occur on the Lower McCloud River at approximately 10 year intervals. Flood events have been recorded in 1955, 1964, 1971, 1974, and 1997.

Erosion Processes

Mass wasting processes continue to erode the Klamath Mountains. Mass wasting features predominate the McCloud Arm Watershed

Climate

Climate in the area is characterized by alternating colder/wetter periods and warmer/dryer periods. Climate fluctuations affect watershed erosion processes, peak flows, and fire regimes.

Klamath Mountain Uplift

The Klamath Mountains continue to be uplifted. This uplift process is continually being offset by the erosion process.

Physical Features

Hydrology

Pre-1850

Very little is known concerning reference conditions for hydrologic processes prior to 1850. The McCloud River was a large, cold river with base flows exceeding 1000 cfs, even during the summer months. The river was periodically impacted by mud flows emanating from Mud Creek on Mount Shasta. Hydrologic processes occurring in tributaries to the McCloud River were probably similar to those occurring in the watershed today, particularly in the limestone dominated, unroaded areas on the eastern side of the McCloud River. Due to the prominence of unstable features in the watershed, tributaries to the river must have been periodically impacted by mass wasting activity. Mass wasting activity appears to have been greatest during wetter climatic periods during the middle to late Pleistocene Epoch.

1850-1945

Land-use activities are not believed to have impacted hydrologic features in the watershed prior to 1850. The first major changes to the watershed were associated with the development of the California-Oregon Trail, grazing allotments and mining activities. The impacts of these activities on hydrologic conditions are not known. Large wildfires occurring in the watershed during the 1920s and 1930s may have resulted in increased base and peak flows due to loss of vegetation.

1945-present

Hydrologic conditions within the McCloud Arm Watershed were drastically altered with the completion of Shasta Lake in 1945. Approximately 12 miles of the McCloud River were inundated and much of the lower canyon and the lower reaches of the McCloud's tributaries were submerged beneath the reservoir. The area of the McCloud River Canyon inundated by Shasta Lake totaled approximately 4500 acres (~7 sq. miles) at high water. The replacement of the McCloud River with a freshwater lake had far reaching impacts on physical, biological and human processes and conditions in the watershed.

Hydrologic conditions in the McCloud River above the reservoir arm were altered again with the completion of Lake McCloud and the McCloud Dam in 1965. Inflows to the Shasta Lake from the McCloud River decreased significantly (Table 4-1). The project also affected water temperatures in upper reservoir arm (see section on water quality).

Table 4-1: Average monthly baseflows in the McCloud River above Shasta Lake before and after completion of McCloud Dam (USGS Water-Data Report CA-94-4).

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1946-1965	1121	1252	2080	2077	2617	2177	2467	1965	1460	1159	1059	1020
1967-1994	308	601	800	1270	1358	1549	910	629	401	310	275	283

Stream Channel Morphologies

Pre-1850

Prior to the mid-1800s, stream channel morphologies were controlled solely by natural fluvial and erosion processes including peak flows and mass wasting activity. No significant land-use impacts are believed to have occurred during this period, with the possible exception of increased channel and hillslope instability due to fires set by Native Americans.

1850-1945

Due to the remoteness of much of the watershed and lack of management activities, very little channel morphology information is available for reference or current conditions; however, Wales (1938) did provide a general description of major tributaries to the McCloud River in the McCloud Arm Watershed. Given the scarcity of current information, it is appropriate to summarize Wales' observations (Table 4-2).

Table 4-2: J.H. Wales' observations of major tributaries to the McCloud River in the McCloud Arm Watershed in 1938 (Wales, 1938).

Tributary	Observations by Wales
Nosoni Creek	Visited in early July. Stream has a more gradual ascent than others in the region. There are many gravelly stretches and a number of fine pools. It is well shaded though not excessively so. In early July stream temperatures measured 65 degrees F. (with air temperatures at 95 degrees F.). The rocks have a fine growth of green filamentous algae in which there is an abundance of aquatic nymphs and larvae.

	Rainbow trout abundant. Several 12-16" rainbow trout were observed.
Campbell Creek	Not as productive as Nosoni, but visited in late October. Flowing ~5 cfs. Water temperature was 53 degrees F. at noon. Channel bed is rough, very rocky and with relatively few large gravel riffles. There are a few good pools and an abundance of shade trees. No fish were sighted in lower reaches.
Greens Creek	Visited in late October. Flowing ~2.5 cfs, or half of Campbell on same day. Lower reaches appeared very unproductive. Channel was rough, heavily shaded, with few pools and very few gravel areas. Water temperature was 52 degrees F.
Caluchi Creek	Channel 3-12 feet wide, 6-12 inches deep. Light canopy cover presumably due to grazing. More good gravel and sandy stretches than in Greens Creek, though at the same time there are some low falls and many riffles. King salmon were observed in creek.
Other Creeks	Wales notes that there are many other small tributaries to the McCloud River between Caluchi Creek and the Pit River but they are very nearly dry in the summer and it was hardly worth considering them. It is surprising that he did not describe other large tributaries in the McCloud Arm such as Dekkas, Hirz, and Ycotti Creeks.

The earliest potential for land-use impacts to stream channel morphologies would have been during early gold prospecting efforts during the mid-1800s. Due to the unsuccessful nature of these attempts, it is likely that early attempts at gold prospecting did not adversely impact stream channels. More intensive, localized impacts to stream channels occurred in response to mining activities occurring between 1880 and 1950. The most significant impacts to the McCloud Arm Watershed appear to have been associated with the operation of the Shasta Iron Mine located to the northeast of the confluence of the Pit and McCloud Arms and with several iron mines on the north side of Hirz Mountain. Large areas within the former site remain unvegetated today. It is possible that this mine may have been in operation prior to 1900; however, the exact operating dates are not known. Mining records show the mine in operation from 1907-26 and 1942-44. The most intensive operations appear to have occurred from 1942-44. The cumulative impacts from mining activities to soil and water resources are not known due to lack of research.

Copper mining in the Squaw Creek drainage is not believed to have impacted vegetation or channel stability in the McCloud Arm Watershed or Azelle Creek sub-watershed (see Kristofors, 1973: Map 8: Fume Damaged Lands in 1939, pg. 96). The southern most portion of the McCloud Arm Watershed, and the Azelle Creek sub-watershed are located within the Shasta County Copper Belt. The Bully Hill, Rising Star, Baxter and Winthrop mines were all located east of the Azelle Creek sub-watershed (Kristofors, 1973). Smelter fumes from the Bully Hill operation killed vegetation and denuded hillslopes to the west of the smelter in the vicinity of Town Creek (Kristofors, 1973). Fumes from an experimental smelter located at Herault, now inundated beneath Shasta Lake, may have impacted vegetation in the Azelle Creek area.

Numerous wildfires occurred throughout the McCloud Arm Watershed during the 1920s and 1930s. Large portions of the Greens, Mathles, Dekkas, Marble, Dooles, Nosoni and Campell Creek drainages appear to have been burned over during this period. No data is available concerning the intensity of these fires; however, it is likely that these fires affected erosion processes within the watershed. Increased hillslope erosion and mass wasting activity would have affected channel morphologies with the most severe problems occurring in the upland channel network.

Stream channels were probably impacted by grazing activity throughout the McCloud Arm. Historical records indicate that cattle grazing occurred along the McCloud River and in the Campbell, Dekkas, Mathles, and Nosoni Creek drainages. The total numbers of cattle and horses (300-500), sheep and goats (500-2000) and hogs (100) that were allowed to graze in the watershed from May 1st to November 30th were probably large enough to impact riparian areas. In his 1938 report on the McCloud River, Wales notes that Caluchi Creek, on the west side of the arm, was "unusually free of sheltering trees, due probably to the fact that it is grazed over more heavily". With the exception of Wales' observations, no information concerning grazing impacts was available for the McCloud Arm Watershed.

Stream channels located in the path of the future Interstate Highway 5 (I-5) transportation corridor in the southwest corner of the watershed were impacted by construction activities associated with the development of this travel route. Impacts to stream channels were mostly associated with the construction of roads, including I-5, powerlines and railroad grades.

1945-present

The completion of Shasta Dam and Shasta Lake resulted in the loss of 12 miles of the McCloud River and the lower reaches of its larger tributaries. The creation of Shasta Lake resulted in changes in the sediment transport capabilities of channels immediately entering the lake. Aggradation of sediment and channel bedload began to occur where channels entered Shasta Lake. The reservoir sedimentation process is believed to be slow due to the interception of sediment from upland reservoirs and soil and geologic conditions in the watersheds tributary to Shasta Lake (NRA Management Guide, 1997).

Stream channels in the Nosoni Creek sub-watershed, along the I-5 corridor and along the lake perimeter were impacted by road building and timber harvest. In the case of the 1-5 corridor, major landscape alterations have totally reshaped drainages and channel networks. General impacts associated with roads included channel aggradation above culverts, channel degradation below culverts, and diversion of channel flow. The majority of timber harvest activities occurred in the Nosoni Creek sub-watershed. The scope of this analysis does not allow for a thorough investigation of impacts associated with timber harvest.

Water Quality

Pre-1850

Prior to 1850, water quality in the McCloud Arm Watershed was very good. Streamflow in the McCloud River was more turbid than in the tributaries due to the influence of glacial sediments and volcanic ash from Mud Creek. Periodic mud flows from Mount Shasta degraded water quality in the McCloud River. Concentrations of suspended sediments were high during the flows which occurred during the summer months.

Water quality conditions in the tributaries to the McCloud River were probably excellent. Water quality was periodically impacted during peak flows when suspended sediments and bedload movement increased and erosion processes were active; however, all impacts were within the range of natural variability. Evidence for peak flow impacts was provided by Wales in his 1938 paper on the McCloud River. He notes that "in 1881 a very bad storm destroyed the salmon hatchery four miles below Baird and many of the brood fish at the Greens Creek ponds were killed at that time. He also notes that several large rainfalls that occurred during the construction of the Greens Creek ponds for the fish hatchery resulted in significant sedimentation and fish kill in Greens Creek" (Wales, 1938).

1850-1945

Of all the impacts that occurred to water resources in the watershed in the early 1900s, land-use impacts to water quality are probably the least understood. The largest impact to water quality from a natural process was probably the increased levels of turbidity and sediment in the McCloud River as a result of several mudflows from mud creek. The largest flow occurred in 1924 and several more smaller flows occurred over the following decade. Wales noted that high winter flows occurring in the winter of 1936-37 removed much of the sediment from Mud Creek that had settled on the river bottom but that in 1938 approximately 1/3 of the river bed from Mud Creek to the Pit River confluence was still covered with mud (Wales, 1938).

The establishment of small communities, such as Baird and Herault probably affected water quality in the Pit and McCloud Rivers. Impacts from timber harvest, road construction, mining and grazing also probably resulted in increased turbidity and sediment delivery to streams in the watershed.

1945-present

Water quality impacts from 1945 to the present are believed to have decreased due to decreased land-use activities following the creation of Shasta Lake and the increased effectiveness of fire suppression. The creation of the lake effectively ended impacts associated with urbanization (Baird and Herault) and transportation corridors in the McCloud River Canyon. Grazing and mining activities also ceased shortly after the creation of the lake. The creation of Lake McCloud in 1965 and water diversions to Iron Canyon Reservoir decreased base flows and raised water temperatures in the McCloud River below Lake McCloud. The constant supply of suspended sediments from Mud Creek were also cut of at this time and the turbidity of the McCloud River was reduced.

Geology, Geomorphology, and Erosion Processes

Pre-1850

The landscape of the watershed area has been formed by natural processes occurring over time scales of hundreds of thousands or millions of years. The most recent period of mountain uplift began in the early to mid-Pleistocene, approximately 1.7-1.5 million years B.P., and continues to the present day.

The present topography of the McCloud Arm Watershed has been created almost exclusively by a combination of tectonic uplift, mass wasting and fluvial and surface erosion processes. The influence of these processes has been continuous from the beginning of the Klamath Mountain uplift. The extensive role that mass wasting has played in forming the present day watershed is evident from the Slope Stability Hazard Map (Map 9). Mass wasting features occur over the entire watershed area. Common mass wasting features that are widespread throughout the watershed include debris slides, torrents and flows with lesser amounts of rotational/translational landslides.

The areal extent or distribution (if not the magnitude and intensity) of mass wasting features across the watershed is believed not to have changed appreciably as a result of land-use activities following Anglo-American settlement. Therefore, this map is believed to reflect the approximate distribution of mass wasting features found in the watershed prior to this time as well as current conditions.

During the past 150 years land-use activities occurring within the watershed have influenced the rates, frequency, magnitudes and areas of occurrence of natural processes. The interactions between natural processes and land-use activities are complex. Some land-use activities, such as mining, fire suppression, and creation of the reservoir have affected natural processes throughout the entire watershed while others have had little to no effect.

1850-1945

Between 1850 and 1945 land-use activities introduced by European settlers began to influence natural erosion processes in watershed. One of the earliest activities was mining   Several gold rushed into the area are reported in the historical record where: “the hills were covered by locations for many miles” (Aubury, 1902, p. 33). At first, interest was entirely in placer mining; but, during the later part of the century oxidized ores overlying the sulfide deposits were mined.

These activities, both on hillsides and within the streams, had a detrimental effect upon erosion and in-stream sedimentation. Hillside denudation would have increased the frequency and magnitude of natural events. The extent, however, cannot be determined at this time.

The period 1900 to 1910 were the boom years for mining within and in the vicinity of the watershed. Copper ore was mined in quantity and smelted locally. But from 1911 to 1920, copper mining became largely dormant owing to smelter smoke litigation. This smoke had been so detrimental that much experimenting was done to devise ways to treat smelter fumes so as to make them less harmful. Some mining resumed after 1921 when zinc-rich sulfide ore was mined and treated mainly at the Bully Hill smelter. This continued until 1927.

Again these fumes would have had a devastating effect on local vegetation causing widespread denudation and resulting in increased erosion and sedimentation. During this time period, substantial areas of the watershed are documented to have burned. Thus it can be speculated that the frequency and magnitude of natural events would have increased substantially.

From 1928 to 1940 virtually no mines were operating in the vicinity owing to the low price of metals. Some recovery of natural conditions could be expected to have occurred during this period.

1945-present

Since 1945, fire (both natural and prescribed) has been the primary influence to natural erosion and mass wasting rates. The specific effects of these has been described in other portions of this analysis, but generally it can be assumed that the impacts and erosional effects were less than those experienced during the early part of the century as a consequence of mining. Some recovery of natural conditions could therefore be expected. An analysis of 1944 aerial photography shows the area to have about the same level of mass wasting activity as seen on photography forty years later. So apparently some stabilization has occurred.

Biological Features

Vegetation

Pre-1850

The description of the McCloud Arm Watershed from a fire perspective may be better understood by examining the evolution of forest stand structure changes over time. To obtain a clear picture of pre-settlement conditions is difficult to come by as little attention was focused on natural disturbance patterns and their effect on fire ecology. While some anecdotal information does describe historical human influence, little is recorded to describe the pre-settlement picture. It is understood that the earliest known habitation in this watershed was that of the Wintu tribe. While there is much controversy as to the landscape level effects of Native American burning, it is well recorded that vegetation burning was practiced by them quite frequently. Whether the forest of the early 1800's was more natural than today appears to be more philosophical than science. It is apparent, however, that pre-settlement fire regimes within the Southern Cascades were much different than evidenced today. These early fire regimes were characterized by frequent low intensity fire disturbance, primarily lightning caused, as opposed to the infrequent moderate to high intensity regimes we have today. The intensity of these fires was generally low due to fire frequency that kept residual fuel loading down, eliminated vertical fuel ladders and were primarily surface fires. Typical return fire intervals for this fire regime before human disturbance was likely at 8-30 years depending on geographical features.

1850-present

Human influences have affected the natural disturbance patterns thus altering the fire regime. The earliest Anglo-Americans in the general area were trappers followed by homesteaders, stockman, miners and loggers. The influence of grazing, mining and successful fire suppression had the greatest effect on development of changing forest fuel profiles. Of the three grazing allotments along the McCloud River, the Salt Mountain allotment was the largest and was used primarily by the Stillwater Land Company. Upwards of 1500 sheep and 400 head of cattle were allowed in this allotment which no doubt contributed to vegetation changes. Of eight larger fires between the late 1920's and the early 1930's (all within heavy grazing years) all were human caused possibly by allotment permittees trying to enhance the grazing forage. Other influences may have been copper mining that took place at the confluence of the McCloud and Pit Rivers. These copper smelters are reported to have denuded much of the surrounding area while in operation perhaps contributing to the large brush components we currently see. The 1930's brought in the motorized suppression era followed in the late 1940's by the aircraft era. Both advancing suppression technologies initially kept fires smaller and fewer thus contributing to dense understory and heavier surface fuels.

Summary of Fire History - 75 years from 1922-1996

Total acres burned = 14,820 acres
Total number of large fires (>50 acres) = 13 recorded
Percent of acres burned by land designation:

Matrix	71%
Managed Late-Successional Reserve	12%
Administratively Withdrawn	17%

While it is evident that total burned acres have diminished in the previous decades, mostly due to suppression technology, it is also apparent that fuel profiles are in transition towards conditions characteristic of high intensity fire events. This transition of fuel models over time is estimated as follows:

	1870 1900 1920 1944 1975 1995
Stratum*	4N/G------>2P--------------------->3P/2G------------------>4G
Fuel model	9/10------->6----------------------->10/6-------------------->10/5
Stratum*	3P/S------->BR--->HW
Fuel model	9/8--------->6-->6/9
Fire frequency	frequent--->infrequent-->
Fire intensity	low-------->mod./high------------>high--------------------->

*BR=brush, HW=hardwoods, other stratum codes are explained on page 3-12.

Fuel Model key:

Fuel Model	Description	Expected fire behavior	Suppression tactic
Model 10	conifer, heavy fuel	6 ft. flame ht.	indirect, dozers
Model 9	conifer, moderate fuel	4 ft. flame ht.	direct hand line
Model 8	conifer, light fuel	2 ft. flame ht.	direct hand line
Model 6	hardwoods, brush	9 ft. flame ht.	serious spotting

Old Growth/Late-Seral Habitat

Pre-1850

Old growth and late seral habitat were probably always in short supply in the watershed. Reasons for this include:

- Climate - The watershed has very long hot, dry summers and cool, rainy winters.
- Fire - The natural fire regime for the watershed is one of frequent (8-20 years), low to moderate intensity fires; however, large stand replacing fires would occur when severe drought conditions combined with high fuel loads.
- Soils - Shallow, rocky soils on steep slopes are more conducive to supporting chaparral and hardwood vegetation.
- Elevation - The watershed is in a transition zone between foothill vegetation types and montane types.

Old growth and late seral habitat would have generally been found near or in drainages and on moist, north facing slopes. Mixed conifer types would have included ponderosa pine, sugar pine, Douglas-fir, gray pine, knobcone pine and incense-cedar. Douglas-fir would have been more abundant on north slopes and in drainages at higher elevations. There would have been a hardwood component of black oak and canyon live oak.

Historical maps show this part of the McCloud River as having a narrow, flat valley floor. Many of the tributary creeks also had flat terraces where they emptied into the McCloud River. These areas would have supported riparian vegetation such as alders, willows, cottonwoods, dogwoods, and possibly meadow-like areas.

It has been documented that the Wintu tribe had many village sites in the area (Appendix E). They used many local plants for food, tools, medicine, shelter, clothing, firewood and basket materials. They may have practiced underburning to maintain certain plants or to maintain open areas. Native American use in the area may have been an important factor in vegetation patterns during this time.

1850-1945

This was a period of change in the watershed. The native Wintu were replaced by Anglo-American settlers. By 1850, miners and ranchers were moving into the area and there was probably a demand for timber for mines, bridges, buildings, fences and fuel. It is assumed that timber harvest impacted old growth and late seral conifer stands during this period.

The establishment of ranches, such as the Ellery Ranch (near Ellery Creek), probably cleared vegetation on the river terraces for grazing and orchards.

In 1872 and 1898, major stand replacing fires burned through much of the watershed. The surviving old growth and late seral conifer stands were found mostly in areas protected from these fires. These areas generally included narrow strips in riparian areas and along some ridgetops.

Copper smelters in the watershed around 1920 were releasing sulfurous smoke that killed vegetation over a large area around Shasta Lake. Although smelters were not located in the watershed, drifting emissions from nearby smelters may have affected old growth and late seral vegetation in the McCloud Arm Watershed also. Most mining had ceased by the 1930's

1945-present

The completion of Shasta Dam in 1945 resulted in the inundation of approximately 4500 acres of the watershed by Shasta Lake. This event eliminated a substantial portion of whatever old growth and late seral habitat was remaining in the watershed.

Logging occurred on private land in the Nosoni Creek drainage and around Minnesota Mountain during this period and significantly altered old growth and late seral habitat in these areas. No timber harvest has occurred on National Forest land in this watershed.

Early-Mid Seral and Oak Woodland Habitats

Pre-1850

Due to the climatic conditions, fire history, soils, and elevation described previously, early-mid seral and oak woodland habitats were probably always abundant in the watershed, particularly on upper slopes, ridges and mountain tops. Chaparral and shrubby oak stands would have been more variable as far as age classes and density than they are today. Open, grassy areas would have been more common. The natural fire regime of frequent, low intensity fires would have maintained a more open understory in oak woodlands with very little encroachment by conifers. These open understory conditions would also reduce fire damage to mature trees in oak woodland habitat.

Ponderosa pine, sugar pine, gray pine and knobcone pine would have provided scattered overstory cover in this habitat.

1850-1945

As with the old growth/late seral habitat, Anglo-American settlement brought many changes to the watershed that also influenced other habitat types. Chaparral and hardwood stands were burned repeatedly to clear areas for grazing. During the period 1929-1935, out of 12 fires recorded in the watershed none were natural. Most of these fires were thought to be grazing related. (Cranfield, 1984). Land was also cleared for orchards and row crops. Oaks and conifers were cut for firewood and construction materials.

Major wildfires in 1872 and 1898 burned through much of the watershed and were probably a major influence on the vegetation patterns found in the watershed today. The following quote is taken from a grazing management plan written either by or for John Gilman, District Ranger for the Redding District from 1938 to 1944 (Gilman, 1940s):

> "Repeated conflagrations over a period of many years destroyed almost every vestige of timber on many ridges and slopes. Dense brush growths succeeded these burns, many of which were burned again and again leaving the inaccessible brush fields of today".

As described previously, emissions from smelter operations in the Shasta Lake area probably affected vegetation in the McCloud Arm Watershed during this period. Although early photographs show a severe and often total loss of vegetation in adjacent watersheds, it is unclear what the actual impacts of smelter emissions were in the McCloud Arm Watershed since smelters were not actually located there. However, drifting smelter emissions most likely moved vegetation towards earlier successional stages and, as a result, would have tended to increase the amount of early-mid seral and oak woodland habitats. The impacts of smelters ceased in the 1930s.

1945-present

Brushfields and chaparral vegetation described in the previous period remain today and show little evidence of moving toward later successional stages. In some areas, chaparral may be the potential vegetation type, such as on sites with low productivity on southfacing slopes. An example of such areas is the southeast slope of Horse Mountain.

Inundation of approximately 4500 acres of the watershed by Shasta Lake in 1945 eliminated a substantial portion of the early-mid seral and oak woodland habitat. Additional habitat was lost with the relocation of Interstate 5 and the railroad prior to filling the lake.

With the creation of Shasta Lake, the area began to develop as a regional recreation attraction. Numerous recreation facilities were developed and recreation became the major land use for the watershed. Essentially all of the recreation facilities were developed in early-mid seral and oak woodland habitat. Concentrated recreation use in these areas had greatly diminished their value as habitat.

Management of the watershed as a high-use recreation area has had other affects on early-mid seral and oak woodland habitat. Concern for public safety has resulted in a sustained removal of hazard trees from campgrounds and roads for several decades. This has resulted in a depletion of trees for shade and screening in some campgrounds. Exclusion of fire from high-use recreation areas during this period has seen the development of overstocked conditions in young conifer stands and the encroachment of young conifers into oak stands. Both of these conditions are accompanied by a shift in species composition. As stocking levels in conifer stands increase, the more shade tolerant species (such as Douglas-fir) are favored and intolerant species (such as ponderosa pine) begin to decline. In oak stands, encroaching conifers will eventually overshadow oaks resulting in a change in habitat conditions.

Aquatic and Riparian Habitats

Pre-1850

Very little information has been documented regarding the condition and extent of aquatic and riparian habitats. No information was documented for associated wildlife species. Based on information compiled by Cranfield (1984), stream systems were healthy enough to continue to support large and consistent salmon runs despite periodic mud flows from Mount Shasta into the McCloud River. Other aquatic associated species, then, most likely recovered from the mud flows as tributaries probably served as reserves which would repopulate the river. As with the river, the riparian habitats and tributaries most likely underwent periodic changes, with associated wildlife species fully adapted to these changes. Which associated aquatic and riparian wildlife species had adapted to these changes, then remained within the system after the 1850s has not been speculated upon.

1850-1945

Species that were restricted to aquatic or riparian habitats (amphibians, willow flycatcher) may have been reduced in number or become less widespread due to habitat that was changed by cattle grazing and settlements along the river.

The results of Anglo-American settlement altered aquatic and riparian habitats for the short term through the introduction of cattle grazing in the 1800s. Cattle grazing occurred unregulated throughout the watershed. Though nothing was built for cattle within the watershed, the east and southern portion of the watershed was 'deteriorating' as a result of grazing (Cranfield, 1984). The deterioration could have referred to direct impacts on the riparian habitat or to indirect impacts, such as laying bare upland herbaceous habitat. Riparian habitat that was grazed reduced suitable nesting habitat for many neotropical migratory bird species. Likewise, aquatic amphibians dependent upon emergent vegetation for reproduction and cover were impacted by grazing. In addition, cattle most likely competed with other grazers and browsers which were already being impacted by reduced forage habitat in the uplands. The north and western portion of the watershed received less use as many natural deterrents made grazing difficult to impossible. By 1907 the Forest Service began reducing the number of cattle grazing on the National Forest lands. With the reduction in cattle, introduction of grazing regulations and periodic resting of the habitat it is expected that aquatic and riparian species populations declined less quickly or stabilized. Then, with the construction of Shasta Dam in the 40's, grazing was ended and riparian habitats continued to recover.

Settlement in the watershed in the 1850s impacted riparian habitat for the long term. This conversion of riparian habitat to buildings and landscape occurred mainly along the McCloud River.

1945-present

Major impacts to aquatic and riparian habitats in the McCloud Arm Watershed occurred during this period with the completion of Shasta Dam in 1945 and McCloud Dam in 1965.

The construction of Shasta Dam in 1945 and the subsequent inundation of much of the watershed by Shasta Lake eliminated 12 miles of riparian habitat along the McCloud River. Additionally, all riparian habitat in tributary streams below 1065 feet elevation (the lake level at full capacity) was inundated and lost. The shoreline around Shasta Lake is not capable of supporting riparian vegetation due to the extent of draw down levels in the lake. Riparian vegetation occurs in some inlets to the lake where tributary streams provide suitable conditions.

Construction of the McCloud Dam in the 1960's may not have significantly changed riparian habitat, and therefore associated species, despite the lower water levels. Riparian and aquatic wildlife species may have benefited from fire suppression as channels were stabilized and riparian vegetation protected.

This period saw the development of roads and recreation facilities in the watershed. Roads impacted associated wildlife species where changes in the stream habitat occurred through the dissection of the stream, the direct or indirect input of debris into the stream and the increased flows and stream scouring. Where culverts were impassable, movement patterns of aquatic associated wildlife species were disrupted and made more difficult. Debris input into streams, such as siltation, certainly would have negatively impacted stream dwelling wildlife which require oxygenated, rocky streams (e.g. Pacific salamander, tailed frog). The filling in of pools would also affect a number of aquatic wildlife which use pools as escape cover or for foraging. The changes in the stream channel through scouring could have been beneficial in that sediments were removed and pools formed. Overall, road impacts have been restricted to the Nosoni Creek drainage and a few other sub-drainages.

Fire suppression increased riparian vegetation along streams. With less fire burning through riparian habitat the vegetation was able to expand and stabilize. This change was beneficial to many riparian associated species as it expanded their distribution. Within streams, those aquatic associated species which favored cool water also benefited from the denser, more expansive riparian habitat. Others, which require some open areas along streams for sunning, were negatively impacted. Where these changes have occurred, though, has not been documented.

Habitat Elements (snags, dead/down, outcrops, caves, mines, buildings)

Pre-1850

Natural habitat elements within the watershed include snags, dead/down wood, caves and limestone outcrops. Though no historical documentation occurs for the densities of snags and dead/down, the densities most likely were always low in the watershed due to the abundance of early-mid seral stages and the lack of denser conifer stands with large trees. Within areas where denser spacing occurred, like the stream channels, the snag and dead/down wood densities most likely were similar to current densities in similar habitats.

Caves and rock outcrops are common in the watershed. The current condition versus historical condition has mainly focused on the vegetational characteristics associated with the cave or rock outcrops. Vegetational characteristics are considered important because a cave opening covered by vegetation would have reduced air temperature within the cave as well as reduced airflow. Vegetation on rock outcrops would also reduce the air temperature in the fissures as well as provide a more protected environment for wildlife.

1850-1945

Due to natural conditions in the watershed that favored early succesional conditions, snag and dead/down levels were probably never very high.

The beginning of fire suppression would have increased the density of snags and dead/down material in those areas where suppression was effective. The history of repeated wildfire on the inaccessible east side of the watershed would have kept snag and dead/down material levels low in that area.

Caves and limestone outcroppings have not changed in their overall composition. The vegetation around these structures may have changed as a result of land use activities, namely fire suppression. Vegetation growth would have increased around cave and possibly changed the caves internal environment. Well known caves in the area have undoubtedly been impacted by recreational users. Exploration of lesser known caves is not expected to have altered the caves from an environmental standpoint as the cave locations and use has been closely monitored by the Forest Service in conjunction with local spelunking groups.

Although there was extensive mining in the area during this period, most activity occurred as placer and surface mining and there are no known adits in the watershed.

Buildings have been constructed since the first settlement was established in the 1800's (Cranfield, 1984). These buildings were concentrated along the river and transportation corridors.

1945-present

The loss of the later seral stages by the inundation by Shasta Lake eliminated a significant source of large diameter snags and down logs.

Fire suppression during this period tended to favor increased levels of snags and dead/down material. Fire history in the watershed indicates fewer wildfires on the east side of the McCloud Arm, possibly as a result of the addition of aircraft and helicopters as fire fighting tools. However, as stated previously, this area has a low capacity for providing snags.

Since the 1940s caves continued to be explored and buildings inhabited. Therefore, there has probably been very few changes in impacts to these areas and associated wildlife.

Human Uses

Heritage Resources

pre-1850

Excavated prehistoric archaeological sites in the McCloud Arm are almost entirely related to the Wintu habitation of the past 500 years, although there are hints of much earlier occupations in the wooden atlatl and dart fragments and projectile point styles from Potter Creek Cave and numerous surface collections made from sites within the pool area.

Ethnographic information is available for 49 Wintu village sites, all of which are now inundated or partly inundated by Shasta Lake. Many of these have been recorded as archaeological sites, either prior to the completion of the dam or during extensive drawdown periods.

1850-1945

The earliest Anglo-American activity appears to have been the establishment of a pack trail along the McCloud River by Ross McCloud in the 1850’s. White settlement soon followed near Campbell Creek and Curl Creek. Several ranches, including the Ellery Ranch, were located on terraces of the McCloud River. The location of most of this early settlement in now under water.

Prospecting for gold began during the middle 1800's, but the McCloud River was not a productive gold field. Iron and copper mining were prevalent during this period. Mining is described in detail later in this chapter.

The California-Oregon Trail, a toll road, was routed in 1871 up the west side of the McCloud River. This route was modernized in 1916 by the State of California as the Pacific Highway, later called Highway 99. Other early road access to the McCloud River was by way of Salt Creek to Hirz Creek (near the current Gilman road) and Middle Salt Creek to Kabyai Creek (in the vicinity of the western portion of the Fenders Ferry Road) which extended down the McCloud to Ellery's. Numerous trails provided access to the rest of the McCloud River area.

In 1872 two U.S. Fish hatcheries were established. The hatchery at Baird, which operated for 65 years, shipped salmon eggs throughout the country and the world, and a hatchery at the mouth of Greens Creek provided trout eggs.

In 1896 the Central Pacific Railroad acquired patented grants to all odd-numbered sections or fragments of sections within the watershed which weren't already deeded, creating the current checkerboard pattern of land ownership.

Fossilized remains of an extinct Pleistocene bear were found in Potter Creek Cave in the McCloud Limestone formation in 1878, leading to extensive paleontological excavations at Potter Creek and Samwell Cave between 1902 and 1905 by the University of California at Berkeley. Fossils of extinct species of mammoth, horse, bison, scrub oxen, giant short-faced bear, dire wolf and ground sloth were recovered. Together these constitute the single most important source of information on the Late Pleistocene fauna of Northern California. Both caves also contain recent archaeological deposits dating within the past several thousand years, and both have been nominated for the National Register of Historic Places.

The 1907 formation of the Shasta National Forest affected about twenty sections of land within the northeastern portion of the watershed, one-half of this in private ownership, as most of the lower McCloud River drainage at that time was outside of the forest boundary.

A 1937 land use map of the McCloud River area shows grazing as the most widespread activity.

1945-present

The construction of Shasta Dam, begun in 1938 and completed in 1945, created a reservoir which inundated about twelve miles of the McCloud River above its confluence with the Pit River, drastically changing the appearance, ecology, and social systems of the McCloud Arm analysis area. Acquisition of private land by the Federal government primarily took place in the late 1930's. The reservoir was designed for flood control, irrigation, and the production of energy, but quickly became an important recreational attraction. The shoreline was originally managed by the National Park Service, but with the 1948 Public Law 449, Congress transferred administrative responsibility to the Shasta National Forest, and the Forest boundaries were moved to include the lake. The National Recreation Area (NRA) was created by Congress in 1965 with its primary goal of public outdoor recreation.

Interstate 5 and the Southern Pacific Railroad line were relocated and still travel through a corridor in the southwestern portion of the McCloud Arm. Much of the McCloud River is accessed by the Gilman road, completed in 1957 and named for District Ranger John Gilman.

Recreation developments followed the formation of Shasta Lake including: resorts, campgrounds, trails, and boat ramps. These facilities are described in the following section.

Recreation Facilities

pre-1850

There was essentially no recreational use of the watershed prior to 1850.

1850-1945

The Shasta National Forest was established in 1907. The Forest Service constructed a series of trails, primarily along ridgelines which were patrolled by horseback with serving as fire lookouts. Trails connected the McCloud River with Minnesota Mountain, Salt Creek Mountain, and Nosoni Mountain. Another trail followed the major ridgeline from Minnesota Mountain north to “Curl Cabin”, near where Horse Ridge joins Curl Ridge.

1945-present

The formation of Shasta Lake in 1945 created an important recreational attraction in the area and began a period of rapid recreational development.

The shoreline was originally managed by the National Park Service, but with the 1948 Public Law 449, Congress transferred administrative responsibility to the Shasta National Forest, and the Forest boundaries were moved to include the lake. The National Recreation Area (NRA) was created by Congress in 1965 with its primary goal of public outdoor recreation.

Interstate 5 and the Southern Pacific Railroad line were relocated during the construction of Shasta Dam but still travel through a corridor in the southwestern portion of the McCloud Arm. Much of the McCloud River is accessed by the Gilman road, completed in 1957.

By 1955, campgrounds had been established at Bailey Cove, Greens Creek, Curl Creek, Jennings Creek, and McCloud Bridge. In 1965, additional campgrounds included Hirz Bay, Dekkas Rock, Ellery Creek, Wyntoon, Hirz Bay, Moore Creek, and Pine Point. Point McCloud was built in 1970. In recent years several of these have been abandoned.

Commercial boat docks were located at Bailey Cove and Hirz Bay in 1955, and other commercial enterprises followed at Lakeview Resort and Marina and at Shasta Caverns. Other privately operated recreational areas include the Shasta Yacht Club, an organizational camp on Dekkas Creek, and a summer home tract at Campbell Creek.

Mining

pre-1850

There is no record of mining activity in the watershed prior to 1850.

1850-1945

Mining in the area first began in 1853, when placer gold was discovered in Town Creek east of Bully Hill. A gold rush ensued as a result of this discovery and many placer claims were located, most of which, were of little value. The placer gold was derived in large part from the lode deposits on Bully Hill, and silver and copper were found with gold in the placers.

In 1862 gold was found in the surface rock on the Excelsior claim near what was to become the mining town of Copper City. As a result of this discovery another rush into the area was begun for the location of the supposed rich veins of gold and silver when supposedly "the hills were covered by locations for many miles".

The history of the area has been one of intermittent activity. Prior to 1900, repeated attempts were made to treat the base-metal ores but little success was attained. The main periods of activity were from 1900 to 1910, and from 1921 to 1921.

There are two mines located within the McCloud Arm Watershed. A third, the Rising Star Mine is located immediately east of the boundary. The Copper City mine area is between Zinc Creek and Baxters Gulch, about 1 mile southwest of Bully Hill. The discovery of native gold and silver in oxidized outcrops of ore in 1862 resulted in the first mining boom in the area and led shortly thereafter to the discovery of the Bully Hill and Afterthought mines to the east.

Exploration of the small but spectacular surface showing was done in the Copper City mine area during the early years. Despite the fairly extensive amount of work, the only known production from the mine areas was 25 tons of ore assaying 8 percent copper, $40 per ton in gold, and $20 per ton in silver shipped in 1863 to Wales, and 119 tons of sulfide ore mined in 1926 and 1927. The mine no longer operates.

An accurate record of iron produced from the Shasta Iron mine is not available. Supposedly ore was mined for the Noble Electric Steel Co. between 1907 and 1926. How much of this period the mine was actually in operation is not known. In 1913 the mine produced 25 tons daily. In 1921 it produced 12 to 15 cars per month averaging 65 percent in iron. In 1925 the mine produced at the rate of 15 to 20 cars per month. From 1942 through 1944 ore was mined for the Navy as ballast at the rate of 100,000 tons per year. The mine no longer operates.

1945-present

No significant mining has occurred in the watershed since 1945.

Chapter 5

Interpretation

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

This chapter is organized by addressing the issues and core topics listed in Chapter 2.

Issues addressed in this chapter are:

- Forest Health
- Fire Management
- Mass Wasting
- Recreation Use Management
- Cave Management

Core topics addressed in this chapter are:

- Erosion Processes
- Hydrology
- Stream Channel
- Water Quality
- Vegetation
- Species and Habitats
- Human Uses

Applicable key questions and core questions are restated at the beginning of each section and are used to guide the analysis.

- Key questions are taken from Chapter 2 - Issues and Key Questions.
- Core questions are taken from the *Federal Guide for Watershed Analysis*.

Forest Health

Key Questions (from Chapter 2):

- What is the future trend for vegetation and wildlife habitat in the watershed?
- What is the desired distribution and condition of various types of wildlife habitat in the watershed?
- What can be done to reach and maintain this desired distribution and condition of wildlife habitat?
- What is the trend for vegetation conditions in campgrounds and other high use recreation areas in the watershed?
- What factors are influencing vegetation conditions in campgrounds and other high use recreation areas?

Present Condition:

Present conditions are arranged according to the three categories of forest health problems listed on page 2-2:

- wildlife habitat
    - there is a lack of suitable existing and replacement nest trees for bald eagles and ospreys.
    - there is a threat of habitat loss due to wildfire.
    - the forage value of chaparral vegetation types is declining as brush becomes decadent.
    - there has been a loss of early seral habitat (grass/forb, grassy openings) through the natural process of succession.
    - dense brush in some areas has created a barrier to wildlife movement.
- recreation
    - vegetation conditions in campgrounds are deteriorating due to:
        - high stocking levels
        - lack of replacement reproduction.
        - gradual loss of shade due to continuous removal of hazard trees.
    - there is a decline in native vegetation for shade and screening.
    - recreation use and construction has impacted vegetation through disturbance and soil compaction.
    - visual quality is threatened by the potential for catastrophic wildfire and high levels of mortality.
- forest stand conditions
    - knobcone pine stands are deteriorating due to aging and insect activity.
    - fire exclusion has allowed fuels in knobcone pine stands to accumulate to undesirable levels.

Causal Mechanism(s):

- fire exclusion
- overstocked conditions
- disturbance and soil compaction in areas of concentrated human use

Trends:

- the occurrence of bald eagle nest trees is expected to remain low, or possibly decline, as stocking conditions in conifer stands increase and growth of large trees is retarded.
- in the absence of fire, the condition of chaparral habitat will continue to decline.
- in the absence of fire, there will be a gradual loss of early seral stages (grass/forb layer, grassy openings) through the natural process of succession.
- high levels of mortality are expected to continue in knobcone pine as stands of this relatively short-lived species increase in age.

Influences and Relationships:

- forest health affects visual quality and the recreation experience.
- soil compaction in campgrounds and areas of high recreation use can influence the health of vegetation.

Conclusions:

- there is a desire to control stocking in conifer stands within one mile of the lake with the objective of accelerating the development of large conifers (esp. ponderosa pine) to provide future bald eagle nest trees.
- there is a need to improve the health of vegetation in campgrounds and high use recreation areas to maintain recreational and visual values.
- there is a need to reintroduce fire into the ecosystem as a disturbance agent to provide a mosaic of fuel, forage, and habitat conditions across the landscape.
- there is a need to reduce fuel loads in knobcone pine stands, especially in areas of high fire risk.
- there is a need to reduce fuel loads in high use recreation areas where fire risk is high.

Fire Management

Key Questions (from Chapter 2):

- Under current management, what are the future trends for fire in the watershed?
- What is the desired role of fire in the watershed?
- How can fire be incorporated as an ecological process?
- What measures need to be taken to ensure adequate fire protection in the watershed.

Present Condition:

Present conditions are arranged according to the three categories of wildfire concerns listed on page 2-3:

- The possibility of wildfire in the watershed is a concern due to heavy recreation use, the presence of homes, and the interstate highway.
- Fire exclusion and increasingly effective fire suppression for the last 100 years have allowed fuels to accumulate and for stand structures to develop fuel ladders.
- Much of the watershed is remote and inaccessible. Access for fire suppression is difficult.

Causal Mechanism(s):

- fire exclusion
- urban interface
- concentrated recreation use, especially on the west side of the McCloud Arm.
- topography and the lake create poor access for fire suppression.

Trends:

- fire events in the watershed will continue to be largely stand replacement in nature.
- stand densities will continue to develop critical vertical fuel ladders.
- high surface fuel loads will continue to contribute to high intensity fires.
- recreation use is expected to increase in the future as regional population increases.
- ignition starts are expected to increase as recreation use at the lake increases.
- urban interface and recreational sites will continue to be at risk to life and property loss.
- fuel loads in knobcone pine stands will continue to increase in response to high levels of mortality.

Influences and Relationships:

- catastrophic wildfire is a threat to habitat.
- catastrophic wildfire is a threat to recreation values.
- catastrophic wildfire will affect physical processes such as erosion, hydrology, stream channel morphology.

Conclusions:

- there is a need to implement prescribed natural fire in concert with aggressive suppression efforts.
- fuel profiles should be managed to mimic fire’s natural role of short interval, low intensity surface fires.
- there is a need to reintroduce fire into the ecosystem as a disturbance agent to provide a mosaic of fuel, forage, and habitat conditions across the landscape.
- there is a need to address fire management issues within urban interface and high-use recreational areas where conventional access is limited.

Mass Wasting

Key Questions (from Chapter 2):

- What are the tradeoffs of several light or moderate controlled burns compared to no treatment?
- What are the tradeoffs between prescribed burning and other means of vegetation manipulation?
- What measures can be taken to reduce the risk of mass wasting following controlled burning?

Present Condition:

- Active mass wasting is occurring in the form of debris slides, debris flows, torrents and colluvial filled hollows.
- Research and literature indicates a potential for mass wasting in this watershed.
- the impacts of wildfire versus prescribed burning on mass wasting in the watershed are not fully understood.

Causal Mechanism(s):

- steep, fractured, highly dissected bedrock slopes.
- shallow soils.
- incised, high-gradient streams.
- past management activities (roads, burning, mining)

Trends:

- natural mass wasting processes are expected to continue in the absence of wildfire and management activities.
- mass wasting conditions could increase due to wildfire and management activities.

Influences and Relationships:

- Management activities that result in surface disturbance (prescribed fire, logging, road building) can accelerate mass wasting.
- Mass Wasting can affect stream channel morphology.
- Mass wasting can accelerate aggradation in Shasta Lake.
- Mass wasting can affect fish habitat.

Conclusions:

- Areas prone to mass wasting need to be identified prior to ground disturbing management activities.
- Proposed management activities in this watershed need to address the potential for mass wasting.
- There is a need to monitor and evaluate specific impacts on erosion and mass wasting between wildfire, prescribed burning and other forms of vegetation manipulation.

Recreation Use Management

Key Questions (from Chapter 2):

- What measures need to be taken to protect other resources and values from recreation use?
- What is the trend for recreation use in the watershed and are existing facilities adequate to meet future demands?

Present Condition:

- Wildlife disturbance occurs in areas of concentrated recreation use.
- Riparian areas around Shasta Lake are impacted by concentrated recreation use.
- There is a potential for water quality problems (toxic spills, waste), especially around marinas.
- There is no coordinated planned monitoring of water quality.

Causal Mechanism(s):

- concentrated recreation use.
- lack of water quality monitoring.

Trends:

- recreation use is expected to increase in the future as regional population increase.
- water quality problems are expected to increase as recreation use at the lake increases.

Influences and Relationships:

- visual quality
- impacts to limestone caves

Conclusions:

- need to monitor water quality (in coordination with WQCB).

Cave Management

Key Questions (from Chapter 2):

- How can caves be managed in this watershed?
- What protection measures need to be taken?
- What management activities are compatible with caves? Which are not?
- What are monitoring needs?

Present Condition:

- Limestone caves in the McCloud Arm Watershed are features of geological and biological uniqueness.
- Vandalism has occurred at Samwell Cave.

Causal Mechanism(s):

- natural processes
- increased recreation use

Trends:

- human disturbance to caves is expected to increase as recreational use of the watershed increases.

Influences and Relationships:

- The risk of disturbance to limestone areas and the caves associated with them is expected to increase with increased human use in the vicinity of Shasta Lake.

Conclusions:

- The effects of prescribed fire on the species that inhabit and/or utilize limestone areas are not known.
- More information is needed to identify the relationships between wildfire and limestone habitats.
- More information is needed to determine how prescribed burning activities occurring in the spring and /or fall could affect limestone habitats and the species associated with them.

Erosion Processes

This section focuses on the topic of surface erosion. Mass wasting has been addressed previously on page 5-5 as a separate discussion and is not repeated here.

Core Questions (from WA Guide):

- 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)?

Present Condition:

- high surface erosion is occurring within areas of steep, fractured bedrock slopes; especially on south and west facing slopes.
- high surface runoff occurs in areas where the road network is dense.
- high surface erosion is occurring on oversteepened, bare slopes at Shasta Iron Mine.
- wave action from wind and boats is a significant source of surface erosion around the shore of the lake.
- rainfall on bare soil in the drawdown area around the perimeter of the lake is a significant source of surface erosion.

Causal Mechanism(s):

- bedrock types
- steep slopes
- past management activities (roads, burning, mining)

Trends:

- high surface runoff conditions are expected to continue in areas of dense road networks.
- high surface erosion at Shasta Iron Mine will be gradually reduced as vegetation encroaches on the site.
- surface erosion around the lake shore and within the drawdown area will continue.

Influences and Relationships:

- Management activities that result in surface disturbance (prescribed fire, logging, road building) can accelerate surface erosion.

Conclusions

- there should be an emphasis on surfacing roads, especially high use roads, that are contributing to high surface runoff.
- monitoring should be established for:
  - surface water sedimentation.
  - sedimentation in creeks.

Hydrology

Core Questions (from WA Guide):

- 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)?

Present Condition:

- low base flows in the McCloud River influence water quality in the McCloud Arm, especially when the lake level is low.
- twelve miles of the McCloud River has been inundated by Shasta Lake.
- roads increase water delivery and, therefore, have the effect of increasing peak flows.
- there is a possibility that local geology (limestone formations) may have an effect on hydrology; but this is unknown at this time.

Causal Mechanism(s):

- formation of Shasta Lake
- construction of McCloud Dam.
- road system.
- local geology.

Trends:

- peak and base flows are expected to remain static.

Influences and Relationships:

- wildfire and prescribed fire could influence runoff.
- runoff could be influenced by road building.

Conclusion:

- there is a lack of understanding of the role of geology (esp. limestone formation) in the hydrologic process.

Stream Channel

Core Questions (from WA Guide):

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

Present Condition:

- little is known about stream channel conditions in large areas of the watershed.
- channel morphology is being affected by mass wasting.
- channel morphology is being influenced by land use activities, such as:
- Interstate 5.
- private logging and road building in Nosoni Creek.
- past mining activity at Shasta Iron Mine.
- aggradation is occurring in the inlets of Shasta Lake.

Causal Mechanism(s):

- lack of survey and difficulty accessing remote parts of the watershed.
- land use activities, such as:
- Interstate 5.
- private logging and road building in Nosoni Creek.
- past mining activity at Shasta Iron Mine.
- natural processes (mass wasting, wildfire, etc.)
- formation of Shasta Lake
- construction of McCloud Dam.

Trends:

- most conditions are expected to remain static.
- reservoir inlets continue to aggrade.
- catastrophic wildfire has the potential to accelerate erosion processes.

Influences and Relationships:

- mass wasting affects channel morphology.
- fish passage (aggradation at inlets to reservoir)
- topography
- catastrophic wildfire and prescribed burning

Conclusion:

- there is a need to conduct channels surveys and to identify sources areas for channel and hillslope restoration opportunities.

Water Quality

Core Questions (from WA Guide):

- 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)?

Present Condition:

- water quality in tributaries is generally very good.
- knowledge of water quality in Shasta Lake limited; there has been no water quality monitoring on a regular basis.
- little is known about the water quality impacts of Shasta Iron Mine.
- areas with dense road networks impact turbidity in the lake and streams.
- wave action around the shore of the lake from wind and boats is a source of turbidity.

Causal Mechanism(s):

- land use activities (esp. road building).
- wave action (both natural and boat wake).
- high recreation use on Shasta Lake.
- lack of water quality monitoring.

Trends:

- the risk of water quality impacts will increase with increased recreational use of Shasta Lake.
- sediment inputs from roads is currently static due to the lack of recent or planned road construction in the watershed.
- shoreline erosion due to wave action is static.
- there is limited knowledge about the impacts of Shasta Iron Mine so trends are unknown; however, it is expected water that water quality impacts from the mine would improve as natural vegetation reestablishes at the site.

Influences and Relationships:

- mass wasting and erosion processes
- human uses

Conclusion:

- there is a need to improve coordination of water quality monitoring.
- there is a need to investigate potential water quality impacts from Shasta Iron Mine.
- there is a need to evaluate the role of roads in sediment delivery.

Vegetation

Core Questions (from WA Guide):

- What are the natural and human causes of change between historical and current vegetation 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)?

Present Condition:

- 12% of the historical landbase in the watershed was lost with the inundation by Shasta Lake.
- late-successional conifer stands are limited in the watershed (<2%).
- typical conifer stands in the watershed have a scattered overstory layer over a denser understory of small conifers, hardwoods, and shrubs.
- chaparral vegetation is generally described as decadent
- knobcone pine stands are experiencing high mortality levels which are resulting in very high fuels loads.
- conifer stands on north slopes and in drainages often tend to be overstocked.
- there appears to have been a loss of larger ponderosa pine trees around campgrounds and marinas.

Causal Mechanism(s):

- fire exclusion
- natural process of succession
- natural conditions (soils, aspect, climate)
- past mining activity
- formation of Shasta Lake
- construction of roads, campgrounds, resorts, etc.

Trends:

- most vegetation types are gradually moving towards later seral stages.
- chaparral vegetation will continue to become more decadent in the absence of fire.
- knobcone pine stands will continue to deteriorate with age.

Influences and Relationships:

- fuel loads and fuel profiles
- geology, soils, slope aspect
- wildlife habitat
- quality of recreation experience
- visual quality
- erosion and stability

Conclusion:

- there is a desire to provide an array of seral stages across the landscape.
- there is a need to reintroduce fire into the ecosystem as a disturbance agent.

Species and Habitats

Core Questions (from WA Guide):

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

Present Condition:

- old growth and late-successional habitat is lacking in the watershed.
- the watershed has limited capability for producing old growth habitat.
- vegetation in the watershed is generally too open to provide effective dispersal habitat.
- chaparral vegetation is generally described as decadent.
- 12% of the historical landbase in the watershed was lost with the inundation by Shasta Lake.
- the prime habitat in the watershed has been inundated by Shasta Lake.
- there is a lack of large ponderosa pine trees for bald eagle nest trees.
- snags and dead/down material in the watershed are below desired levels, but the area is not capable of producing desired levels.
- limestone formations provide habitat for several wildlife and plants species of concern.

Causal Mechanism(s):

- fire exclusion
- natural process of succession
- shallow soils and aspect
- past mining activity
- formation of Shasta Lake
- construction of roads, campgrounds, resorts, etc.

Trends:

- there is expected to be a slow development of late-successional and dispersal habitat.
- continued senescence of chaparral vegetation - assuming no fire.
- reduction in the availability of suitable bald eagle nest trees

Influences and Relationships:

- fuel loads and fuel profiles
- geology, soils, slope aspect
- wildlife habitat
- quality of recreation experience
- visual quality
- erosion and stability
- psychological impacts to fish

Conclusion:

- there is a desire to provide an array of seral stages across the landscape.
- there is a need to reintroduce fire into the ecosystem as a disturbance agent.
- there is a need to provide for the long-term habitat requirements of the bald eagle.

Human Uses

Core Questions (from WA Guide):

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

Present Condition:

- Shasta Lake attracts high levels of recreation use.
- Easy access is provided for recreational users by Interstate 5.
- There has been a deterioration in vegetation conditions around campgrounds and resorts.
- Visual quality in the watershed is threatened by the potential for catastrophic wildfire and high levels of conifer mortality.
- High human use increases the probability of fire ignition occurring.
- The possibility of wildfire in the watershed is a public safety concern due to heavy recreation use, the presence of homes, and the interstate highway.
- Two potential conflicts of high recreation use with other resources have been identified:
  - wildlife disturbance - specifically around eagle nests.
  - riparian areas - specifically riparian vegetation around boat ramps, trails, etc.

Causal Mechanism(s):

- regional population
- dam construction
- highway construction
- development of recreational facilities (resorts, campgrounds, boat ramps, trails, etc.)
- mining

Trends:

- recreation use is expected to increase in the future as regional population increases.
- traffic on Interstate 5 is expected to increase in the future as regional population increases.
- impacts to wildlife and habitat are expected to increase in the future in areas of concentrated human use.

Influences and Relationships:

- stream processes
- fisheries
- habitat fragmentation and loss
- direct impacts to wildlife
- increased fire risk

Conclusion:

- there is a need to minimize impacts to wildlife, especially TES species and other species of concern.

Chapter 6

Recommendations

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

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

Recommendations included in this chapter are:

- Vegetation/Habitat Management
- Fire/Fuels Management
- Riparian Reserves
- Recreation Management
- Road Management
- Cave Management
- Restoration Opportunities
- Research Needs
- Survey, Inventory, Monitor

Vegetation/Habitat Management

Present Situation:

- Old growth and late-successional stands currently occur on less than 2% of the watershed.
- Chaparral vegetation is generally described as decadent.
- Knobcone pine stands are experiencing high mortality levels.
- There is a threat of losing habitat to wildfire.
- There is a threat of losing visual quality and recreational values to wildfire.
- There is a lack of suitable existing and replacement nest trees for bald eagles and ospreys.

Recommendations:

Protect all remaining old growth and late-successional stands in the watershed consistent with Standards and Guidelines (LMP 4-63).

Apply prescribed burning to chaparral vegetation types to increase palatability of forage and to improve wildlife movement through dense brushfields. Refer to the following Fire/Fuels Management Recommendations.

Apply prescribed burning to knobcone pine and chaparral vegetation types with high fuel loads to reduce the potential for wildfire. Refer to the Fire/Fuels Management Recommendations.

Implement silvicultural recommendations described in Appendix F to protect and maintain suitable bald eagle habitat at Hirz Bay. Look for additional opportunities to apply similar treatments in other areas in the watershed that could provide suitable bald eagle habitat. Silvicultural treatments should emphasize maintaining forest health and accelerating the development of large trees, especially large ponderosa pine.

Rationale/Objective:

Old growth and late-successional stands currently occur on less than 2% of the watershed. Management direction in the LMP (4-63) requires that "...in fifth field watersheds in which federal forest lands are currently comprised of 15 percent or less late-successional forest... all remaining late-successional stands should be protected".

Long-term prescribed burning in the watershed will approximate vegetation, forage, and fuel conditions that would be found under a natural fire regime of frequent light fire. Such treatments will reduce the potential for catastrophic wildfire in the watershed.

Prescribed burning is considered to be the only feasible alternative to manipulating vegetation in most of the watershed due to

- economics
- poor access
- topography

Fire/Fuels Management

Present Situation:

- There is a need to provide continued fire suppression in the watershed.
- There is a need to reintroduce prescribed fire into the ecosystem to approximate the natural fire regime.
- There is a need to create compatible fuel profiles.
- There is a need to reduce surface fuel loads in the watershed.
- Management activities that result in surface disturbance (including prescribed fire) can accelerate mass wasting.
- Wildfire can accelerate mass wasting and has detrimental effects on forest soils.
- Knobcone pine stands have been experiencing high mortality levels and fuel loads are high.

Recommendations:

Apply prescribed burning where appropriate to meet resource objectives in the watershed, including:

- maintaining forest health.
- reducing natural fuel accumulations.
- improving wildlife forage and habitat.
- reducing risk to life and property by catastrophic wildfire.
- reducing risk to resource values by catastrophic wildfire.

Reduce the potential for mass wasting during prescribed burning by incorporating mitigation measures described in the following section on Riparian Reserves into the project design.

Rationale/Objective:

The accumulation of natural fuels in the area, coupled with high recreation use, creates a potential for large catastrophic wildfire in the area.

Long-term prescribed burning in the watershed will approximate fuel loading conditions that would be found under a natural fire regime of frequent light fire.

The impacts of prescribed burning are preferable to those resulting from catastrophic wildfire.

Riparian Reserves

Present Situation:

- The Riparian Reserve along the shore of Shasta Lake cannot support riparian vegetation and is not critical in providing coarse woody debris to aquatic and riparian ecosystems.
- Active mass wasting is occurring in the form of debris slides, debris flows, torrents and colluvial filled hollows.
- Management activities that result in surface disturbance (prescribed fire, logging, road building) can accelerate mass wasting.
- Wildfire can accelerate mass wasting and has detrimental effects on forest soils.
- Aggradation is occurring in the inlets to Shasta Lake through the mass wasting process.

Recommendations:

- Use Riparian Reserve widths as listed in Standards and Guidelines (LMP 4-53) unless wider widths are specified by a hydrologist or geologist on a site specific basis.
- Do not manage the Riparian Reserve along the shore of Shasta Lake with the objective of providing coarse woody debris for aquatic and riparian habitat. However, this area may be managed to provide snags and dead/down woody material for terrestrial habitats.
- The following resource activities are considered acceptable within Riparian Reserves when designed to meet the objectives of the Aquatic Conservation Strategy:
    - thinning to control stocking
    - thinning (or similar treatment) to reduce fuel loads
    - precribed burning
- Avoid prescribed burning during periods when intense storms events are predicted.
- Use low intensity “backing” fires in the following situations:
    - Riparian Reserves
    - unstable slopes
    - slopes exceeding 20%
- Apply prescribed fire with the objective of retaining 60% duff and ground cover.
- Consider consolidating unstable areas and leaving larger areas unburned if management objectives can still be met.
- Include a geologist in the design process for all prescribed burning projects in this watershed.

Rationale/Objective:

- There is no benefit to aquatic and riparian habitat from large woody debris introduced from the Riparian Reserve along the shoreline of Shasta Lake. Such material is also considered a hazard to recreation use on Shasta Lake.
- Prescribed burning is preferable to wildfire because there is some degree of control on the scale and intensity of fire.
- Burn plans that incorporate unstable area concerns will greatly reduce the risk of mass wasting.

- Shallow debris slides and debris flows often occur once a threshold rainfall intensity has been exceeded. For example, if the rainfall intensity exceeds 10 cm in 24 hours at any time during a storm, the risk of landslides can be expected to be high (assuming previously saturated soils).

Recreation Management[1]

Present Situation:

- Vegetation conditions in campgrounds are deteriorating. There has been a decline in native vegetation for shade and screening.
- Concentrated recreation use and construction has impacted vegetation through disturbance and soil compaction.
- Visual quality is threatened by the potential for catastrophic wildfire and high levels of mortality.
- Recreation demands will continue to increase in the McCloud Arm Watershed

Recommendations:

- Thin overstocked vegetation in campgrounds.
- Plant conifers and other native vegetation where needed in campgrounds and other high use recreation areas.
- Manage recreation in the McCloud Arm Watershed in compliance with the establishing legislation (H.R. 6797) An Act establishing the Whiskeytown-Shasta-Trinity National Recreation Area.
- Manage in compliance with direction provided in the Whiskeytown-Shasta-Trinity National Recreation Management Area Management Guide.
- Review Water Recreation Opportunity Spectrum (WROS) classification map for compatibility when evaluating changes in use.
- Turntable Bay is the most feasible new location on Shasta Lake for a resort/marina operation and or public boat ramp.

Rationale/Objective:

- Overstocked conditions lead to a decline in the health and vigor of vegetation and increase mortality levels. Thinning encourages health and crown development, which are desired in campgrounds.
- There is a need to continue to actively manage recreation activities in the watershed and to modify existing plans to adjust for changes in human use trends, patterns, and numbers.

[1] These recommendations updated February 2005

Road Management

Present Situation:

- Sediment is being delivered to streams as a result of inadequate road maintenance.
- High surface runoff is occurring where road networks are dense.
- Channel morphology in Nosoni Creek is being influenced by the road network.
- Areas with dense road networks impact turbidity in the lake and streams.

Recommendations:

- Increase the level of road maintenance in the watershed.
- Surface roads, especially high use roads, that are contributing to high surface runoff.
- Work with adjacent landowners to reduce existing road network in the Nosoni Creek drainage. Any road closures must consider existing right-of-way and cost share agreements.

Rationale/Objective:

- Regular maintenance will reduce the risk of road impacts associated with plugged culverts and poor drainage.
- Surfacing high use roads will reduce stream turbidity during winter storms.
- Reducing the existing road network will reduce road impacts to water quality, habitat fragmentation, and channel morphology.

Cave Management

Present Situation:

- Limestone formations, and the caves found within them, are features of geological and biological uniqueness.
- Vandalism has occurred at Samwell Cave.
- Limestone has an effect on surface and groundwater hydrology; however, the extent of this effect is unknown.
- Limestone formations and outcrops are habitat for several wildlife and plant species of concern.

Recommendations:

Avoid prescribed burning on limestone formations.

Rationale/Objective:

Limestone formations are both unique and sensitive. Treatment of vegetation in these areas is not considered a priority at this time. The sparse nature of vegetation in these areas often makes them unsuitable for prescribed burning.

Restoration Opportunities

Present Situation:

- Channel morphology is being influenced by mining activity at Shasta Iron Mine.
- Little is known about water quality impacts of Shasta Iron Mine.
- High surface erosion is occurring on oversteepened, bare slopes at Shasta Iron Mine.

Recommendations:

Evaluate the need and feasibility of restoration activities at the Shasta Iron Mine site.

Rationale/Objective:

The Shasta Iron Mine site has been observed on aerial photos and from a distance in the field. Such preliminary observations indicate that restoration opportunities probably exist at this site. However, no field visits were made to the site and there is insufficient knowledge to make specific recommendations at this time.

Research Opportunities

Present Situation:

- Limestone has an effect on surface and groundwater hydrology; however, the extent of this effect is unknown.

Recommendations:

Pursue cooperative research opportunities with groups outside the agency (universities, etc.). Questions that could be investigated include:

- Is there a link between surface and groundwater hydrology and the subterranean movement of water?
- Is cold subterranean water contributing to lower stream temperatures in surface streams (such as Natawaket Creek in the Lower McCloud River Watershed)?
- Does the quality of surface water have an effect on cave biota and the geologic features found within caves?

Rationale/Objective:

An understanding of the influences and relationships between limestone formations and surface hydrology can provide valuable information for making many land management decisions.

Survey, Inventory, Monitor

Present Situation:

- There is no coordinated monitoring of water quality in Shasta Lake.
- Monitor streams for surface water sedimentation and for sedimentation in creeks.
- There is a need to evaluate the role of roads in sediment delivery.
- Little is know about stream channels in the watershed due to difficulty accessing remote areas.
- Little is known about water quality impacts of Shasta Iron Mine.
- Due to anticipated long-range prescribed burning programs in the watershed, there is a need to understand the effects of prescribed burning on the mass wasting process and compare it them to other forms of vegetation manipulation (mechanical, chemical, manual, etc.).
- Little is know about the effects of smoke from wildfire and prescribed fire on caves.
- Little is known about the presence and habits of S&M species (esp. mollusks) in limestone caves. Access to remote areas is a problem for surveying.
- Peregrine falcons are frequently seen in the watershed and the area has a high potential for a peregrine eyrie. Observations are still being conducted to confirm presence of an eyrie.

Recommendations:

- Coordinate with the Water Quality Control Board to insure proper water quality monitoring programs are in place.
- Conduct stream channel surveys and identify sources of channel and hillslope restoration opportunities.
- Investigate existing and potential water quality impacts at Shasta Iron Mine.
- Monitor the effects of prescribed burning on the mass wasting process.
- Assess limestone caves to learn more about S&M species (esp. mollusks).
- Assess the Grey Rocks limestone formation to determine the presence of peregrine falcons.

Rationale/Objective:

- Information gathered from monitoring the effects of prescribed burning on the mass wasting process will help in the design of future burning programs in the watershed, and possibly in adjacent watersheds.

Appendix A

Possible Management Practices

McCloud Arm Watershed Analysis

Possible Management Practices

	WA Recommendation	Possible Management Practices	Required Documentation	Linkages	Scheduling
1.	Improve chaparral habitat; reduce fire hazard in chaparral.	Prescribed burning	EA/CE	link with #8	NEPA 11/97; implement 1/98
2.	Thin to promote eagle habitat.	Thinning	EA/CE	possible link with #3	
3.	Improve condition of vegetation in campgrounds.	Thinning/planting	EA/CE	possible link with #2	
4.	Reduce runoff on high use roads.	Road surfacing	EA/CE		
5.	Evaluate feasibility of site restoration at Shasta Iron Mine.	Site restoration	EA/CE		
6.	Research opportunities in limestone.	Research	CE		
7.	Monitor water quality in lake.	Monitoring	CE		
8.	Monitor effects of burning on mass wasting.	Monitoring	CE	link with #1	
9.	Stream surveys.	Survey	CE		
10.	Survey of S&M species.	Survey	CE		
11.	Survey for peregrine eyries.	Survey	CE		

EA - Environmental Assessment required
CE - Categorical Exclusion is probably adequate
EA/CE - Scope of the project will determine which documentation is appropriate.
LSRA - LSR Assessment required with REO review
exempt (LSRA) - LSR Assessment required but exempt from REO review

Proposed Projects

Project: Prescribed Burning

Main Activities:
Prescribed burning of chaparral and knobcone pine

Related Activities:
Monitoring effects of prescribed burning on mass wasting

Required Documentation:
EA; BE

Scheduling:
NEPA is planned for FY 1998 (11/97) with implementation to occur in 1/98.

Funding:
Rocky Mountain Elk Foundation

LMP Consistency:
All activities in this project would be consistent with LMP direction.

WA Priorities:

Proposed Projects (cont.)

Project: Thinning

Main Activities:

Thinning of overstocked conifer stands to promote eagle habitat.

Related Activities:

Campground improvement activities, such as thinning and planting, could be combined with this project. Commercial timber sale could generate KV funds for planting and other work.

Required Documentation: EA; BE

Scheduling: Dependent on funding.

Funding:

Thinning and slash treatments could be covered by a timber sale. KV funds generated by a timber sale could help fund other activities such as thinning and planting in campgrounds.

LMP Consistency:

All activities in this project would be consistent with LMP direction.

WA Priorities:

Proposed Projects (cont.)

Project: Campground Improvement

Main Activities:

- Thinning of overstocked vegetation in campgrounds.
- Planting of vegetation in campgrounds.

Related Activities:

Thinning in campgrounds could possibly be combined with thinning recommendation to promote eagle habitat (previous page).

Required Documentation: EA; BE

Scheduling: Dependent on funding.

Funding:

Could be covered by KV funding if included as part of a commercial timber sale.

LMP Consistency:

All activities in this project would be consistent with LMP direction.

WA Priorities:

Proposed Projects (cont.)

Project: Road Surfacing

Main Activities:
Surfacing of high use roads to reduce sediment runoff into streams.

Related Activities:

Required Documentation: EA; BE

Scheduling: Dependent on funding.

Funding: unknown

LMP Consistency:
All activities in this project would be consistent with LMP direction.

WA Priorities:

Proposed Projects (cont.)

Project: Shasta Iron Mine Site Restoration

Main Activities:
Evaluate and/or implement restoration activities at the Shasta Iron Mine site.

Related Activities:
This activity could be included in stream survey and restoration activities (#9).

Required Documentation: CE

Scheduling: Dependent on funding.

Funding:
Jobs-in-the-Woods

LMP Consistency:
All activities in this project would be consistent with LMP direction.

WA Priorities:

Proposed Projects (cont.)

Project: Research

Main Activities:

Investigate cooperative research opportunities to study the links between limestone and local hydrology.

Related Activities:

Required Documentation: CE

Scheduling: Dependent on funding.

Funding: unknown

LMP Consistency:

All activities in this project would be consistent with LMP direction.

WA Priorities:

Proposed Projects (cont.)

Project: Water Quality Monitoring

Main Activities:

Coordinated with the Water Quality Control Board to insure proper water quality monitoring programs are in place.

Related Activities:

Required Documentation: CE

Scheduling: Dependent on funding.

Funding: unknown

LMP Consistency:

All activities in this project would be consistent with LMP direction.

WA Priorities:

Proposed Projects (cont.)

Project: Mass Wasting Monitoring

Main Activities:
Monitor the effects of prescribed burning on the mass wasting process.

Related Activities:
Coordinate with prescribed burning activities.

Required Documentation:
Monitoring should be included in EA for prescribed burning.

Scheduling:
During and following prescribed burning activities

Funding:
Possible funding as part of prescribed burning activities.

LMP Consistency:
All activities in this project would be consistent with LMP direction.

WA Priorities:

Proposed Projects (cont.)

Project: Stream Survey

Main Activities:

Conduct stream channel surveys and identify sources of channel and hillslope restoration opportunities.

Related Activities:

Required Documentation: CE

Scheduling: Dependent on funding.

Funding: unknown

LMP Consistency:

All activities in this project would be consistent with LMP direction.

WA Priorities:

Proposed Projects (cont.)

Project: S&M Species Survey

Main Activities:

Survey for S&M species. Asses limestone caves to learn more about S&M species that occur there.

Related Activities:

Required Documentation: CE

Scheduling: Dependent on funding.

Funding: unknown

LMP Consistency:

All activities in this project would be consistent with LMP direction.

WA Priorities:

Proposed Projects (cont.)

Project: Survey for Falcon Eyries

Main Activities:

Assess limestone formations (esp. Grey Rocks) for presence of peregrine falcon eryies.

Related Activities:

Required Documentation: CE

Scheduling: Dependent on funding.

Funding: unknown

LMP Consistency:

All activities in this project would be consistent with LMP direction.

WA Priorities:

Appendix B
Management Direction

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

Land Allocation

The ROD identifies four land allocations within the McCloud Arm Watershed (see Map 6 in the Watershed Analysis):

- Late-Successional Reserve (LSR)

  Late-Successional Reserves are identified with an objective to protect and enhance conditions of late-successional and old-growth forest ecosystems, which serve as habitat for late-successional and old-growth forest related species including the northern spotted owl. Limited stand management is permitted, subject to review by the Regional Ecosystem Office (ROD A-4).
- Riparian Reserve (RR)

  Riparian Reserves provide an area along streams, wetlands, ponds, lakes, and unstable and potentially unstable areas where riparian-dependent resources receive primary emphasis. Riparian Reserves are important to the terrestrial ecosystem as well, serving, for example, as dispersal habitat for certain terrestrial species (ROD A-5).
- Administratively Withdrawn Areas

  Administratively Withdrawn Areas are identified in current Forest and District Plans or draft plan preferred alternatives and include recreation and visual areas, back country, and other areas where management emphasis precludes scheduled timber harvest (ROD A-4).
- Matrix

  The matrix consists of those federal lands outside the three categories of designated areas listed above (ROD A-5).

Management Prescriptions

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

The LMP identifies eight Management Prescriptions in the McCloud Arm Watershed area (see Map 7 in the Watershed Analysis):

- II Limited Roaded Motorized Recreation
    - The purpose of this prescription is to provide for semi-primitive motorized recreation opportunities, while maintaining predominantly natural-appearing areas with some modifications (LMP 4-46).
    - Recreational and visual resources are important values; semi-primitive activities are emphasized(LMP 4-46).
    - This prescription applies to the Administratively Withdrawn Areas land allocation.
- III Roaded Recreation
    - The purpose of this prescription is to provide for an area where there are moderate evidences of the sights and sounds of humans (LMP 4-64).
    - This prescription emphasizes recreational opportunities associated with developed road systems and dispersed and developed campsites (LMP 4-64).
    - This prescription applies to the Matrix land allocation.
- IV Roaded, High Density Recreation
    - The purpose of this prescription is to provide for areas which are characterized by a substantially modified natural environment (LMP 4-48).
    - Recreational and visual resources are important values with rural recreation emphasized (LMP 4-48).
    - This prescription applies to the Administratively Withdrawn Areas land allocation.
- VI Wildlife Habitat Management
    - The primary purpose of this prescription is to maintain and enhance big game, small game, upland bird game and non-game habitat (LMP 4-66).
    - While this prescription does not emphasize those wildlife species dependent on late seral stages, habitat favorable to these species will occur within this prescription (4-66).
    - This prescription applies to the Matrix land allocation.
- VII LSRs and Threatened, Endangered, and Selected Sensitive Species
    - The purpose of this prescription is to provide special management for LSRs and Threatened and Endangered species (LMP 4-43).
    - This prescription emphasizes retention and enhancement of sensitive plant species, old-growth vegetation, and hardwoods (LMP 4-43).
    - This prescription applies to the Late-Successional Reserve land allocation.
- IX Riparian Management
    - The purpose of this prescription is to maintain or enhance riparian areas, wildlife and fisheries habitat, and water quality by emphasizing streamside and wetland management (LMP 4-59).
    - Multiple resource uses and activities will occur in support of, and to the extent that they do not adversely affect the maintenance of riparian area dependent resources (e.g., fish, wildlife, water quality) (LMP 4-59).
    - This prescription applies to the Riparian Reserve land allocation and is unmapped in the LMP.

- X Special Area Management
  - This prescription provides for protection and management of special interest areas and research natural areas (LMP 4-49).
  - Samwel Cave is proposed as a geologic Special Interest Area (LMP 4-111).
  - This prescription applies to the Administratively Withdrawn Areas land allocation.
- XI Heritage Resource Management
  - The primary theme of this prescription is to protect designated cultural resource values, interpret significant archaeological and historical values for the public, and encourage scientific research of these selected properties (LMP 4-50).
  - This area is unmapped and applies to all land allocations.

Management Areas

Supplemental management direction for specific units of land is provided in the LMP under Management Area Direction (LMP - Chapter 4 - Section G). A management area is a contiguous unit of land with separate, distinct management direction in response to localized issues and resource opportunities.

The LMP identifies two Management Areas in the McCloud Arm Watershed area (see Map 7 in the Watershed Analysis). Supplemental management direction that applies to the McCloud Arm Watershed is summarized as follows:

- National Recreation Area (NRA) - Shasta Unit (#8) (LMP-4-115)
  - Search for additional populations of Shasta snow-wreath. Avoid disturbance pending completion of a conservation strategy.
  - Construct no additional permanent roads on the Shasta Unit for timber harvest. Existing roads may be relocated to improve esthetics.
  - Cooperate with DFG in developing a fish habitat management plan for Shasta Lake. Maintain a fishery consistent with demand, recognizing that there are habitat limitations that cannot be overcome. Emphasize coldwater and warmwater fish habitat management at Shasta Lake.
  - Consolidate public ownership with emphasis on shoreline property.
  - Do not acquire lands with significant known pollution sources, especially those lands affected by mine discharges.
  - Authorize no new exclusive uses of National Forest lands or water within the NRA except for those private recreation occupancy vessels (ROVs) provided for in the NRA Management Plan. Phase out existing exclusive uses, other than private ROVs, as opportunities and conditions allow.
  - Administer the NRA according to specific direction provided in the Management Plan for the Shasta Unit.
  - Maintain Potter Creek Cave and Hirz Mountain in their current conditions until their suitability as Special Interest Areas is determined.
  - Treat slash from timber harvest activities to meet adopted VQOs or fire hazard reduction objectives, whichever are the most restrictive standards. Natural fuel manipulation for fire hazard reduction will be done to maximize protection of forest investments and interface areas.
  - Plan no regulated timber harvest in the Shasta Unit. Unregulated harvest will occur to maintain a healthy, diverse, esthetic, residual stand.

  - Maintain or improve habitat for wildlife, including self-sustaining populations of ospreys, bald eagles, and Shasta salamanders. Improve habitat for harvest wildlife species.
- Nosoni (#12) (LMP-4-131)
  - Reduce naturally occurring fuels to protect forest investments and interface areas from losses due to wildfire.
  - Provide low development and dispersed recreation facilities and emphasize hunting, fishing, and hiking opportunities.
  - Develop and implement a program to manage and use hardwoods for energy, fiber, and wildlife habitat.
  - Observe the following special management direction in the McCloud River corridor:

    Timber access:

    a. Minimize new road construction and attempt to locate new roads away from streamcourses.
    b. Minimize stream crossings.
    c. Design logging systems for maximum resource protection.
  - Maintain or improve selected habitats for deer, elk, turkey, bear, bald eagle, northern spotted owls, and Shasta salamander.
  - Continue to work with interest groups such as the Rocky Mountain Elk Foundation, Wild Turkey Federation, and Quail Unlimited to improve wildlife habitat.
  - During project level planning identify cultural and historical values. Manage significant sites under Management Prescription XI.

The above Supplemental Management Direction consists only of those excerpts from the LMP that apply to the McCloud Arm Watershed. Refer to the LMP (Chapter 4 - Section G) for a complete list of supplemental management direction.

Management Guide for the National Recreation Area

Additional management direction for the National Recreation Area (NRA) is provided in the *Management Guide for the Shasta and Trinity Units of the Whiskeytown-Shasta-Trinity National Recreation Area* (4/96). This management guide integrates past decisions that are pertinent for managing the NRA with standards, guidelines and management prescriptions incorporated from the LMP. It is an analysis of direction in the LMP, a summary of existing conditions, and a strategy on management recommendations, opportunities, and mitigation measures that will be used to implement the LMP.

Appendix C
Species List

List of Wildlife Species Possibly Occurring in the McCloud Arm Watershed. Species Listed by Guild Association

HABITAT TYPES

MCN:	Mixed Conifer	DFR:	Douglas-fir
PPN:	Ponderosa Pine	WFR:	White Fir
VFH:	Valley Foothill Hardwood	MCH:	Mixed Chaparral
VRI:	Valley Foothill Riparian	RIV:	Riverine

GUILD(S)

AQFA:	Fast water required, usually indicating streams or river
AQSL:	Areas of slow water required, be they lacustrine or riverine habitat
AQUAT:	Can use either the fast or slow water components
C/C:	Cliff and caves
CHAP:	Chaparral communities
DEAD/D:	Dead and down material (logs, stumps, slash, litter, duff)
FOREST:	Can use any forested habitat
HDWD:	Hardwoods
LATE:	Late seral stages (4a, 4b, 4c) and multi-layered
OPEN:	Meadows, open areas, seral stages 1, 2, and 3a
OPEN-GRASS:	Seral stage 1; mutually exclusive from OPEN-SHRUB
OPEN-SHRUB:	All forested habitat types: openings, seral stages 2 and 3a
RIPAR:	Associated with riparian vegetation
SNAGCAV:	Tree cavity dependent species found in snags or live trees
T/R:	Talus and rocks

WHRI Wildlife Habitat Relationship ID code

STATUS

S&M	Survey and Management species listed in Appendix R of the Shasta-Trinity LMP, 1995
CSC	CDF 'Species of Special Concern' (Special 8/94)
C2	Catagory 2 Candidate for listing by USFWS (Special 8/94)
CaE	California State-listed Endangered (TES&P 1/95)
CaT	California State-listed Threatened (TES&P 1/95)
FS	Forest Service Sensitive (TES&P Animals of the Pacific Southwest Region 1/95)
FT	Federally Listed Threatened (Endangered and Threatened Animals of Calif. 1/95)
FE	Federally Listed Endangered (Endangered and Threatened Animals of Calif. 1/95)
FSC	Federal Species of Concern

NT Neotropical Migratory Birds

Wildlife Species Possibly Occurring in the McCloud Arm Watershed and Associated with Habitat Types MCN, DFR, PPN, WFR, VFH, MCH, VRI, and RIV. Species Listed by Guild Association.

Sparse to Dense Canopy (10-100%) and Seedling to Large Trees (5" to 40" DBH)

GUILD(S)	WHRI	COMMON NAME	STATUS	NT
AQFA	A004	PACIFIC GIANT SALAMANDER		
	A026	TAILED FROG	CSC, FSC	
	A043	FOOTHILL YELLOW-LEGGED FROG	C2,CSC, FSC	
	B373	AMERICAN DIPPER		
AQSL	A006	ROUGH-SKINNED NEWT		
	A032	WESTERN TOAD		
	A039	PACIFIC TREEFROG		
	A040	RED-LEGGED FROG	CSC, FT, FSC	
	A046	BULLFROG		
	B006	PIED-BILLED GREBE		
	B010	WESTERN GREBE / CLARK'S GREBE		
	B044	DOUBLE-BREASTED CORMORANT	CSC	
	B051	GREAT BLUE HERON		
	B052	GREAT EGRET		
	B076	WOOD DUCK		
	B077	GREEN-WINGED TEAL		
	B079	MALLARD		
	B080	NORTHERN PINTAIL		
	B094	LESSER SCAUP		
	B149	AMERICAN COOT		
	R004	NORTHWESTERN POND TURTLE	C2, CSC, FS	
AQUAT	B104	HOODED MERGANSER		
	B105	COMMON MERGANSER		
	B110	OSPREY	CSC	4
	B113	BALD EAGLE	FT, CaE	
	B170	SPOTTED SANDPIPER		
	B293	BELTED KINGFISHER		4
	B343	CLIFF SWALLOW		4
	M112	BEAVER		
	M163	RIVER OTTER		
C/C	B108	TURKEY VULTURE		4
	B126	GOLDEN EAGLE	CSC	4
	B129	PEREGRINE FALCON	FE, CaE	4
	B265	GREAT HORNED OWL		
	B279	BLACK SWIFT	CSC	4
	B341	NORTHERN ROUGH-WINGED SWALLOW		4
	B343	CLIFF SWALLOW		4
	B344	BARN SWALLOW		4
	M021	LITTLE BROWN MYOTIS		
	M023	YUMA MYOTIS	FSC	
	M025	LONG-EARED MYOTIS	S&M, FSC	
	M026	FRINGED MYOTIS	S&M, FSC	

GUILD(S)	WHRI	COMMON NAME	STATUS	NT
	M027	LONG-LEGGED MYOTIS	S&M, FSC	
	M028	CALIFORNIA MYOTIS	C2, CSC	
	M032	BIG BROWN BAT		
	M037	TOWNSEND'S BIG-EARED BAT	C2, CSC	
	M038	PALLID BAT	CSC, S&M	
CHAP	B391	WRENTIT		
	B404	WATER PIPIT		4
	B482	GREEN-TAILED TOWHEE		4
	M038	PALLID BAT	CSC, S&M	
	M059	SONOMA CHIPMUNK		
	M119	BRUSH MOUSE		
	M149	GRAY FOX		
	M181	MULE DEER		
	R023	SAGEBRUSH LIZARD		
	R053	CALIFORNIA WHIPSNAKE		
DEAD/D	A004	PACIFIC GIANT SALAMANDER		
	A012	ENSATINA		
	A014	CALIFORNIA SLENDER SALAMANDER		
	A021	CLOUDED SALAMANDER		
	M117	DEER MOUSE		
	M120	PINYON MOUSE		
	M151	BLACK BEAR		
	M155	PACIFIC FISHER	C2, CSC, FS	
	M157	LONG-TAILED WEASEL		
	R048	RINGNECK SNAKE		
	R049	SHARP-TAILED SNAKE		
	R058	COMMON KINGSNAKE		
	R059	CALIFORNIA MOUNTAIN KINGSNAKE		
FOREST	B127	AMERICAN KESTREL		4
	B264	WESTERN SCREECH OWL		
	B267	NORTHERN PYGMY OWL		
	B279	BLACK SWIFT	CSC	4
	B294	LEWIS' WOODPECKER		4
	B300	WILLIAMSON'S SAPSUCKER		4
	B307	NORTHERN FLICKER		4
	M037	TOWNSEND'S BIG-EARED BAT		
HDWD	B052	GREAT EGRET		
	B116	COOPER'S HAWK	CSC	4
	B251	BAND-TAILED PIGEON		4
	B296	ACORN WOODPECKER		
	B303	DOWNY WOODPECKER		
	B326	ASH-THROATED WOODPECKER		4
	B362	WHITE-BREASTED NUTHATCH		
	B417	HUTTON'S VIREO		
	B418	WARBLING VIREO		4
	B547	HOUSE SPARROW		
	M077	WESTERN GRAY SQUIRREL		

GUILD(S)	WHRI	COMMON NAME	STATUS	NT
	M176	WILD PIG		
LATE	B051	GREAT BLUE HERON		
	B117	NORTHERN GOSHAWK	CSC, FS, FSC	4
	B134	BLUE GROUSE		
	B263	FLAMMULATED OWL		4
	B270	NORTHERN SPOTTED OWL	FT	
	B304	HAIRY WOODPECKER		
	B305	WHITE-HEADED WOODPECKER		
	B308	PILEATED WOODPECKER		
	B309	OLIVE-SIDED FLYCATCHER		4
	B317	HAMMONDS' FLYCATCHER		4
	B346	STELLER'S JAY		
	B356	MOUNTAIN CHICKADEE		
	B357	CHESTNUT-BACKED CHICKADEE		
	B361	RED-BREASTED NUTHATCH		
	B363	PYGMY NUTHATCH		
	B364	BROWN CREEPER		4
	B375	GOLDEN-CROWNED KINGLET		4
	B390	VARIED THRUSH		4
	B415	SOLITARY VIREO		4
	B438	HERMIT WARBLER		4
	B539	RED CROSSBILL		
	B546	EVENING GROSBEAK		
	M012	TROWBRIDGE'S SHREW		
	M030	SILVER-HAIRED BAT	S&M	
	M034	HOARY BAT		
	M079	DOUGLAS' SQUIRREL		
	M080	NORTHERN FLYING SQUIRREL		
	M129	WESTERN RED-BACKED VOLE		
	M151	BLACK BEAR		
	M154	AMERICAN MARTEN	CSC, FS	
	M155	PACIFIC FISHER	C2, CSC, FS	
	M159	WOLVERINE	C2, CaT	
	M177	ELK		
OPEN	B108	TURKEY VULTURE		4
	B126	GOLDEN EAGLE	CSC	4
	B140	CALIFORNIA QUAIL	CSC	
	B141	MOUNTAIN QUAIL	C2	
	B264	WESTERN SCREECH OWL		
	B265	GREAT HORNED OWL		
	B267	NORTHERN PYGMY OWL		
	B276	COMMON NIGHTHAWK		4
	B277	COMMON POORWILL		4
	B279	BLACK SWIFT	CSC	4
	B281	VAUX'S SWIFT	CSC	4
	B307	NORTHERN FLICKER		4
	B354	COMMON RAVEN		

GUILD(S)	WHRI	COMMON NAME	STATUS	NT
	B366	ROCK WREN		4
	B380	WESTERN BLUEBIRD		4
	B381	MOUNTAIN BLUEBIRD		4
	B489	CHIPPING SPARROW		4
	B505	SONG SPARROW		4
	B509	GOLDEN-CROWNED SPARROW		
	B512	DARK-EYED JUNCO		4
	B524	BREWER'S BLACKBIRD		4
	B538	HOUSE FINCH		
	B542	PINE SISKIN		4
	B543	LESSER GOLDFINCH		4
	M021	LITTLE BROWN MYOTIS		
	M025	LONG-EARED MYOTIS	S&M, FSC	
	M026	FRINGED MYOTIS	S&M, FSC	
	M028	CALIFORNIA MYOTIS	C2, CSC	
	M032	BIG BROWN BAT		
	M037	TOWNSEND'S BIG-EARED BAT		
	M049	SNOWSHOE HARE	CSC	
	M051	BLACK-TAILED HARE		
	M105	CALIFORNIA KANGAROO RAT		
	M142	HOUSE MOUSE		
	M145	PORCUPINE		
	M146	COYOTE		
	M151	BLACK BEAR		
	M156	ERMINE		
	M162	STRIPED SKUNK		
	M165	MOUNTAIN LION		
	M166	BOBCAT		
	M177	ELK		
	M181	MULE DEER		
	R004	NORTHWESTERN POND TURTLE		
	R022	WESTERN FENCE LIZARD		
	R042	NORTHERN ALLIGATOR LIZARD		
	R048	RINGNECK SNAKE		
OPEN-GRASS	B123	RED-TAILED HAWK		4
	B127	AMERICAN KESTREL		4
	B158	KILLDEER		4
	B199	COMMON SNIPE		
	B255	MOURNING DOVE		4
	B262	COMMON BARN OWL		
	B333	WESTERN KINGBIRD		4
	B341	NORTHERN ROUGH-WINGED SWALLOW		4
	B344	BARN SWALLOW		4
	B389	AMERICAN ROBIN		4
	B404	WATER PIPIT		4
	B411	EUROPEAN STARLING		
	B521	WESTERN MEADOWLARK		4

GUILD(S)	WHRI	COMMON NAME	STATUS	NT
	M018	BROAD-FOOTED MOLE		
	M072	CALIFORNIA GROUND SQUIRREL		
	M084	WESTERN POCKET GOPHER		
	M113	WESTERN HARVEST MOUSE		
	M133	MONTANE VOLE		
	M136	LONG-TAILED VOLE		
	M142	HOUSE MOUSE		
	R036	WESTERN SKINK		
	R051	RACER		
	R057	GOPHER SNAKE		
OPEN-SHRUB	B287	ANNA'S HUMMINGBIRD		4
	B318	DUSKY FLYCATCHER		4
	B326	ASH-THROATED FLYCATCHER		4
	B360	BUSHTIT		
	B368	BEWICK'S WREN		
	B376	RUBY-CROWNED KINGLET		4
	B377	BLUE-GRAY GNATCATCHER		4
	B382	TOWNSEND'S SOLITAIRE		4
	B407	CEDAR WAXWING		4
	B425	ORANGE-CROWNED WARBLER		4
	B426	NASHVILLE WARBLER		4
	B435	YELLOW-RUMPED WARBLER		4
	B436	BLACK-THROATED GRAY WARBLER		4
	B471	WESTERN TANAGER		4
	B477	LAZULI BUNTING		4
	B483	RUFOUS-SIDED TOWHEE		4
	B504	FOX SPARROW		4
	B510	WHITE-CROWNED SPARROW		4
	B536	PURPLE FINCH		4
	M057	ALLEN'S CHIPMUNK		
	M075	GOLDEN-MANTLED GROUND SQUIRREL		
	M152	RINGTAIL		
	M161	WESTERN SPOTTED SKUNK		
	R039	WESTERN WHIPTAIL		
	R040	SOUTHERN ALLIGATOR LIZARD		
RIPAR	A026	TAILED FROG	CSC, FSC	
	A039	PACIFIC TREEFROG		
	A040	RED-LEGGED FROG	FT, CSC, FSC	
	A076	WOOD DUCK		
	B105	COMMON MERGANSER		
	B115	SHARP-SHINNED HAWK	CSC	4
	B128	MERLIN	CSC	4
	B129	PEREGRINE FALCON	FE, CaE	4
	B138	TURKEY		
	B255	MOURNING DOVE		4
	B293	BELTED KINGFISHER		4

GUILD(S)	WHRI	COMMON NAME	STATUS	NT
	B299	RED-BREASTED SAPSUCKER		4
	B303	DOWNY WOODPECKER		
	B311	WESTERN WOOD-PEWEE		4
	B315	WILLOW FLYCATCHER	FS, SE	4
	B320	WESTERN FLYCATCHER		4
	B321	BLACK PHOEBE		
	B338	PURPLE MARTIN	CSC	4
	B339	TREE SWALLOW		4
	B340	VIOLET-GREEN SWALLOW		4
	B369	HOUSE WREN		4
	B370	WINTER WREN		
	B385	SWAINSON'S THRUSH		4
	B386	HERMIT THRUSH		4
	B430	YELLOW WARBLER	CSC	4
	B460	MACGILLIVRAY'S WARBLER		4
	B461	COMMON YELLOWTHROAT		4
	B463	WILSON'S WARBLER		4
	B467	YELLOW-BREASTED CHAT	CSC	4
	B475	BLACK-HEADED GROSBEAK		4
	B506	LINCOLN'S SPARROW		4
	B528	BROWN-HEADED COWBIRD		4
	B532	NORTHERN ORIOLE		4
	M001	VIRGINIA OPOSSUM		
	M003	VAGRANT SHREW		
	M052	MOUNTAIN BEAVER		
	M112	BEAVER		
	M153	RACCOON		
	M158	MINK		
	M163	RIVER OTTER		
	R061	COMMON GARTER SNAKE		
	R062	WESTERN TERRESTRIAL GARTER SNAKE		
	R063	WESTERN AQUATIC GARTER SNAKE		
SNAGCAV	B076	WOOD DUCK		
	B105	COMMON MERGANSER		
	B110	OSPREY	CSC	4
	B113	BALD EAGLE	FT, CaE	
	B127	AMERICAN KESTREL		4
	B263	FLAMMULATED OWL		4
	B264	WESTERN SCREECH OWL		
	B265	GREAT HORNED OWL		
	B267	NORTHERN PYGMY OWL		
	B270	NORTHERN SPOTTED OWL	FT	
	B274	NORTHERN SAW-WHET OWL		
	B281	VAUX'S SWIFT	CSC	4
	B294	LEWIS' WOODPECKER		4
	B296	ACORN WOODPECKER		

GUILD(S)	WHRI	COMMON NAME	STATUS	NT
	B299	RED-BREASTED SAPSUCKER		4
	B300	WILLIAMSON'S SAPSUCKER		4
	B303	DOWNY WOODPECKER		
	B304	HAIRY WOODPECKER		
	B305	WHITE-HEADED WOODPECKER		
	B307	NORTHERN FLICKER		4
	B308	PILEATED WOODPECKER		
	B326	ASH-THROATED FLYCATCHER		4
	B338	PURPLE MARTIN	CSC	4
	B339	TREE SWALLOW		4
	B340	VIOLET-GREEN SWALLOW		4
	B356	MOUNTAIN CHICKADEE		
	B357	CHESTNUT-BACKED CHICKADEE		
	B358	PLAIN TITMOUSE		
	B361	RED-BREASTED NUTHATCH		
	B362	WHITE-BREASTED NUTHATCH		
	B363	PYGMY NUTHATCH		
	B364	BROWN CREEPER		4
	B380	WESTERN BLUEBIRD		4
	B381	MOUNTAIN BLUEBIRD		4
	B411	EUROPEAN STARLING		
	M025	LONG-EARED MYOTIS	FSC, S&M	
	M027	LONG-LEGGED MYOTIS		
	M030	SILVER-HAIRED BAT		
	M077	WESTERN GRAY SQUIRREL		
	M079	DOUGLAS' SQUIRREL		
	M080	NORTHERN FLYING SQUIRREL		
	M155	PACIFIC FISHER	C2, CSC, FS	
T/R	B366	ROCK WREN		4
	B367	CANYON WREN		
	M066	YELLOW-BELLIED MARMOT		
	R071	NIGHT SNAKE		
	R076	WESTERN RATTLESNAKE		

Appendix D

Wildlife Habitat Descriptions

Peregrine Falcon (Federally Endangered)

Peregrines have relatively strict nesting requirements: vertical cliff habitat with large potholes or ledges that are inaccessible to land predators and are preferentially located near habitat that has a high avian prey population. Peregrines are known to forage near and occasionally within forested habitat types; however, it is not considered a crucial habitat for any stage of their life history.

Bald Eagle (Federally Threatened)

Shasta Salamander (FS Sensitive, Survey & Manage Species, Fed Species of Concern, CA Threatened)

Suitable habitat for Shasta salamander is described as limestone caves or outcroppings which provide a cool, moist microclimate during the summer months, occurring below 3000 feet. They are most common where there is a light cover of oak among the limestones, though they do occur where digger pine-chaparral to sheltered canyons of Douglas-fir occur. These forested habitat also provide moist, cool microclimates, where salamanders can be found on the forest floor or under dead/down material. Salamanders are not known to use this type of habitat more than 50' from a limestone outcrop. Preferred habitat is usually found on north and east facing sides of outcrops below the 2000 foot elevation. (Bogener, D. and P. Brouha. 1979. Shasta Salamander (Hydromantes shastae), Shasta-Trinity National Forests: Comprehensive species management plan and a species status report. USFS-Shasta-Trinity National Forests. Unpublished, 35 pp.)

Northern Red-legged Frog (FS Sensitive, Fed Species of Concern)

This frog inhabits cool, deep, still to slow moving water such as lakes, ponds, ditches, or slow streams (Zeiner et al. 1990). Associated dense shrubby or emergent vegetation is required, and well vegetated terrestrial areas within the riparian corridor may provide important sheltering habitat during the winter (Davidson, 1994).

Northern Goshawk (FS Sensitive, Fed & CA Species of concern)

Suitable habitat for goshawks is described as late seral, dense coniferous, riparian or upland forests near early seral openings. Prey are medium to large birds or small mammals. According to the LMP, 'preferred' nest stand structure is 4b, 4c, and 5 conifer habitats with 60% of the nest stand containing a habitat mosaic with >60% canopy closure, 20% brush or small trees, and two or more 1/10 acre openings. The remaining 40% is dense mature forest with no openings and greater than 60% canopy closure. Forage stands also contain a 60% habitat mosaic with the remaining 40% having younger stands and openings.

Willow Flycatcher (FS Sensitive)

The willow flycatcher tend to nest in large clumps of willows separated by openings (Zeiner et al., 1990). Willow flycatchers have been detected in more linear willow habitat (some alder) along the main stem of the Trinity River; however, no nest sites were located (Wilson et al., 1992).

Pacific Fisher (FS Sensitive, Fed & Ca Species of Concern)

Suitable habitat for fishers consists of large areas of mature dense forest stands below 6000', with snags and canopy closure greater than fifty percent . Fishers use cavities in large trees, snags, logs (>30" DBH), rock areas and brush piles for cover and den sites. This species is largely carnivorous taking small mammals and birds. Riparian habitats are used as travel corridors and key habitat. Preferred road densities are <1 mi./mi.^{2}, with 1-2 mi./mi.^{2} acceptable for maintaining moderate habitat (LMP Appendix G).

American Marten (FS Sensitive, CA Species of Special Concern)

Suitable habitat consists of various mixed conifer forests types under 4000' elevation, with more than forty percent crown closure with large trees and snags. Martens use tree cavities, snags, stumps, logs, burrows, caves, and rocky crevices for cover and den sites. Habitat with limited human use is important. Small clearings, meadows, and riparian areas provide forage habitat. This species is mostly carnivorous taking small mammals and birds, but insects, fruit and fish are also consumed. See Pacific fisher for preferred road densities (LMP Appendix G).

Northwestern Pond Turtle (FS Sensitive, Fed species of Concern)

This species is found in a variety of habitat types associated with permanent or nearly permanent water (Holland, 1991; Zeiner, 1988). These turtles are often concentrated in low flow regions of rivers and creeks, such as side channels and backwater areas. They prefer creeks that have deep, still water and sunny banks. Hatchlings are small and require shallow edgewater areas with minimal currents. This species depends on basking to regulate their body temperature. Basking sites include logs and other woody material, rocks, emergent vegetation, overhanging vegetation that touches the water, and sloping banks. Studies conducted on the main stem of the Trinity River indicate this turtle prefers slow moving water (e.g., pools) where basking sites exist (Wilson et al., 1992).

Pallid Bat (Survey and Manage Species. CA Species of Concern)

This species is a year-round resident from low to high elevations. It selects a variety of day roosts including rock outcrops, mines, caves, hollow trees, buildings and bridges. Food items are primarily large ground-dwelling arthropods but also include large moths. Foraging occurs in and among vegetation as well as on the ground surface.

Long-eared Myotis (Survey and Manage Species, Fed Species of Concern)

This species is a year-round resident, primarily of the higher elevations associated with coniferous forests. The day roosts include hollow trees, under exfoliating bark; crevices in small rock outcrops; and occasionally in mines and caves. Nigh roosts show more variety but appear to favor caves and mines. Food items includes small beetles, flies and moths. Foraging occurs near vegetation and the ground.

Fringed Myotis (Survey and Manage Species, Fed Species of Concern)

This species is a year-round resident. Although found from low desert scrub to high elevation coniferous forest, it is primarily associated with middle elevation habitats. It uses mines, caves, trees, and buildings for day and night roosts. Its diet is composed primarily of beetles but includes a variety of other types of insects including moths.

Long-legged Myotis (Survey and Manage Species, Fed Species of Concern)

This species is a year-round resident primarily of the middle to high elevation forest habitats. It day roosts primarily in hollow trees, although it also uses rock crevices and mines. It feeds mostly on moths but will also eat beetles, flies, termites, and other small insects. Foraging occurs in open areas, often at canopy height.

Silver-haired Bat (Survey and Manage Species)

This species is primarily a resident of forested habitats. Winter roosts include hollow trees, rock crevices, mines and caves. Food items include a variety of insects but moths are the primary prey. Foraging occurs in or near wooded areas and along water courses.

Yuma Myotis (Fed Species of Concern)

No habitat description available

Tailed Frog (Fed & CA Species of Concern)

This species has been found in Shasta, Tehama, and Trinity counties. Suitable habitat is often referred to as mountain streams, but it is also found in steep walled valleys and coastal creeks. It is not associated with any particular plant species. In California, frog populations have been found in a variety of habitats including Sitka spruce, redwood, Douglas-fir and ponderosa pine forests as well as single populations in Yellow pine forest and Northern Coastal Shrub. Most known California Ascaphus populations are in areas with at least 40 inches of annual precipitation. However, farther north and east, Ascaphus can be found in areas with as little as 22 inches a year of precipitation.

Foothill Yellow-legged Frog (Fed & CA Species of Concern)

This species requires shallow, flowing water, apparently preferring small to moderate-sized streams with at least some cobble-sized substrate. They are infrequent or absent in habitats where introduced species are present (e.g., various fishes and bullfrogs).

Townsend's Big-eared Bat (Fed & CA Species of Concern)

This species is a year-round resident from low desert to high mountain habitats. It is a cavern dwelling species that uses mines, caves and buildings. It is one of the bat species most dependent on mines and caves in California. Food items are primarily small moths. Foraging occurs near vegetation and other surfaces, and prey is probably gleaned from these surfaces.

Snag Cavity Dwellers

General nest tree habitat requirements for primary excavator species are snags with signs of heart rot, firm sapwood, over 50% of the bark remaining (i.e., decay class 2 or 3), and 15” dbh or greater. Some species, like the pileated woodpecker, are able to excavate in firmer wood (decay class 1), whereas others, like the pygmy nuthatch, require softer wood (decay class 4). Forest habitat requirements vary from open canopy (western bluebird) to moderate and dense canopy habitat (house wren and flammulated owl). Snag density needs vary from 1.5 to 4.0 snags per acre, with the majority of snags in the 15-24" dbh size range. Species needing >24" dbh snags include marten, fisher, Northern spotted owl, pileated woodpecker and, on occasion, Northern goshawk. Recruitment required to maintain this snag density over time is approximately 3 green trees to one hard snag. Forage requirements are insect infested trees or logs, seeds, flying insects, terrestrial insects, or small mammals. Snags are also used by snag and non-snag dependent species for communication, courtship, food storage, thermal regulation, denning, cover, and perches.

Bark Cavity Dwellers

Some species nest or roost primarily under the bark, such as the brown creeper and long-legged bat. Only the snag tree requirements for bats are discussed here. Bats roost under the bark of snags, within snags, under wooden bridges, within caves, in tree foliage, and other similar areas. Suitable snags have been described as hollow snags or snags with peeling bark of 1" thickness or greater, located where it can be warmed by solar radiation, and standing 20+ feet tall. During the summer, bats may use a variety of roost sites, moving from one site to another depending on the time of day and temperature of the roost. Maternity roosts are very sensitive to disturbance during the summer months and hibernaculums during the winter. Eleven species of bats are suspected to occur within the watershed, with a few species not utilizing snags. No bat roost sites have been detected within the watershed. Formal surveys for bat roost sites have not been conducted and their snag requirements are unknown.

Dead/Down Dependent Species

General characteristics of the dead/down wood required by these species are medium to large (15" - 40"+) hollow or soft heartwood and sapwood with large sections of bark remaining. Bark helps to retain the moisture required by salamanders and warmth required by reptiles. Piles of small diameter dead/down wood (<10" dbh) provide cover and nesting sites for small mammals, birds and reptiles. If available, these small animals may also use shrubs for cover and duff for burrows. For small animals, approximately

25% of an area covered with small diameter dead/down wood (8" depth or greater) is recommended (Maser et al., 1979). Suitable amounts of medium to large diameter dead/down wood for foraging, varies by species from 10 tons/acre (fisher) to 15 tons/acre (black bear). Denning requirements are 20-40" dbh logs, with the number required per acre unknown.

Appendix E

History of the McCloud Arm Watershed

Prepared by Elaine Sundahl, Archaeologist at Shasta Lake Ranger Station

<u>Pre-1900:</u> Excavated prehistoric archaeological sites in the McCloud Arm are almost entirely related to the Wintu habitation of the past 500 years, although there are hints of much earlier occupations in the wooden atlatl and dart fragments and projectile point styles from Potter Creek Cave and numerous surface collections made from sites within the pool area.

The Wintu practiced an economic pattern heavily based on fishing and the storage of dried fish and acorns. Ethnographic information is available for 49 Wintu village sites, all of which are now inundated or partly inundated by Shasta Lake. Many of these have been recorded as archaeological sites, either prior to the completion of the dam or during extensive drawdown periods. Some 227 Wintu ethnographic placenames were collected for the McCloud Arm analysis area. Most describe locations now inundated by Shasta Lake, but many also name mountain peaks, ridges, caves, springs, rock formations, and trails which cross eastward to Squaw Creek via Nosoni Creek and Curl Ridge or westward to Salt Creek or Middle Salt Creek and the Sacramento River. Most placenames are not translated, but those which are provide clues to the Wintu life style and the natural world around them. Plant and animal references as translated are:

ANIMALS	**FISH/BIRDS**	**INSECTS**	**PLANTS**
bearskin	salmon	grasshopper	pine needles
deer licks	suckers	fleas	live oak brush
wolf	sturgeon		white oak acorn
beaver	hummingbird		black oak
grey squirrel	night hawk		maple tree
kangaroo rat	eagles		thorn apple
bat house	goose rocks		pepperwood
lizard	wild canary		yew wood bow
river mussels	duck		smoking material
			sarvis berry

<u>1850-1945:</u> The McCloud River apparently derived its name from Ross McCloud who, in the 1850's, explored the entire length of the river and attempted to establish a pack trail which he later abandoned in favor of the Sacramento River. Anglo-American settlement soon followed including Jeremiah Blizzard Campbell at Campbell Creek and Wesley Curl at Curl Creek, both of whom married Wintu wives, and Henry Hirz, on Hirz Creek. Government Land Office (GLO) surveys were conducted between 1870 and 1882 and a number of other homesteads and Indian Allotment Trusts were filed and patented in the late 1800's. Several ranches, including the Ellery Ranch, were located on terraces of the McCloud. The location of most of this early settlement in now under water.

Undoubtedly there was prospecting for gold during the middle 1800's, but the McCloud River was not a productive gold field. Iron mining began early with one claim shown on the 1882 GLO plat, but is primarily concentrated in two areas: just northeast of the confluence of the McCloud and Pit Rivers and on the north side of Hirz Mountain. Some copper mining took place around the turn of the century near the confluence of the McCloud and Pit, but was very limited compared to the mining on Squaw Creek and the Sacramento River. Some limestone was mined in the same area to use as flux in the Bully Hill smelter. Barite was mined in the early 20th century (see table below for summary of mines reported in The Mines and Mineral Resources of Shasta County, California, by Philip Lydon and J. C. O'Brien). An experimental smelter which electrically reduced iron ore was built in 1907 on the north side of the Pit River just east of the mouth of the McCloud and was discontinued in 1919. The settlement of Herault, which grow up around the smelter, lasted until 1928.

MINES IN THE MCCLOUD RIVER ARM ANALYSIS AREA

Name/Current Owner	Mineral	Location	Comments
Afterthought/U.S.A.	barite	T34N, R4W, Sec. 2	pre-1939
Austin/U.S.A.	barite	T34N, R3W, Sec. 29	1921-1924
Black Diamond/undetermined	iron	T35N, R3W, Sec. 8	
Blue Jacket/U.S.A.	copper	T34N, R4W, Sec. 25	developed 1896
California Consolidated/ Bass et al., Redding	iron	T34N, R4W, Sec. 26	early1900's to WW II
Greenwood/U.S.A.	barite	T35N, R4W, Sec. 35	
Hirz Mt. Iron Mine/SPI	iron	T35N, R3W, Sec. 7-8	1903-1044
Hirz Mt./U.S.A	barite	T35N, R4W, Sec. 12	
Kane and Wilber Group/U.S.A.	copper	T34N, R4W, Sec. 24	pre-1926
Minnie Haley Group/undeter.	copper	T34N, R4W, Sec. 24	pre-1923
Moxley/	limestone	T34N, R4W, Sec. 13	undeveloped
Shasta Belmont/U.S.A	copper	T34N, R4W, Sec. 24	pre-1908
Shasta Cement Materials/ Shasta Iron Co.	limestone	T34N, R4W, Sec. 13, 14, 16, 23	1920's-1940's, undeveloped
Shasta Iron Co. Group/ Shasta Iron Co.	iron	T34N, R4W, Sec. 26	pre-1894
Shasta Iron Co. Group/ Shasta Iron Co.	limestone	T34N, R4W, Sec. 26	quarried for use at smelter

The California-Oregon Trail, a toll road, was routed in 1871 up the west side of the McCloud River and followed Bailey Creek to cross the ridge into the Sacramento River drainage. It progressed up the Pit and McCloud by a series of switchbacks called "turntables". This route was modernized in 1916 by the State of California as the Pacific Highway, later called Highway 99. It was rerouted up Johns Creek, and the bed of this highway is still used for access to Bailey Cove Campground and extends into Shasta Lake as the boat ramp. Other early road access to the McCloud were by way of Salt Creek to Hirz Creek (near the current Gilman road) and Middle Salt Creek to Kabyai Creek (in the vicinity of the western portion of the Fenders Ferry Road) which extended down the McCloud to Ellery's. Numerous trails provided access to the rest of the McCloud River area.

The rich McCloud River fisheries were recognized early, and in 1872 two U. S. Fish hatcheries were established. The hatchery at Baird, which operated for 65 years, shipped salmon eggs throughout the country and the world, and a hatchery at the mouth of Greens Creek provided trout eggs.

In 1896 the Central Pacific Railroad acquired patented grants to all odd-numbered sections or fragments of sections within the watershed which weren't already deeded, creating the current checkerboard pattern of land ownership. They sold some of the river frontage for small ranches or homesites, such as that at the McCloud Bridge Campground.

Fossilized remains of an extinct Pleistocene bear were found in Potter Creek Cave in the McCloud Limestone formation in 1878, leading to extensive paleontological excavations at Potter Creek and Samwell Cave between 1902 and 1905 by the University of California at Berkeley. Fossils of extinct species of mammoth, horse, bison, scrub oxen, giant short-faced bear, dire wolf and ground sloth were recovered. Together these constitute the single most important source of information on the Late Pleistocene fauna of Northern California. Both caves also contain recent archaeological deposits dating within the past several thousand years, and both have been nominated for the National Register of Historic Places.

The 1907 formation of the Shasta National Forest affected only about twenty sections of land within the northeastern portion of the watershed area, one-half of this in private ownership, as most of the lower McCloud River drainage at that time was outside of the forest boundary. Forest Service duties consisted primarily of fire suppression and grazing management. Forest Service-managed lands in the watershed area formed part of the Salt Creek Grazing Allotment which also extended into the Squaw Creek drainage. Records dating from 1917 through 1919 show seven permittees ran a total of 300 to 500 cattle and horses each year from May lot to Nov. 30th, 500 to 2000 sheep and goats, and 100 hogs. Cattle were driven up the McCloud River and then allowed to drift up Campbell Creek, Dekkas, Mathles, and Nosoni Creek drainages. The owners provided malt, ideally every two weeks. Some rounded up their stock in the fall but others just allowed their animals to drift out to their homes. Grazing also took place on what was then private lands on the western side of the McCloud. The Central Pacific Railroad leased their land for grazing at 2 1/2 cents per acre.

The Forest Service constructed a series of trails, primarily along ridgelines which were patrolled by horseback with high points serving as fire lookouts. Single wire telephone lines connected many of these points with the ranger stations. Trails connected the McCloud River with Minnesota Mountain, Salt Creek Mountain, and Nosoni Mountain. Another trail followed the major ridgeline from Minnesota Mountain north of "Curl Cabin", near where Horse Ridge joins Curl Ridge.

With the inception of the Civilian Conservation Corps (CCCs), 400 enrollees based in the old fish hatchery buildings at Baird were engaged in work projects for the Bureau of Reclamation. Many other CCC members worked on projects for the National Forest. As the construction of Shasta Dam was in its planning stages, much of the CCC effort was used in relocating roads, such as the Fenders Ferry Road. The CCCs also built Hirz Mountain Lookout in 1940. It's unique tower and cab combination is the only one of its kind in California, qualifying it for the National Register of Historic Places.

A 1937 land use map of the McCloud River areas shown grazing as the most widespread activity. A number of homes and ranches are plotted from the Pit River to Baird and again from Hirz Creek to Ellery Creek, and commercial recreation is shown at the confluence of Hirz Creek and the McCloud and at Ellery's Lodge. The latter, built in 1913 of native stone, is now inundated at highwater. The stone foundations remains and are recorded as an archaeological site.

<u>1945 to present:</u> The construction of Shasta Dam, begun in 1938 and completed in 1945, created a reservoir which inundated about twelve miles of the McCloud River above its confluence with the Pit River, drastically changing the appearance, ecology, and social systems of the McCloud Arm analysis area. Acquisition of private land by the Federal government primarily took place in the late 1930's. The reservoir was designed for flood control, irrigation, and the production of energy, but quickly became an important recreational attraction. The shoreline was originally managed by the National Park Service, but with the 1948 Public Law 449, Congress transferred administrative responsibility to the Shasta National Forest, and the Forest boundaries were moved to include the lake. The National Recreation Area (NRA) was created by Congress in 1965 with its primary goal of public outdoor recreation.

Interstate 5 and the Southern Pacific Railroad line were relocated but still travel through a corridor in the southwestern portion of the McCloud Arm. Much of the McCloud River is accessed by the Gilman road, completed in 1957 and named for District Ranger John Gilman.

Government docks were developed at Turntable Bay to facilitate Forest Service responsibilities on the lake. By 1955, campgrounds were located at Bailey Cove, Greens Creek, Curl Creek, Jennings Creek, and McCloud Bridge. In 1965, additional campgrounds included Hirz Bay, Dekkas Rock, Ellery Creek, Wyntoon, Hirz Bay, Moore Creek, and Pine Point. Point McCloud was built in 1970. In recent years several of these have been abandoned. Commercial boat docks were located at Bailey Cove and Hirz Bay in 1955, and other commercial enterprises followed at Lakeview Resort and Marina and Shasta Caverns. Other privately operated recreational areas include the Shasta Yacht Club, an organizational camp on Dekkas Creek, and a summer home tract at Campbell Creek.

Multiple use activities of the National Forest for the area outside of the NRA focused on timber production, watershed protection, wildlife habitat improvement, and recreation. Although grazing was continued briefly after the filling of Shasta Lake with the Forest Service barging animals across the lake, it ceased as permits expired, and there are currently no grazing allotments on the District. Mining was prohibited in the NRA and no active mines are known for the watershed area.

Appendix F

Bald Eagle Habitat Improvement

The following proposal includes recommendations for improving bald eagle habitat at Hirz Bay on the McCloud Arm of Shasta Lake. This document is included as support for vegetation and habitat recommendations in Chapter 6 of the analysis (pg. 6-2).

Date: October 26, 1994

Subject: Bald Eagle Habitat Improvement Proposal-Shasta Lake RD

To: District Ranger, Shasta Lake

Attn.: Nancy Hutchins, District Wildlife Biologist

At the request of Shasta Lake Ranger District, we completed several field analysis of selected bald eagle nesting sites on Shasta Lake. Our primary objective was to evaluate current habitat conditions and propose appropriate silvicultural strategies to protect habitat over the short term and manage to maintain suitable nesting, roosting and foraging conditions over the long run. Our team consisted of two silviculturists and two wildlife biologists; Nancy Hutchins, District Wildlife Biologist; Jeff Wood, Biological Technician; Jeff Paulo, Forester/Silviculturist; Ralph Phipps, Planner/Silviculturist. Steve Clauson, Forest Planning Officer, also accompanied us on our initial field review.

We made initial visits to approximately ten bald eagle nesting sites which had shown evidence of active nesting within the past year. Sites were located on the three major arms of Shasta Lake, the Sacramento, McCloud, and Pit River arms. We determined that three sites were more conducive to silvicultural practices which would provide for the short-term maintenance of nesting habitat. The three sites recommended include O'Brien, Jones Valley, and Hirz Bay.

Bald Eagle Habitat Improvement Proposals: Long-term and Short-term

Long-term:

Long-term bald eagle habitat improvement is highly conducive to the level of analysis afforded by Ecosystem Management planning. This would allow for an integrated assessment of affected resources within the Shasta RNA. Long-term habitat needs, including stand structure, age class distribution, and suitable habitat regeneration could be assessed. No site-specific long-term proposals were assessed by the review team.

Short-term:

Three bald eagle nesting sites were identified which could benefit in the short-term through the application of silvicultural practices. The three sites recommended for habitat enhancement include O'Brien, Jones Valley, and Hirz Bay.

O'Brien:

The O'Brien site consists of a multi-aged, generally two-storied ponderosa pine and black oak stand. Nest trees are predominant layer ponderosa pine which are infected by low-moderate levels of dwarf mistletoe (Kimmey 2-4). Bark beetle activity, primarily the western and mountain pine beetle, are contributing to nest tree mortality. Nest trees are generally high-risk. Small, even-aged, over-stocked aggregations of ponderosa pine are scattered throughout the stand.

Silvicultural options: Provide for the basal application of EPA-approved insecticide to provide for maintenance of nest tree, and selected high-risk potential nest trees, to reduce risk of mortality due to bark beetles. Provide for stocking control (thinning) of over-stocked ponderosa pine aggregations.

Planning Timeline/Budgetary Needs: FY95; ID Team/NEPA analysis-District estimate. Plans/Analysis for thinning-$1200. FY96; Systemic Insecticide Application-$1500. Thinning (including premarking, thinning contract, contract administration, fuels treatment) $500/acre X 20 acres (eat)=$10000.

Jones Valley

The Jones Valley site consists of a generally one-storied, even-aged mature ponderosa pine stand. The understory is primarily composed of canyon live oak and black oak. Nest trees are predominant layer ponderosa pine which are infected by low levels of dwarf mistletoe (Kimmey 1-2). Bark beetle activity, primarily the western and mountain pine beetle, are contributing to nest tree mortality. Nest trees are generally high-risk.

Silvicultural Options: Provide for the systemic application of EPA-approved insecticide to provide for maintenance of nest tree, and selected high-risk potential nest trees, to reduce risk of mortality due to bark beetles. Provide for the commercial thinning of the well-stocked ponderosa pine stand.

Planning Timeline/Budgetary Needs: FY9.5; ID Team/NEPA analysis-District estimate. Plans/Analysis for thinning-$500. FY96; basal Insecticide Application-$1500. Thinning (including premarking, thinning contract., contract administration, fuels treatment) $1500/acre X 20 acres (eat)=$30000.

Hirz Bay

The Hirz Bay site consists of three vegetatively distinct stands. One is a multi-aged, generally two-storied ponderosa pine and black oak stand. Nest trees are predominant layer ponderosa pine which are infected by low-moderate levels of dwarf mistletoe (Kimmey 2-4). Bark beetle activity, primarily the western and mountain pine beetle, are contributing to nest tree mortality. Nest trees are generally high-risk. The second is a multi-storied, generally mixed conifer stand in which Douglas-fir is the primary species. Predominant ponderosa pine which are capable of being currently utilized as suitable nest trees are scattered throughout the stand. The third stand is on a site generally incapable of providing suitable bald eagle nesting habitat.

Silvicultural options: Provide for the basal application of EPA-approved insecticide to provide for maintenance of nest tree, and selected high-risk potential nest trees, to reduce risk of mortality due to bark beetles. Provide for stocking control (thinning) of over-stocked ponderosa pine aggregations.

Planning Timeline/Budgetary Needs: FY95; ID Team/NEPA analysis-District estimate. Plans/Analysis for thinning-$2000. FY96; Systemic Insecticide Application-$2500. Thinning (including premarking, thinning contract, contract administration, fuels treatment) $500/acre X 60 acres (est)-$30000.

These proposals were developed in a collaborative manner under the direction and through the assistance of the District Wildlife Staff.

We will provide detailed, integrated silvicultural prescriptions if and when the District decides to proceed with project/NEPA process implementation.

/s/Ralph Phipps
Planner/Silviculturist (SO)

/s/Jeff Paulo
District Silviculturist (YBRD)

Appendix G

Recreation Facilities on the McCloud Arm

Commercial Services

Resorts/Marinas

Holiday Harbor

Holiday Harbor is a full service resort located on the north shore of Bailey Cove. Visitor services provided include: houseboat rentals and other vessels such as patio boats, ski boats, fishing boats, personal watercraft, canoes and parasailing. Moorage, gas stations (both on and off the lake); laundry facilities, grocery store with sundries, bail and tackle and restaurant. A campground, located adjacent to the marina, has 28 campsites with full hookups and showerhouse on the premises.

Lakeview Marina Resort

Lakeview Marina Resort is located approximately one mile north (up river), of the Shasta Caverns Chalet on the McCloud River Arm. Visitor services provided include: houseboat rentals, moorage, marine gas, grocery store with sundries, and bait and tackle available on floating dock. A boat ramp is available for houseboat customers only.

Shasta Caverns

Shasta Caverns is located on the McCloud River Arm. The Shasta Caverns headquarters chalet is located at the end of Shasta Caverns Road, approximately 2 miles east of I-5. A large parking lot and adjacent picnic area are located next to the chalet. Services available to the public include: souvenir/gift shop, snack bar, restroom facilities and waiting area for the guided tour. Restroom facilities and a small natural history museum are located on the east side of the McCloud Arm, adjacent to the cave entrance.

Government Services

Campgrounds

Bailey Cove

Bailey Cove is a family campground located 0.5 mile south of Shasta Caverns Road at the end of FS road 34N40Y. This newly remodeled campground has 5 single sites that will accommodate up to 2 vehicles and 8 people per site. Each site has a picnic table and fire ring. There are two double sites that will accommodate up to 16 people and 4 vehicles. The restroom is wheelchair accessible and has flush toilets and sinks. There are 3 water faucets located within the campground.

Greens Creek

Greens Creek is a boat access campground. It is located on the east side of the McCloud Arm at Greens Creek. There are 7 family campsites each with a table and fire ring. Each site will accommodate up to 8 people. Boats are brought to the shoreline and visitors carry their gear to the sites which are located above the high water mark. There is one restroom facility which is a vault toilet. The Greens Creek Trailhead is located adjacent and to the north of the campground.

Hirz Bay

Hirz Bay is a family campground located 10 miles east of I-5 along the Gilman Road. It has 37 single sites that will accommodate up to 2 vehicles and 8 people per site. Each site has a picnic table and fire ring. There are 11 double sites that will accommodate up to 16 people and 4 vehicles. Overflow parking areas will accommodate 28 additional vehicles.

Hirz Bay Group Camp #1

Hirz Bay Group Camp #1 is located 0.2 miles south of Hirz Bay family campground. This facility will accommodate up to 120 people. There are 21 parking sites, 11 tables, 4 campstoves, 2 sinks, 2 hydrants and 4 outhouses each with two vault toilets.

Hirz Bay Group Camp #2

Hirz Bay Group Camp #2 is located 0.5 miles south of Hirz Bay family campground. This facility will accommodate up to 100 people. There are 16 parking sites, 3 hydrants, 8 tables, 2 small bar-b-q pits, one pedestal grill and one fire ring. There is one outhouse with 4 vault toilets.

Dekkas Rock Group Camp

Dekkas Rock Group Camp is located along Gilman Road one mile north of the Hirz Bay facility exit. This facility will accommodate up to 35 people. There are 6 parking sites, two hydrants, 8 tables, one large bar-b-q pit and 7 fire rings. There are two vault toilets. Overflow parking will accommodate 7 vehicles.

Moore Creek

Moore Creek is a family campground located along Gilman Road 2.5 miles north of the Hirz Bay facility exit. There are 12 single family campsites each with a fire ring, picnic table and parking site. Each site will accommodate up to 2 vehicles. There are 3 hydrants and two vault toilets. Each single site will accommodate up to 8 people.

Ellery Creek

Ellery Creek is a family campground located along Gilman Road 5.5 miles north of the Hirz Bay facility exit. There are 19 single family campsites each with a fire ring, picnic table and parking site. Each site will accommodate up to 2 vehicles. There are 5 hydrants and two outhouses each with two vault toilets. Each single site will accommodate up to 8 people.

Pine Point

Pine Point is a family campground located along Gilman Road 6.5 miles north of the Hirz Bay facility exit. There are 14 single family campsites each with a fire ring, picnic table and parking site. Each site will accommodate up to 2 vehicles. There are 3 hydrants and one outhouse with 2 vault toilets. Each single site will accommodate up to 8 people.

McCloud Bridge

McCloud Bridge is a family campground located along Gilman Road 8 miles north of the Hirz Bay facility exit. There are 20 single family campsites each with a fire ring, picnic table and parking site. Each site will accommodate up to 2 vehicles. There are 7 hydrants, one vault toilet and two flush toilets. Each single site will accommodate up to 8 people. There are 4 overflow parking sites.

Day Use Picnic Areas

Bailey Cove Picnic Area

Bailey Cove Picnic Area is located adjacent to the Bailey Cove campground and boat ramp, which is 0.5 miles south of Shasta Caverns road at the end of FS road 34N40Y. There are 11 parking sites in the no fee area. There are 9 picnic sites, each with a pedestal grill and table. There is a drinking fountain adjacent to the restroom which has 4 flush toilets and two sinks,

Dekkas Rock Picnic Area

Dekkas Rock Picnic Area is located adjacent to the Dekkas Rock group campground, which is along Gilman Road 1 mile north of the Hirz Bay campground exit. There are 5 picnic sites, with 4 fire rings and 2 hydrants. There is one vault toilet. The site parking capacity is 5 vehicles.

Trails

Bailey Cove Trail

The Bailey Cove trailhead is located adjacent to the Bailey Cove picnic area and boat ramp. This is a loop trail, so the trail ends at the same place it begins. It is 2.9 miles long, and offers good lake fishing access and sightseeing opportunities. Views of the McCloud Arm of Shasta Lake and the Grey Rocks directly across Bailey Cove are available from this trail that circles what was once a mountain. Trailhead parking is available in both the boat ramp (59 sites) and picnic area (11 sites). This trail is too narrow for mountain bike use.

Hirz Bay Trail

The Hirz Bay Trail connects Hirz Bay family campground and Dekkas Rock picnic area. Trailhead parking is available in both the Dekkas Rock picnic area (4 sites) and the Hirz Bay family campground overflow parking (28 sites). This trail is 2 miles long and follows the shoreline giving easy access for swimming and fishing. The trail crosses a small limestone formation that provides good fossil viewing opportunities. This trail is too narrow for mountain bike use.

Greens Creek Trail

Greens Creek Trail begins on the north side of Greens Creek boat access campground which is on the east side of the McCloud Arm. This trail ends in Corey Cove which is just south of Bear Creek on the Squaw Creek Arm. Trail access is by boat only. This trail is 6.5 miles long and connects the McCloud Arm with the Squaw Creek Arm by climbing through the limestone formation between the two arms.

Samwel Cave Trail

Samwel Cave Trail begins from the shoreline at Point McCloud which is on the east side of the McCloud Arm directly across the lake from Ellery Creek Campground. This trailhead access is by boat only. Vehicle access for this trail is from a small undeveloped parking area (4 sites) 2.3 miles past McCloud Bridge Campground along Fenders Ferry Road. From the Fenders Ferry Road to the Point McCloud lake access, the trail is 1.4 miles long. This steep, narrow trail climbs through fossil-bearing limestone rocks; providing excellent views of the McCloud Arm river canyon. Both trailhead access points lead to the mouth of Samwel Cave, 0.4 miles via Fenders Ferry Road and 1 mile from Point McCloud.

Boat Ramps

Bailey Cove Boat Ramp

Bailey Cove boat ramp is located adjacent to the Bailey Cove campground and picnic area which is 0.5 mile south of Shasta Caverns Road at the end of FS road 34N40Y. The ramp is located on the south side of the cove. There are 2 launching lanes with a floating courtesy dock. This ramp is unusable when the lake draw down exceeds 50 feet, but boat launching still occurs from old highway 99 that surfaces after the main ramp is up out of water. There are a total of 59 parking sites within the fee area.

Hirz Bay Boat Ramp

Hirz Bay boat ramp is located 0.6 mile south of Hirz Bay family campground. It has a total of 3 ramps. Three launching lanes are available until the lake drawdown exceeds 75 feet. Two lanes are available until the lake drawdown exceeds 95 feet. This ramp is out of the water when the lake drawdown exceeds 115 feet. There is one outhouse with two vault toilets and one hydrant. There are 62 parking sites within the fee area.

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