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).

Announcements were published in local newspapers in Redding and Southern Siskiyou County inviting public input to this analysis. Open Houses were held in Redding, McCloud and Big Bend, where resource specialists presented information on existing conditions and management direction for National Forest lands within the Iron Canyon Watershed.

The Iron Canyon Watershed Analysis was prepared with input and involvement from the following resource specialists:

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Chapter 1

Characterization of the Iron Canyon Watershed Area

The purpose of this chapter is to place the watershed in context within the river basin, provinces, and the broad geographic area. This chapter will briefly analyze the dominant physical, biological, and human dimension features, characteristics, and uses of the watershed.

The major topics covered in this chapter are:

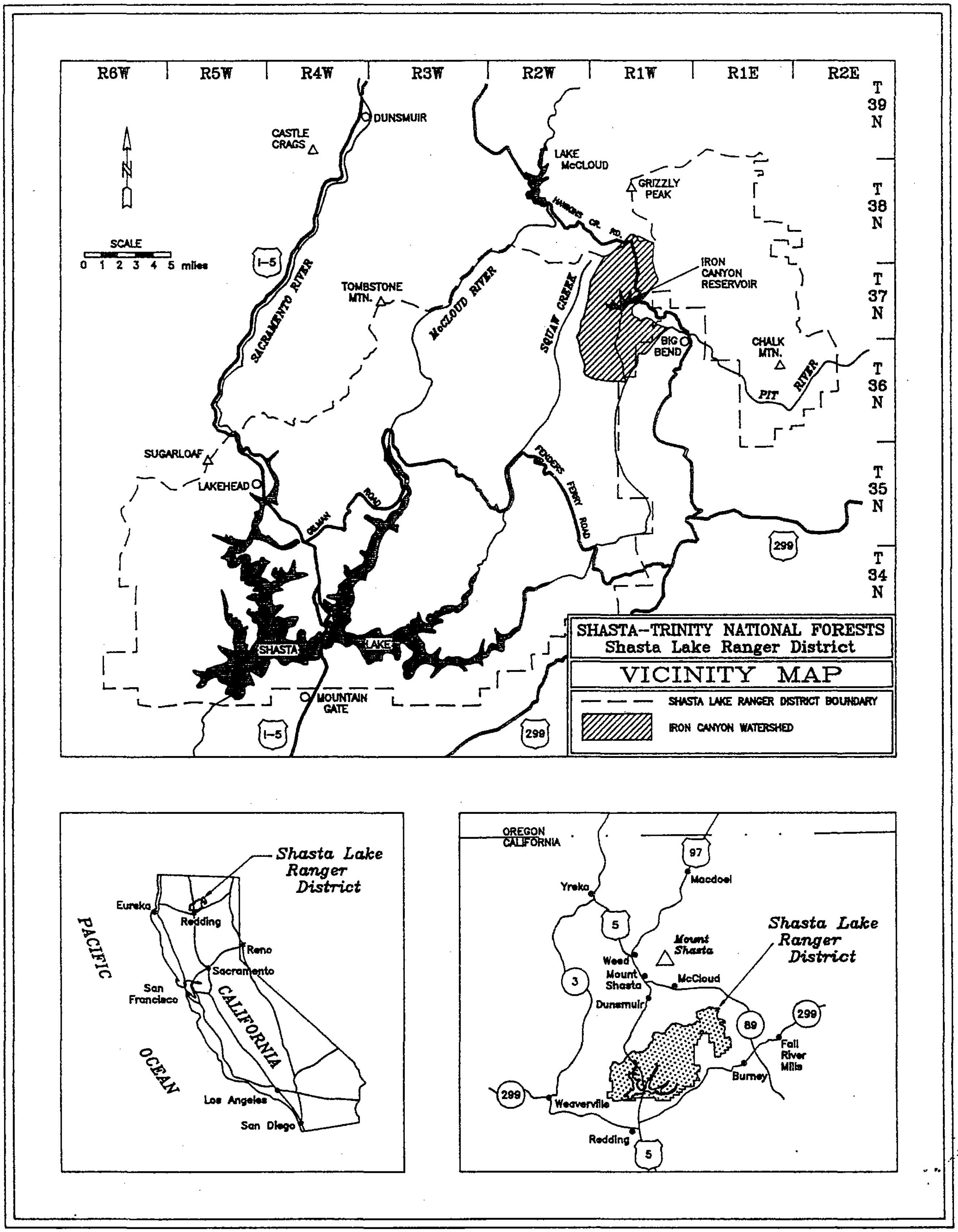
- Location and land management relationships
- Physical features of the watershed
- Late-successional forests and habitat
- Riparian and aquatic ecosystems
- Social characteristics and uses

Location and land management relationships

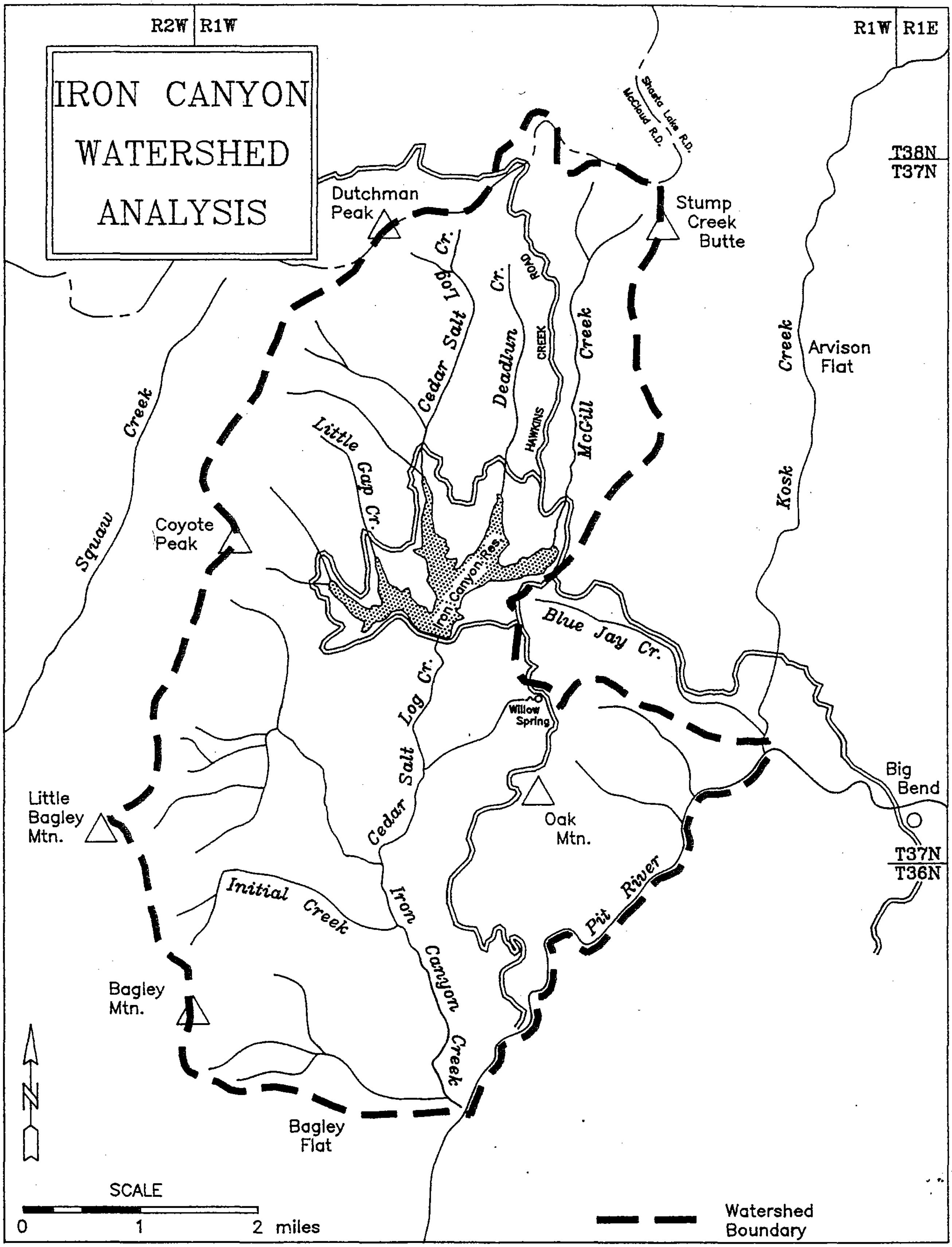
The Iron Canyon Watershed is located near the small town of Big Bend, within Shasta County, California. The watershed lies about 26 miles north and east of the larger regional center Redding, and is a component of the Pit River Drainage (see "Vicinity map, (Map 1)). The watershed is about 17,000 acres in size, of which 12,300 acres are National Forest (see "Private Ownership" map, (Map 3)).

The Iron Canyon Watershed is entirely within the boundary of the Shasta-Trinity National Forests. The watershed is a component of Management Area 11 in the Forest Land Management Plan (LMP), and also comprises the eastern 1/6th of Late Successional Reserve (LSR) RC-335 (see "Late Successional Reserve", (Map 4)), as detailed in 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*" and "*Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl*" (April 1994). Management direction for activities within LSRs is:

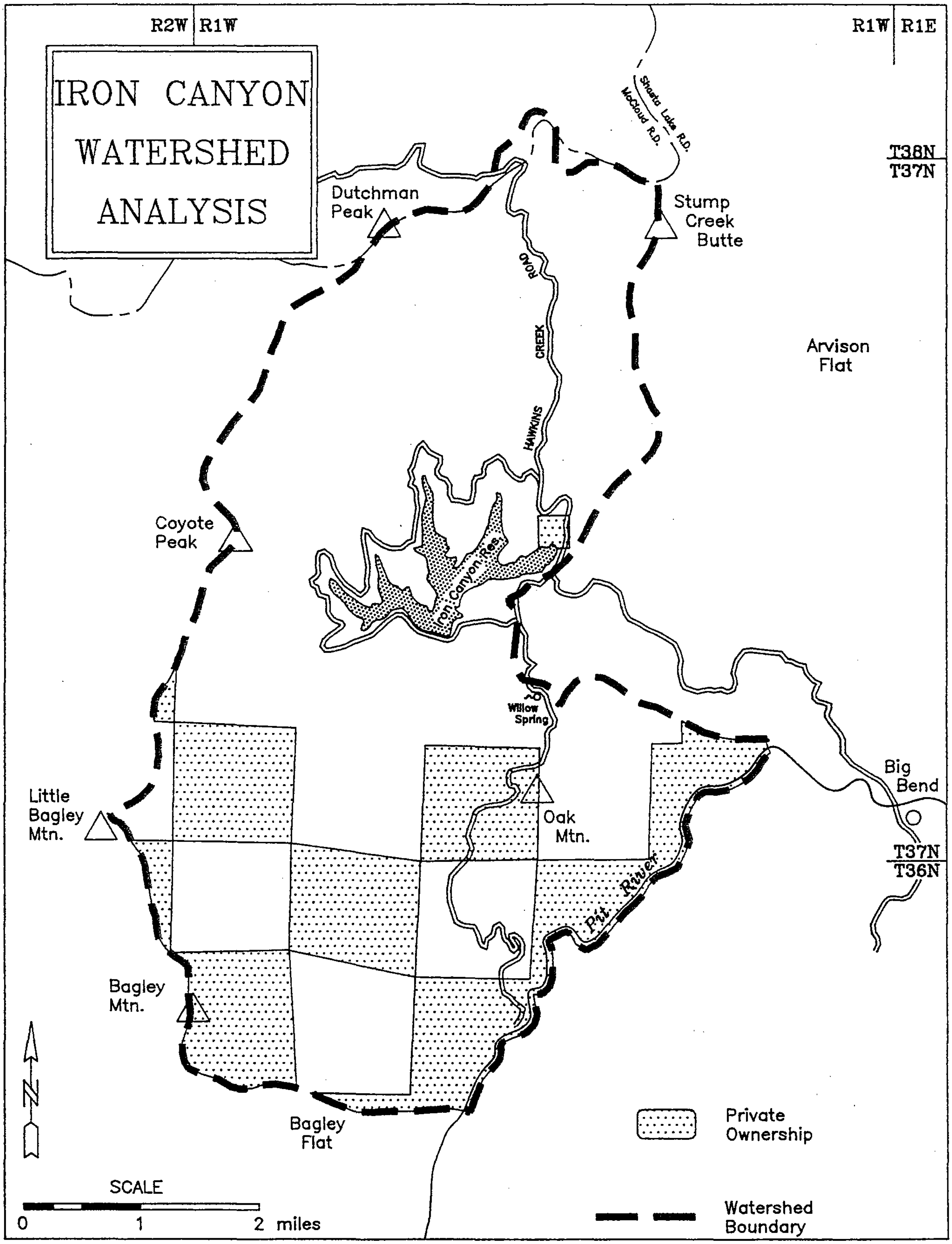
- to maintain the viability of late-successional habitat dependent species within the Shasta-McCloud subprovince
- to provide a source population of northern spotted owls
- to provide a linkage for genetic interchange between the northern and California spotted owl sub-species



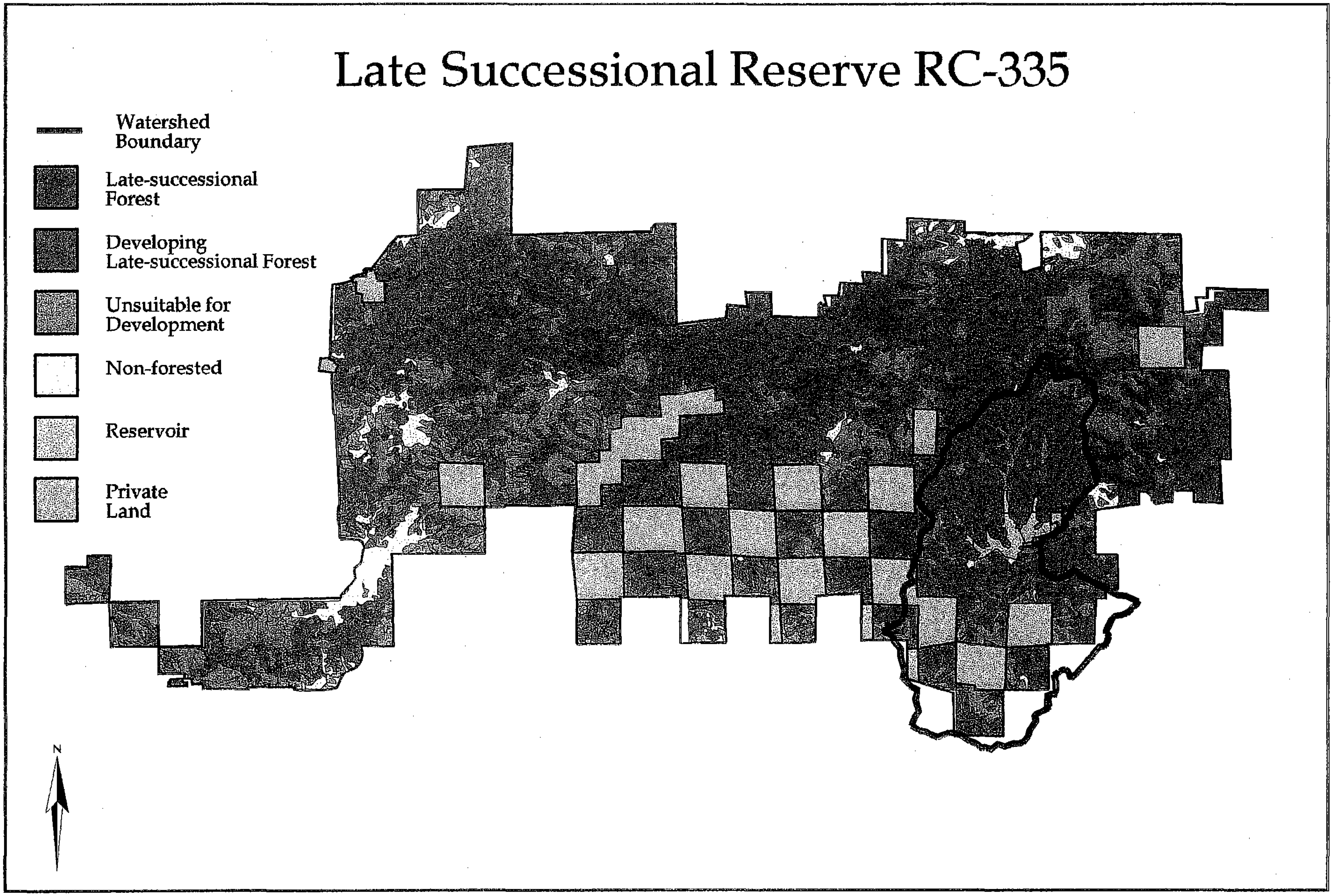
Map 1. Vicinity Map



Map 2. Dominant Features



Map 3. Private Ownership



Map 4. Late-successional Reserve

Physical features of the watershed

The Iron Canyon Watershed lies within the Eastern Klamath Plate of the Klamath Mountains geomorphologic province. Elevations run from 1700 to 4300 feet. The geologic strata of this area are subdivided into formational units consisting of inter-fingered volcanic and alluvial sediments, limestone, and volcanic flows. A major fault (*Willow Creek*) crosses the area southwest from Arvison Flat/Kosk Creek into Iron Canyon. Several other faults criss-cross the area. In general, these faults form broad fault zones which themselves form the contacts between the formational units and are the focus of the active mass wasting processes that occur in the area.

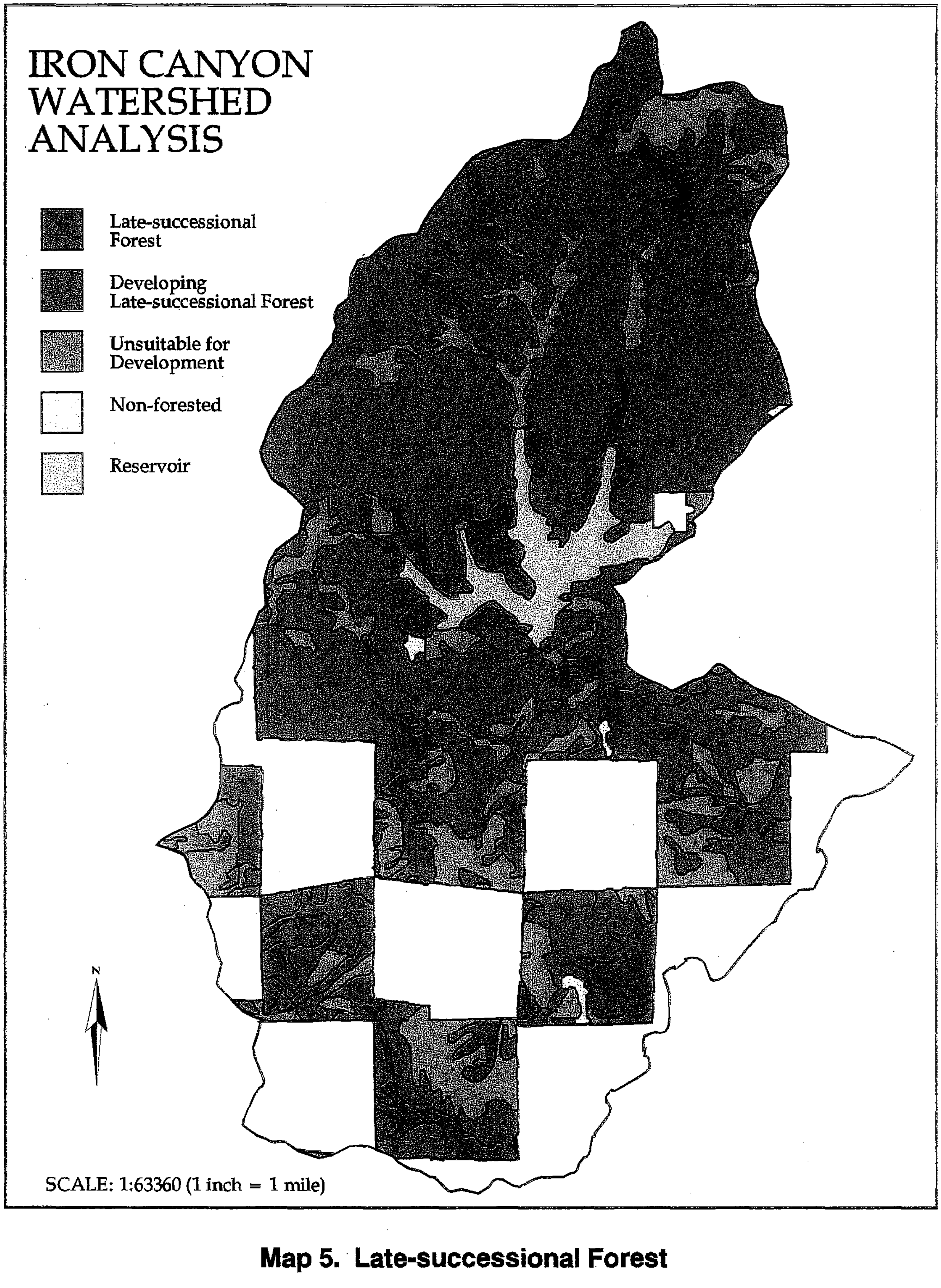
Another key factor that contributes to mass wasting is the present rapid uplift rate typical of the Klamath Province. Mass wasting risks tend to vary greatly across the area depending upon localized geological conditions, aspect, and topographic position. Debris slides, torrents, rotational/translational landslides, and earth flows are in evidence throughout the area. The vast majority are naturally occurring, but poor road construction, past logging practices, and construction of the reservoir and associated works have all contributed to accelerated soil erosion processes.

The soils of the Iron Canyon Watershed Analysis area have developed from very old and weathered metasediments and lava flows. Soil depths range from shallow to deep. The shallow soils are represented by the series Deadwood and Goulding; the moderately deep soils by Neuns, Marpa and Washougal and the deep soils by Marpa (deep) and Holland (deep). In general, these soils are considered to be highly productive. This is not only due to the high percent of deep and moderately deep soils, but also to the high precipitation that the area receives. The greatest potential damage to soil productivity and water quality within the area is associated with rutting in the roads and subsequent gully erosion.

Late-successional forests and habitat

Old-growth forests are not present within the watershed. Less than 20% of the watershed's forested stands can be characterized as "late-successional". These stands are very fragmented, relatively small in size (less than 300 acres) and not well-connected by suitable corridors (see "Late-successional Forest", (Map 5)). Most of these stands are located within Riparian Reserves associated with streams and Iron Canyon Reservoir.

Periodic fires were a regular part of the local ecology prior to the arrival of settlers. The fire return interval for this period is estimated at 8-20 years. Forest composition and arrangement were controlled by these fires, and forests were well adapted to its influences. Large fires of the late 1800s are believed to have eliminated large amounts of old-growth and late-successional forest, opening up the watershed for growth of forbs and grasses. Extensive grazing by sheep and cattle occurred during the early 1900s as a result. Since the early part of this century, fire has been excluded within the watershed, other than some fuels management activities in the 1970s and 1980s associated with logging.



Map 5. Late-successional Forest

Logging, other land management activities, and fire exclusion have all contributed to the altered state of the watershed's vegetation today. In the past, riparian areas and cooler, moister sites were primarily Douglas-fir dominated mixed conifer forests, and upland forests tended toward pine (sugar and ponderosa) dominated mixed conifer forests. Today's forests are dominated by Douglas-fir.

The Iron Canyon Reservoir vicinity supports two pairs of nesting bald eagles. There have been two goshawk sightings within the watershed, and one osprey nest is located to the north of the reservoir. There have also been two pine marten sightings in the McGill Creek drainage. Based upon habitat types existing in the area, Pacific fisher, willow flycatcher, northwestern pond turtle, tailed frogs, and northern red-legged frog are also expected to be present. No northern spotted owls are known to inhabit the watershed at this time. The watershed may provide suitable foraging habitat for the American peregrine falcon, however, no known nest occur, nor are suitable cliffs present. This watershed lies east of the range of the marbled murrelet and suitable habitat is not present.

In addition to the threatened, endangered, and sensitive (TES) species known and suspected to exist, many wildlife species common to western forests also inhabit the watershed. A complete list of terrestrial species is located within Appendix C. The watershed provides summer and transitional range for the McCloud deer herd. A small elk herd is also known to use the general area.

Riparian and aquatic ecosystems

The Iron Canyon Watershed lies within the Pit River Basin. Waters originating from the Iron Canyon area flow into Shasta Lake via the Pit River, down the Sacramento River system to the Delta, and finally into the Pacific Ocean at the Golden Gate. This watershed is dominated by Iron Canyon Reservoir, an impoundment with a surface area of 426 acres. Five streams flow into the reservoir: McGill, Deadlum, Cedar Salt Log, Little Gap, and Gap Creeks. Initial Creek and an unnamed stream are the major tributaries that flow into Iron Canyon Creek below the dam.

Water is imported to Iron Canyon Reservoir from Lake McCloud, to augment Pacific Gas and Electric Company's electrical power generation program on the Pit River. This imported water additionally helps to maintain the reservoir surface level and provide more seasonally stable flows to Iron Canyon Creek. The dam has interrupted some aquatic related ecological processes in Iron Canyon Creek, including sediment transport, stream flow rates (including the absence of flood events), recruitment of large woody debris, and has stopped the movement of aquatic species past the dam structure.

There are approximately 30 miles of fish bearing streams within the analysis area. Habitat quality within these streams varies, but is generally considered fair. The primary limiting factor to fish production within streams appears to be a lack of deep pools.

Rainbow trout are the only native game fish known to occur in the area. Within the reservoir, most of the population is planted by the California Department of Fish and

Game, although some natural reproduction does occur. There are also native populations of rainbow trout that reside in headwater streams, such as Upper McGill Creek.

Other fish species that may occur in lower Iron Canyon Creek (from the Pit River) include the riffle sculpin, Sacramento sucker, Sacramento squawfish, and the speckled dace. There are no known federally listed TES species of fish within the watershed. The Shasta crayfish and Pit River sculpin, which are State listed species, occur upstream on the Pit river system but are not found within this watershed.

Social characteristics and uses

The Iron Canyon area was inhabited historically by the Madesiwi band of the Pit River Indian Tribe. It is believed that the area was inhabited for 4,000 to 5,000 years by these people, whose lives revolved around hunting and fishing, and the collection of plant and mineral resources. The salmon of the Pit River, which in part migrated up Iron Canyon Creek, were a major food source, and winter villages were commonly located along the river. Upland areas were used for hunting and other resource collecting, primarily during the warmer seasons. A number of place names in the Pit River language testify to the use of the Iron Canyon area. No religious or other culturally important sites are known to exist in the area.

Homesteading of the area occurred between 1899 and 1920. Some sections of land were privately acquired through railroad grants. The 1965 construction of Iron Canyon Dam and Reservoir created a major change in local land use patterns. What had previously been flat to gentle terrain with meadows, supporting homesteads and sheep grazing, became a popular recreation area for fishing and camping.

About 70% of the public lands within the watershed have been surveyed for heritage resources. Sixteen archeological sites have been recorded to date. Of these, eight prehistoric sites lie within the pool area of Iron Canyon Reservoir. These sites are being heavily damaged by erosion, artifact collection, and vehicular traffic during low water periods. Sites outside of the reservoir, including a historic trail, a can scatter, a corral, and prehistoric sites are less subject to ongoing damage.

Past logging activities in the area focused on the removal of large-diameter conifer trees, primarily sugar pine, ponderosa pine, and Douglas-fir, whose wood was used for construction. Milling activities, where logs were converted into lumber products, occurred primarily in Burney and Redding.

The Iron Canyon road system is characterized by an arterial/collector system (Hawkins Creek Road and the road around the reservoir), a considerable number of local roads, and a collection of low standard non-system roads and ridgetop jeep trails. Although most area roads were constructed to support logging operations, they still provide access within the area. Most of the mid-slope roads with flatter grades and the surfaced high-traffic roads provide good access and acceptable levels of erosion. The most serious road drainage and erosion problems are along roads within or near Riparian Reserves. Road use in wet weather has resulted in accelerated soil erosion. Gates and other road closure methods appear to have largely failed to prevent traffic access.

The watershed is a relatively popular area for outdoor recreational activities. Hunting, fishing, woodcutting, off-road vehicle use, camping, and sightseeing are the primary activities pursued in the area. Fishing occurs primarily in Iron Canyon Reservoir with limited use in the surrounding streams. Winter recreational use of the watershed is often severely restricted due to snow and weather-related road conditions. The road system, originally constructed to transport logs out of the woods, now serves the public by providing easy access within the area, outside of the winter season.

Chapter 2

Issues and Key Questions

The purpose of this chapter is to focus on the key elements of the ecosystem relevant to future land management activities, and to identify the data and analysis needed to provide broad direction for future projects. Issues and key questions were developed by the interdisciplinary team. Major issues of immediate concern are identified and characterized, and corresponding key questions asked.

The three major issues identified are:

1. Lack and loss of late-successional habitat and forests
2. Impacts to riparian and aquatic ecosystems
3. Compatibility of social uses with LSR objectives

Issue:

Lack and loss of late-successional habitat and forests

Review of the Iron Canyon Watershed shows that no old-growth forest remains. Future old-growth forest stands will be recruited from developing late-successional stands. There is a high risk of losing large acreages of these developing stands to wildfire due to the fuel loads and stand conditions that exist today.

LSRs 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. Activities within the watershed will need to be compatible with protecting and enhancing the condition of late-successional forests and habitats over the long term.

Less than 20% of the watershed's forests can be classified as "late-successional", which means the forests are in their mature and/or old-growth stages. No northern spotted owls currently inhabit the watershed and many forest characteristics required by late-successional dependent species are absent or extremely fragmented and unusable.

Forests within the watershed are constantly changing as their individual components become established, grow, mature, and die. Over the long run, the composition, arrangement, and characteristics of a forest can be controlled by many different methods, depending on the site involved and the outcomes desired. With the status of the Iron Canyon Watershed as a portion of a LSR, forests in the watershed should be reviewed to determine not only their current composition and arrangement, but to determine if they are evolving in an acceptable manner, and at a desirable rate. If not, then actions can be prescribed to achieve those characteristics within the watershed's forests.

Chapter 1 of this analysis mentions that wildfires were a natural occurrence within the watershed. The exclusion of wildfire for the last sixty years has profoundly affected the condition of today's late-successional forests. The buildup of combustible forest fuels, both live and dead, has created a condition in which stand replacing fire events are possible. This condition is contrary to the goals of the LSR because it places at risk the existing late-successional forest, and the younger forests which should develop into the late-successional forests of the future. The hazard of stand replacing fire events exists now within the watershed, and will continue to worsen until such time as a fire occurs, or the hazard is mitigated.

Based on this issue, the following key questions were generated:

1. What is the current composition and structure of vegetative communities? What is missing and what needs to be restored?

2. Are there known locations of threatened, endangered and sensitive (TES) species in the watershed? Is habitat present for TES species to meet objectives outlined in the ROD, LMP, recovery plans, etc.?

3. Are younger stands evolving optimally toward late-successional or old-growth conditions? If not, what can be done to accelerate development? Where?

4. How can stand replacing wildfire be prevented from reducing the amount of existing late-successional forest, and delaying the development of younger forests into old-growth forests.?

5. Is habitat present for Survey and Manage (S&M) species which occupy the terrestrial ecosystem?

6. Is fragmentation of late-successional forest habitat affecting the function of ecological processes in the LSR? What areas in the watershed are the highest priority for treatment to decrease fragmentation? Are corridors adequate?

Issue:

Impacts to riparian and aquatic ecosystems

The Shasta-Trinity National Forests LMP (April, 1995) provides direction in the Pit River Management Area (Area 11) to maintain high water quality levels to meet a variety of objectives, including promoting a healthy trout fishery. From the Standards and Guidelines for the ROD, the Aquatic Conservation Strategy Objectives include direction to:

- Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features, to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted.

- Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.

- Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.

- Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.

As characterized in Chapter 1, past land management activities are believed to have degraded riparian ecosystems from their historic condition. Current and future land management activities have the potential to do so as well. In addition, conditions within the watershed create the hazard that otherwise "natural" events will have a degrading effect upon riparian ecosystems. Wildfire and soil erosion are two examples.

Based on this issue, the following key questions were generated:

1. Which management activities continue to adversely effect aquatic habitat and riparian ecosystems? Are they significant and in need of rehabilitation within the next two years?

2. What are the optimum transportation needs for management and use of the watershed, balanced with the needs of the LSR and Riparian Reserves?

3. What opportunities exist to preserve or enhance Riparian Reserve attributes?

4. Is habitat present for S&M and riparian obligate species that occupy the Riparian Reserves? What conditions need to be improved?

Issue:

Compatibility of social uses with LSR objectives

The Iron Canyon Watershed serves many different purposes, including recreation, the production of commodities (such as electrical power and timber), a LSR, and as a source of water. Each of these elements, and others not mentioned, interact to some extent to create a complex situation where the needs of one resource may conflict with the needs of another, or several others. Determining the priority, objectives, and constraints of future land management activities will require interaction with this issue also. Analysis of this issue, and the key questions it raises, should allow for good general guidance to land managers in pursuing project activities.

Based on this issue, the following key questions were generated:

1. What opportunities exist to provide forest products consistent with LSR objectives?

2. Are natural trout production and present fish stocking levels adequate to meet fish user demand?

3. What social activities may be affecting the late-successional condition? Is the existing level of recreation compatible with LSR objectives?

Summary of Issues and Key Questions

Issue: <u>Lack and loss of late-successional forests.</u>

Based on this issue, the following key questions were generated:

1. What is the current composition and structure of vegetative communities? What is missing and what needs to be restored?
2. Are there known locations of TES species in the watershed? Is habitat present for TES species to meet objective outlined in the ROD, LMP, recovery plans, etc.?
3. Are younger stands evolving optimally toward late-successional or old-growth conditions? If not, what can be done to accelerate development? Where?
4. How can stand replacing wildfire be prevented from reducing the amount of existing late-successional forest, and delaying the development of younger forests into old-growth forests.?
5. Is habitat present for S&M species which occupy the terrestrial ecosystem?
6. Is fragmentation of late-successional forest habitat affecting the function of ecological processes in the LSR? What areas in the watershed are the highest priority for treatment to decrease fragmentation? Are corridors adequate?

Issue: <u>Impacts to riparian and aquatic ecosystems</u>

Based on this issue, the following key questions were generated:

1. Which management activities continue to adversely effect aquatic habitat and riparian ecosystems? Are they significant and in need of rehabilitation within the next two years?
2. What are the optimum transportation needs for management and use of the watershed, balanced with the needs of the LSR and Riparian Reserves?
3. What opportunities exist to preserve or enhance Riparian Reserve attributes?
4. Is habitat present for S&M and riparian obligate species that occupy the Riparian Reserves? What conditions need to be improved?

Issue: <u>Compatibility of social uses with LSR objectives</u>

Based on this issue, the following key questions were generated:

1. What opportunities exist to provide forest products consistent with LSR objectives?
2. Are natural trout production and present fish stocking levels adequate to meet fish user demand?
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Chapter 3

Current Conditions in the Watershed

The purpose of this chapter is to detail field conditions as they are currently known to exist within the Iron Canyon Watershed. This chapter follows the three major issues identified in Chapter 2, and is responsive to the key questions identified for each issue.

The three major issues identified in Chapter 2 are:

1. Lack and loss of late-successional habitat and forests
2. Impacts to riparian and aquatic ecosystems
3. Compatibility of social uses with LSR objectives

Lack and loss of late-successional forests

Topics discussed in this issue include:

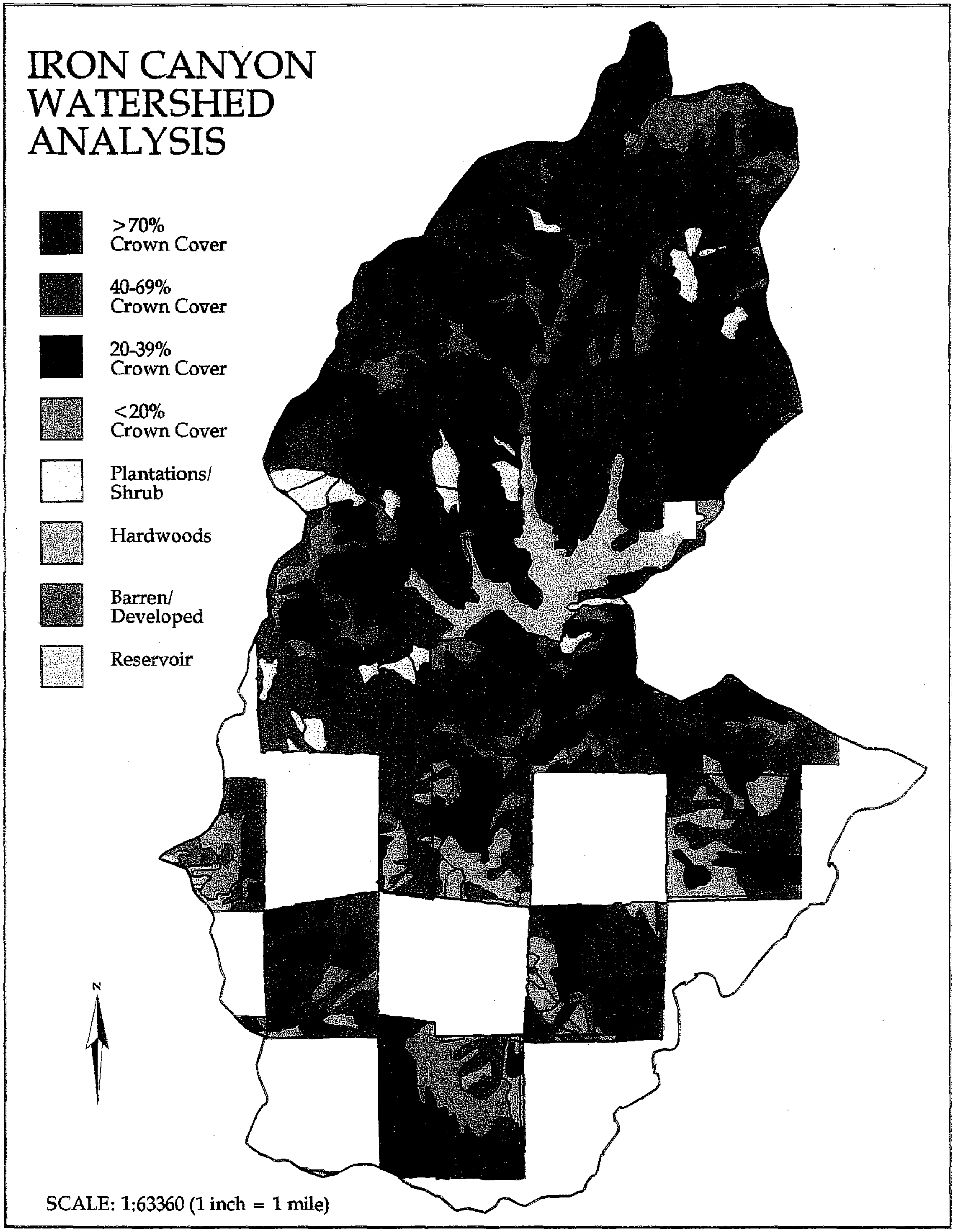
- Composition and structure of vegetative communities.
- Fragmentation of late-successional forest.
- Fuels and fire hazard conditions within late-successional forests.
- Terrestrial S&M species habitat.
- TES species within the watershed.

Composition and structure of vegetative communities

The Iron Canyon Watershed is a vegetative mosaic of conifer dominated forests. Approximately 76% of the watershed is comprised of open and moderate canopied forest. Dense canopied forest comprises approximately 11% of the watershed. Late-successional forest patches generally have dense canopy closure.

Forest Canopy Types on National Forest in the Iron Canyon Watershed

Canopy Type	% Crown Cover	% Present in Watershed	Acres
Open	10-39	40	4910
Moderate	40-69	36	4420
Dense	70-100	11	1350
Pure oak stands		6	737
Plantation/shrub		3	368
Non-National Forest			4496
Reservoir		4	491
Total		100	16,774



Map 6. Forest Canopy Cover

Vegetation Types in the Iron Canyon Watershed

Vegetation Type	Acres
Conifer Forests	
Douglas-fir	2,163
Mixed conifer	829
Mixed conifer (Douglas-fir dominated)	7,087
Mixed conifer (ponderosa pine dominated)	996
Conifer plantations	390
Total Conifer Forest acres	11,465
Hardwood Forests	
Black oak & mixed hardwood	329
Canyon live oak	421
Total Hardwood Forest acres	750
Non-forested Areas	
Barren (dam, pipeline, quarries)	46
Reservoir	513
Shrub	14
Total Non-forested acres	573

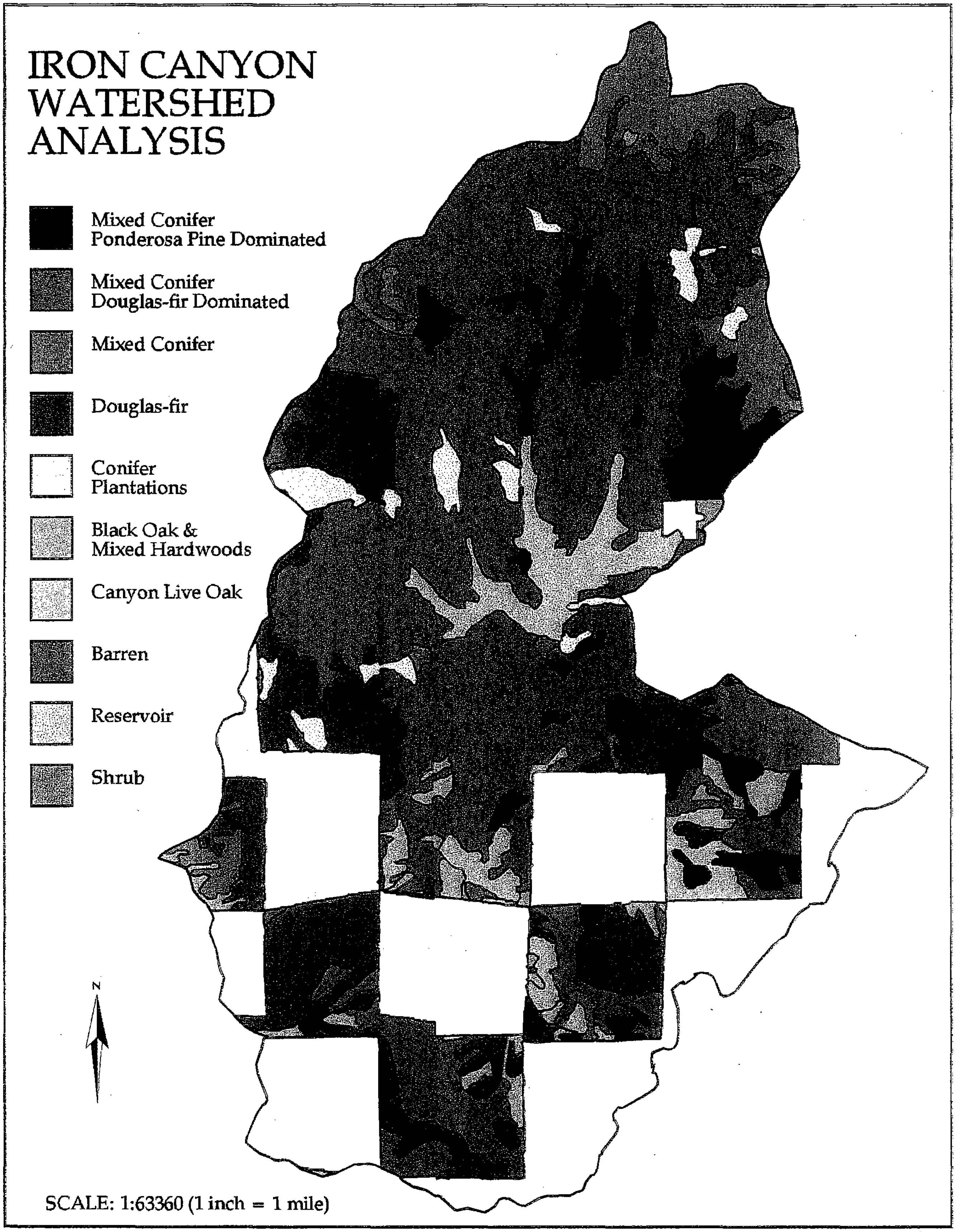
Two general conifer forest types are found in the Iron Canyon Watershed:
Douglas-fir - Douglas-fir comprises 80% or more of the trees
Mixed conifer - no single species comprises 80% or more of the trees

Besides Douglas-fir, other species in both forest types include white fir, ponderosa pine, sugar pine, and incense-cedar. Pacific yew is found in riparian areas. The Douglas-fir forest type is found mostly in the western portion of the watershed. The mixed conifer forest type dominates the remainder of the area. The "Vegetation Types" map (Map 7) depicts the location and extent of the various forest types with the watershed.

California black oak and canyon live oak occur in both of these general forest types in varying densities. Oak also occurs in pure stands on approximately 6% of the watershed - mostly in the southern portion.

Understory vegetation occurs in varying densities depending on the closure of the canopy. Principal shrub species include California hazel, deerbrush, mock-orange, poison-oak, tanoak, and snowberry.

Stands identified as late-successional forest within the Iron Canyon Watershed are much younger in age than normally associated with such forests. These stands are often not utilized by late-successional wildlife species due to lack of sufficient habitat, absence of critical habitat components, fragmentation of habitat, poor travel corridors, and other factors. Remnants of older components are scattered throughout the stands, such as large



Map 7. Vegetation Types

snags, large old-growth black oaks, and large down logs. True old-growth forest stands greater than 200 years old are absent in this watershed. Crown diameters on the largest trees range from 12 to 24 feet. Some of these stands are multi-layered and multi-aged.

Areas of high live and dead fuels accumulation have been identified in the watershed and are delineated on the "Dead and Down Fuel Loading" (Map 9) and "Live Fuel Hazard" (Map 8) maps. These conditions generally occur in stands less than 100 years old.

Fragmentation of late-successional forest habitat

As shown on the "Late-successional Forest Map" (Map 5), patches of suitable habitat for late-successional species are fragmented throughout the watershed and small in size (less than 300 acres). Suitable habitat patches are often poorly connected by adequate corridors, resulting in isolation of these habitat patches. Riparian zones are the natural corridors to connect late-successional suitable habitat; however, most of these areas are highly disturbed as a result of logging, road construction, and reservoir and dam construction As a result, they no longer provide adequate corridors for the travel of species that require continuous, forested canopy.

Ridgetops also provide natural corridors within the watershed. The utility of these corridors has also been degraded by logging, road construction, and the exclusion of wildfire. A relatively shrubby understory in areas where the canopy has been opened up has developed in some areas, thus inhibiting wildlife movement and impeding foraging. This condition is believed to affect animal species such as the marten and fisher.

Fuels and fire hazard conditions within late-successional forests.

There are two main components to measuring the potential for wildfire in the watershed. One component is hazard, which is determined from the conditions under which a wildfire would burn, mainly fuels (both live and dead), topography, and weather. The other component is fire risk, which measures the chance of a fire occurring in the area, and is calculated from fire occurrence.

Fire Hazard

Winter storms in the last four years have created concentrations of heavy dead standing and downed fuels in some areas of the watershed. These concentrations occur generally along major ridges. There are, however, a few areas on mid and lower slopes which are also showing concentrations of fuel. The location of these areas is shown on the "Dead and Down Fuel Loading" (Map 9) map.

Fire hazard is determined for various areas in the watershed through the following process:

- Step 1 - A fuel model is selected that characterizes the area.
- Step 2 - Flame lengths are predicted for that model based on weather conditions and slope.
- Step 3 - Hazard ratings are determined based on predicted flame lengths.

Model 10

Timbered areas with a heavy dead and down component are typed as fire behavior Fuel Model 10. This fuel model characterizes the storm damaged areas and the LMP vegetation density type "G" and "N" stands (greater than 40% crown closure). Fire burning in this fuel model is of fairly high intensity. Flame lengths on an average summer day range from 4 to 10 feet high, depending on slope and wind speed. Flame lengths exceeding 8 feet will probably present serious fire control problems, such as torching, spotting and crowning. Fires of this type are usually very damaging to the forest, and often are stand replacing.

Fuel Model 10 Flame Length, ***feet***

Midflame Wind	Slope						
(Mile/hr.)	10.0	20.0	30.0	40.0	50.0	60.0	70.0
2.0	4.3	4.6	5.0	5.5	6.1	6.7	7.4
4.0	6.1	6.3	6.6	7.0	7.4	7.9	8.5
6.0	7.8	7.9	8.1	8.4	8.8	9.2	9.7

Model 6

In the watershed, timbered stands that have an open canopy (less than 40% crown closure) tend to have a heavy understory of chaparral and mixed conifer. This arrangement creates ladder fuels that carry fire into the overstory. Fuel Model 6 characterizes fire behavior in these stands as well as in pure chaparral stands and in plantations, which also have a heavy live fuel component. Flame lengths in this model range from 5 feet to 11 feet high, with the same control consequences as Fuel Model 10.

Fuel Model 6 Flame Length, ***feet***

Midflame Wind	Slope						
(Mile/hr.)	10.0	20.0	30.0	40.0	50.0	60.0	70.0
2.0	5.0	5.3	5.7	6.3	6.9	7.6	8.3
4.0	7.2	7.4	7.7	8.1	8.6	9.2	9.8
6.0	9.1	9.3	9.5	9.8	10.2	10.7	11.2

Model 9

Black oak stands in the watershed are characterized by Fuel Model 9. Components contributing to fire behavior in this model are a deep surface litter layer of fine fuels and fairly open understory. Closed stands of ponderosa pine also fall into this fuel model, although there are few pure stands of this type in the watershed. Flame lengths from fires in this fuel model are from 2 to 6 feet. Fires may be fast spreading but are responsive to direct fire suppression tactics. Concentrations of dead downed material may contribute to torching of individual or small groups of trees.

Fuel Model 9 Flame Length, *feet*

Midflame Wind	Slope						
(Mile/hr.)	10.0	20.0	30.0	40.0	50.0	60.0	70.0
2.0	2.3	2.5	2.7	3.0	3.4	3.7	4.1
4.0	3.5	3.6	3.8	4.0	4.2	4.5	4.8
6.0	4.7	4.7	4.9	5.0	5.2	5.4	5.7

Analysis of these fuel models with slope and aspect show a fire behavior pattern of low, medium, and high hazards. See the "Live Fuel Hazard" map (Map 8).

Low hazard
Flame lengths of less than 4 feet. Can generally use direct attack suppression tactics. Less damage to residual stand, depending on species and time of year.

Medium Hazard
Flame lengths of 4 to 8 feet. Wildfires too intense for direct attack. Hand line may not be effective. Will cause stand mortality, especially on steeper slopes.

High Hazard
Flame lengths more than 8 feet high. Wildfire may present serious control problems such as torching, crowning, and spotting. Extensive stand mortality can be expected.

Fire risk

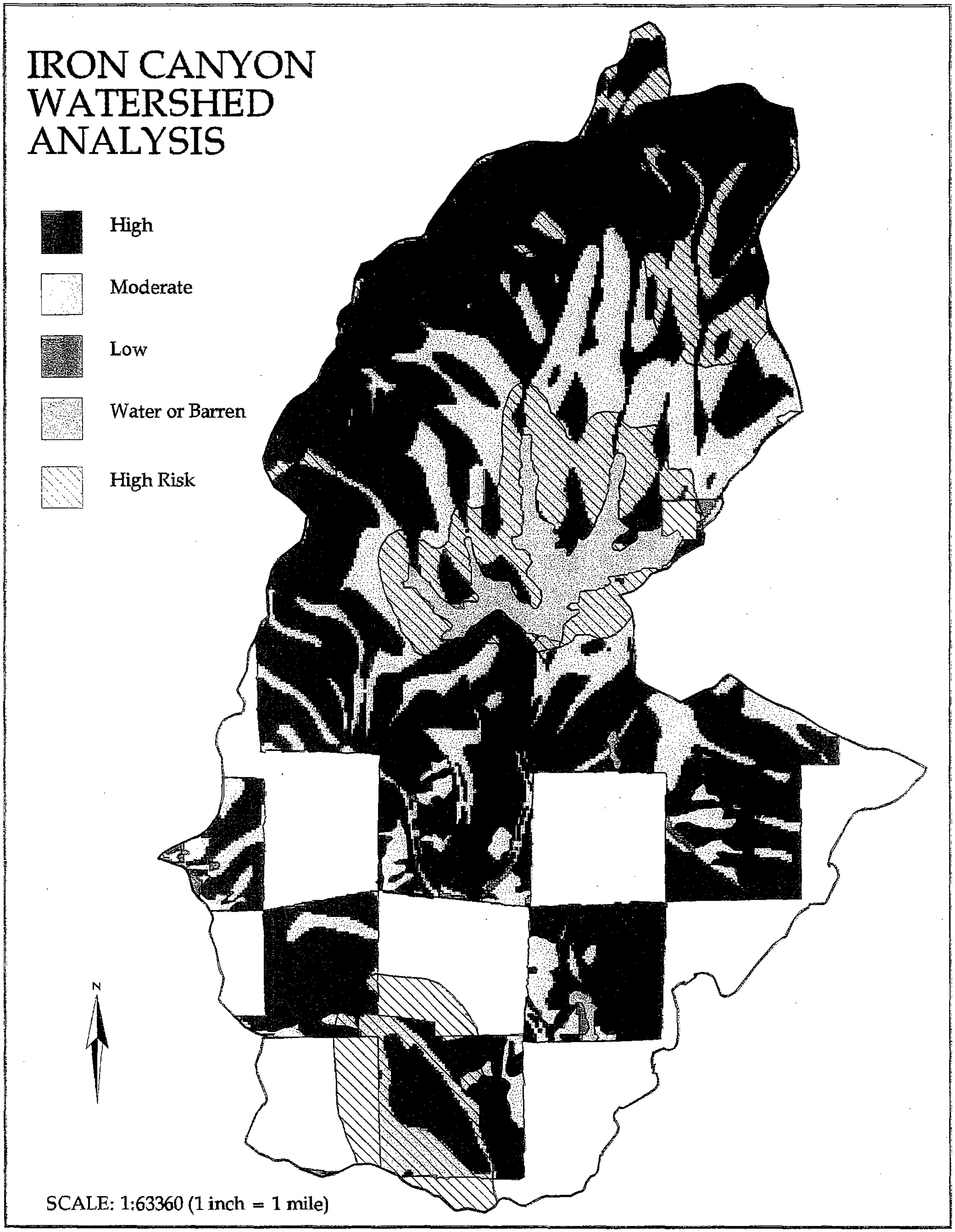
There have been 21 fires in the watershed between 1974 and 1993 (20 years). Seven were human caused and 14 were lightning caused. Analysis of fire occurrence densities shows that there are 3 areas of high fire occurrence and 1 area of low fire occurrence. The "Live Fuel Hazard" map (Map 8) details those areas where a high risk of fire starts exists.

The relationship of hazard and risk to late-successional forests

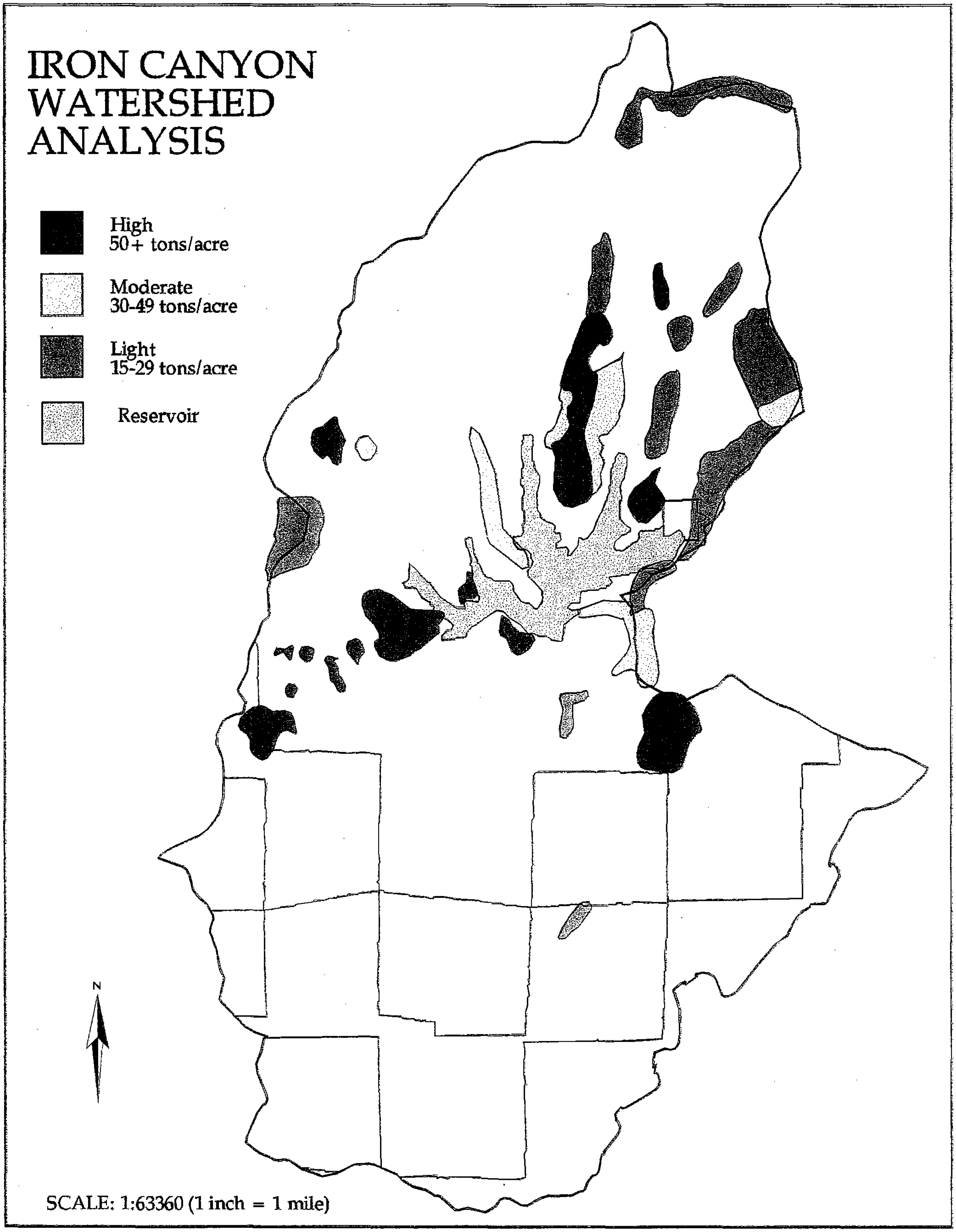
Many of the areas identified as having concentrations of downed fuels are in vegetation typed as late-successional forest or are adjacent to late-successional forest. Suppression of wildfires will be difficult in these fuel conditions. Many of the intermediate stands are also located in high hazard areas. See the "Late-successional Forest and Fire Hazard" map (Map 10).

Terrestrial "Survey and Manage" species habitat

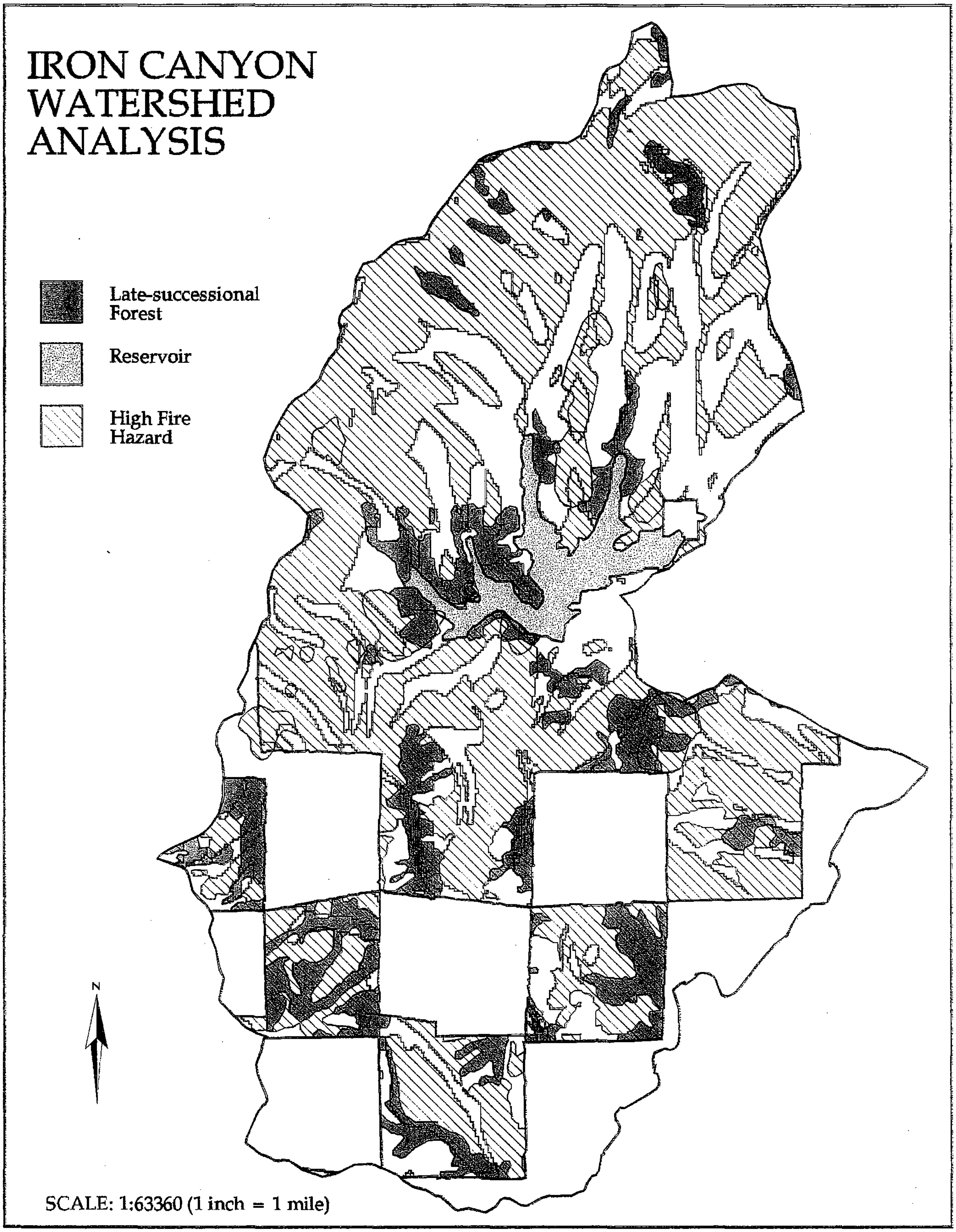
The ROD includes standards and guidelines intended to protect and enhance habitat for certain late-successional and old-growth forest-related species throughout the range of the northern spotted owl. These species are listed in Table C-3 of Attachment A to the ROD and are commonly referred Survey and Manage (S&M) species. A subset of these species



Map 8. Live Fuel Hazard



Map 9. Dead and Down Fuel Loading



Map 10. Late-successional Forest & Fire Hazard

known or potentially occurring on the Shasta-Trinity National Forests is published in Appendix R of the Shasta-Trinity National Forests Land Management Plan (LMP).

Four Strategies apply to the S&M species. Each strategy has its own timetable for implementation.

- Strategy 1: (manage known sites) applies to activities implemented in 1995.
- Strategy 2: (survey prior to ground-disturbing activities and manage all sites) is phased in for certain salamanders, red tree voles and lynx for all projects implemented in 1997. For species in other groups, Strategy 2 will apply to activities implemented in 1999. Survey protocols are currently being developed for these species.
- Strategy 3: (conduct extensive surveys and manage sites) surveys must be underway by 1996, but standardized survey protocols are yet to be developed.
- Strategy 4: (general regional surveys) will be initiated in 1996 and are to be completed by 2006.

Survey and Manage Plants

There is no existing information regarding the habitat requirements for the S&M species of fungi, lichens or bryophytes listed in Appendix R of the LMP. Many of these species of plants are suspected and some are known to occur on the Shasta-Trinity National Forests, so it is possible that some of these species may inhabit the Iron Canyon Watershed. No known sites occur within the watershed at present.

Habitat is present for the following S&M vascular plant species which may inhabit the terrestrial ecosystem.:

- *Allotropa virgata*-- **Candy stick**
  - Candy Stick is found in oak, mixed or coniferous forests, 250-10,000 feet in elevation.
- *Cypripedium montanum*--**Mountain lady's slipper**
  - This plant may be found in moist areas, dry slopes, mixed evergreen, or coniferous forests, 700-7,000 feet in elevation.
- *Cypripedium fasciculatum*--**Clustered lady's slipper**
  - This plant may be found in moist areas in open coniferous forests below 5,500 feet in elevation.

Survey and Manage Animals

Amphibians

The Shasta salamander is the only S&M amphibian species that may inhabit the watershed. No specific surveys have been conducted to date in this watershed. There are small limestone outcrops scattered in the watershed, possibly providing suitable habitat. These areas will need to be surveyed prior to ground-disturbing activities implemented in 1997 or later.

Birds

One past great gray owl sighting is recorded in the vicinity of Iron Canyon Reservoir; however, the reliability of this report is not known at present. This species is only suspected to occur within the Shasta-Trinity National Forests. This species generally inhabits high elevation meadows and nests in large stem diameter snags.

Mammals

Red tree voles and lynx, both S&M animals, are not found within the watershed because the area is outside of the range of these animals.

Mollusks

18 species of mollusks are listed as possibly occurring on the Shasta-Trinity National Forests. Specific habitat requirements and ranges of these species are not known at present. Based on information in the 1995 S&M database, no known sites occur within the watershed.

Arthropods

No information is known about these species, nor have surveys been conducted. General regional surveys will be conducted prior to 2006.

Bats

Five species of bats are listed as S&M species, and all could potentially occur within the watershed.

Survey and Manage Bats that could be present

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

No surveys have been conducted to date, nor are there any known sites at present. All five species use caves, mines, buildings, crevices, hollow trees, snags, under bark or dense foliage near water for roosting and nursery colonies. Silver-haired, long-eared, and long-legged bats prefer older forests where loose bark, snags, hollow trees or dense foliage are present. The fringed and pallid bats appear to be more closely associated with early seral stage and open forests.

TES species within the watershed

TES species and habitat needs are discussed in this section in the following manner:

- Plants
- Animals

Threatened, Endangered, and Sensitive Plants

There are no known species of TES plants in this watershed. No surveys have been conducted, however. The Iron Canyon Watershed does provide some suitable habitat for the following species of sensitive and endemic species:

- *Neviusia cliftonii*--Shasta snow-wreath
- *Ageratina shastensis*--Shasta eupatory
- *Arnica venosa*--Veiny arnica
- *Lewisia cotyledon var. howellii*--Howell's lewisia
- *Streptanthus shastensis*--Shasta jewelflower

Threatened, Endangered, Sensitive Animals

The following TES animal species have been located within the watershed or would be expected to inhabit late-successional forest within the watershed:

Animal	Status
bald eagle	Federally threatened
northern spotted owl	Federally threatened
marten and fisher	Forest Service sensitive
northern goshawk	Forest Service sensitive
Pacific western big-eared bat	Federal Category 2

Bald eagle

Two pairs of bald eagles are known to nest within the Iron Canyon Watershed. The nest sites are located on National Forest land, along the shoreline of Iron Canyon Reservoir. The first nest (104-1) is located on the western side of the reservoir within Section 20, T37N, R1W (MDM). The second nest (104-2) is located in the eastern portion of the reservoir, within the northeast quarter of Section 21, T37N, R1W. This nest has been active since its discovery.

Iron Canyon Reservoir has supported nesting populations of bald eagles since the mid-1970s. The first nesting record is from 1977, but it appeared at that time that the eagle had been using the nest for several years. There was only one known bald eagle nest on the reservoir until 1991, when a second active nest was located. No other potential bald eagle nest territories areas have been identified within the watershed. The following table details the reproductive history based on monitoring data:

Bald eagle Nest Ca-Sh-27-BE (ST) (104-2)

Pair Verified	Young Verified	Pair Verified	Young Verified	Pair Verified	Young Verified
1977	0	1984	1	1991	1
1978	0	1985	0	1992	2
1979	1	1986	?	1993	2
1980	2	1987	1	1994	0
1981	2	1988	0	1995	0
1982	2	1989	0		
1983	0	1990	2		

Bald eagle Nest Ca-Sh-27-BE (ST)-2 (104-1)

Pair Verified	Young Verified
1993	0
1994	1
1995	1

Bald eagles in this watershed forage in Iron Canyon Reservoir and in the Pit River adjacent to the watershed. Iron Canyon Reservoir is stocked annually by the California Department of Fish and Game with rainbow and other species of trout. These fish provide an enhanced food source for the birds.

Currently, suitable habitat appears to be adequate to meet the needs of nesting bald eagles. Low water levels in Iron Canyon Reservoir may be a problem. One nest was abandoned in 1994 during a low water event and repeated draw downs may effect the suitability of eagle habitat. Drawdowns occur as a result of Pacific Gas and Electric's use of the lake for hydroelectric power generation.

Ponderosa pines are the preferred nest and perch trees for bald eagles in California. The existing trees are suitable at this time, but are becoming decadent, and will eventually need to be replaced. Future nest trees will need to be recruited from late-successional forest in the general vicinity of the lake, and it appears that suitable trees are extremely rare at this time.

Northern spotted owl

The entire watershed lies within a Late-successional Reserve (RC-335) and Critical Habitat (CA-4). Three spotted owl activity centers are located within the watershed. There is no evidence that owls are nesting in this watershed at this time. The watershed was surveyed to protocol three times in 1995, and no owls were located. The watershed has not been surveyed to a comprehensive 2-year protocol. There have been three additional past sightings of spotted owls in this watershed, two in the vicinity of Cedar Salt Log Creek and one in the southwestern portion of the watershed near an unnamed tributary of Iron Canyon Creek. Suitable habitat is not present in that area, however, and surveyors at the time believed that they called the birds in from a distance. The following details the recent presence and nesting status of northern spotted owls within the watershed:

Nesting Status of spotted owls
within the Iron Canyon Watershed

Owl	Status	Status Verified	Young Verified
ST-110	Single	1986	no
	Pair	1992	no
ST-112	Pair	1991	yes
	Single	1992	no
ST-115	Single	1991	no

The entire watershed was surveyed during the late 1980's as part of the preparation for the Dutchman Peak, Lil Bagley, Coyote Peak and McGill Timber Sales. The single owl in ST-110 was located during these efforts. The watershed was surveyed to protocol during 1991 as part of the surveys of HCA-42. This was before the two year protocol was mandatory.

Suitable habitat in the watershed is not adequate for spotted owls. The Shasta-Trinity National Forests definition of suitable habitat is mature and older forest stands having multi-layered conditions, a canopy closure of 60 percent or more and displaying obvious decadence. The overstory should be comprised primarily of trees 21 inches dbh or larger, and should occupy at least 40% of the canopy. Where stands lack age, but have multiple canopy layers, adequate canopy closure, proper tree size and decadence, these stands may also be included as suitable owl habitat. At the 0.7 mile radius level, all three territories where owls were previously located have less than 500 acres of suitable habitat. At the "home range" 1.3 mile radius level, all three owl pairs have less than the 1336 acres required. Both radius levels are below the incidental take threshold.

Acres of suitable habitat near spotted owl activity centers

Activity Center	0.7 Circle	1.3 Circle
110	298 acres	648 acres
112	240 acres	680 acres
115	70 acres	673 acres

Only "nesting and roosting" (NR) habitat is defined and tracked for the Shasta-Trinity National Forests. Spotted owls will also forage in NR habitat. This NR habitat is included in suitable habitat.

Current amounts of habitat present
Iron Canyon Watershed

Habitat Type	Acres, National Forest	% of National Forest	% Total Watershed
suitable	2318	18.8	13.6
foraging	3789	30.8	22.2
capable	7750	63.0	45.6

There are 3789 acres of forests which may provide additional suitable foraging habitat for northern spotted owls. These forests are comprised of trees 12-21 inch DBH with a moderate (40%-69%) canopy closure and a relatively open understory. Open understory permits flying space within the canopy, and enables successful capture of prey. Foraging habitat may be much more variable than NR habitat.

Since the watershed is entirely within an LSR, dispersal within reserves is not an issue. Currently, dispersal across the landscape is fragmented. Areas expected to be avoided by dispersing young owls include the 514 acre reservoir and some of the sparse younger stands in the northern portion of the watershed. These areas provide suitable habitat for predators of the spotted owl, including the red-tail hawk. Lack of overstory cover in harvested riparian corridors may also increase the potential for predation upon spotted owls by great horned owls. In addition, sparse stands also do not provide a cooler microclimate for the heat sensitive spotted owl. Habitat fragmentation and forest conditions on private land in the area may also hinder dispersal to surrounding LSRs. Stands that may be too dense to permit spotted owl movement include the live oak stands in the southern portion of the watershed and some of the riparian corridors which have been previously harvested, enabling growth of dense understory shrubs.

Marten and Fisher

There are two past marten records of sightings within the McGill Creek drainage. These sightings have not been confirmed, but it is likely that they were fisher since they are more likely to inhabit lower elevation mixed conifer forests. They prefer late-successional forested landscapes with continuous cover, abundant snags, and large downed logs for denning and resting sites.

Pacific western big-eared bat

This species may use mesic habitats in this watershed for foraging but it is unlikely that this species roosts or breeds in this area. These bats require caves, mines, tunnels, or buildings for roosting and nesting. There is no known suitable habitat present in the watershed for this species.

Impacts to riparian and aquatic ecosystems

Topics discussed in this issue include:

- Current conditions that adversely affect aquatic habitat and riparian ecosystems.
- Current transportation system within the watershed.
- Habitat for survey and manage and riparian obligate species that occupy riparian ecosystems.

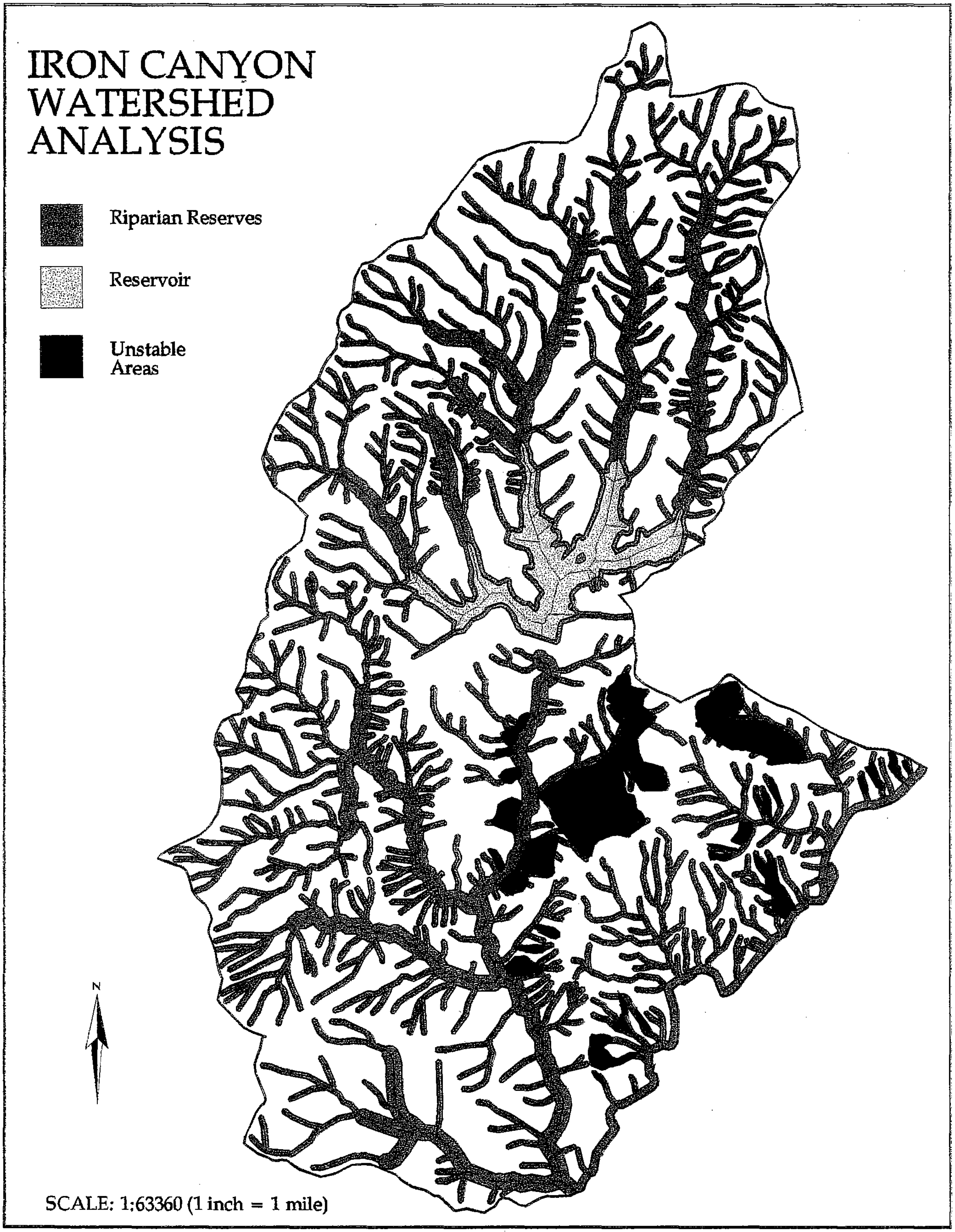
Current conditions that adversely affect aquatic habitat and riparian ecosystems

The aquatic ecosystem includes any body of water, such as a stream or lake, and the living and non-living components, all functioning as a system. Riparian ecosystems are transitional between terrestrial and aquatic ecosystems. These ecosystems can be identified by the presence of vegetation that requires free or unbound water or conditions that are more moist than in a true terrestrial ecosystem. In this analysis, the term riparian zone or corridor is synonymous with riparian ecosystem. In addition, the President's Forest Plan has established "Riparian Reserves" at the margins of streams, lakes, wetlands, and unstable areas.

Past land management activities have resulted in excessive sedimentation in streams and riparian zones within the watershed. Erosion rates continue to be excessive, and are attributed primarily to the existing road system. Lack of rocking the road surface, poor road location, lack of waterbars, washed out culverts and poor stream crossings all contribute to the situation. Many of these conditions are due to inadequate road maintenance levels in the area.

Above the reservoir, excessive sedimentation within some of the streams and adjacent riparian zones has adversely affected aquatic habitat. Pools have become shallower as they fill with fine sediments. Loss of deep pools has reduced the suitability of trout habitat. The stream channels have become aggraded creating a homogeneous environment for fish and aquatic salamanders. The fine sediments have also reduced benthic invertebrate production as they fill substrate interstitial spaces and at the same time affect gravel permeability and the suitability of trout spawning habitat. This is particularly evident in Deadlum and Cedar Salt Log Creeks and portions of Gap Creek. In McGill Creek the effects of fine sediment are not as apparent, but the potential for serious bank erosion exists within the stream's drainage. Such erosion would have a severe effect on fish and amphibian habitat within the stream.

Large downed logs are limited within the stream channels of Gap Creek, Deadlum Creek, Iron Canyon Creek, and portions of Cedar Salt Log Creek. They are also uncommon in riparian zones within the watershed. Large downed logs are an important component of aquatic and riparian ecosystems. They increase habitat diversity and provide cover. These



Map 11. Riparian Reserves

logs are also essential for the survival of some species of salamanders, such as the ensatina. They provide essential nutrients and growing medium for certain fungi and plants, and are also important habitat components for marten, fisher, goshawk, and rodents.

Riparian zones currently support a mix of conifers and hardwoods, including Douglas-fir , white fir, incense-cedar, sugar pine, Pacific yew, bigleaf maple, Pacific dogwood, and alders. The shrub understory is primarily California hazel, vine maple, and snowberry. There are also small, isolated pockets of willows, located primarily around Iron Canyon Reservoir. Riparian zones are often associated with streams in the watershed. Streams which have been highly disturbed in the past support riparian zones which are extremely shrubby, and lacking overstory canopy closure. Streams which have had little disturbance support relatively dense, multi-layered vegetation, typical of late-successional forests.

Riparian zones also function as corridors to allow the movement of wildlife between suitable habitat areas. Logging, road building practices, blown down trees, and tree mortality have removed critical old-growth forest components, fragmenting or eliminating late-successional habitat and causing an extreme contrast between late-successional closed canopied forest in the riparian zones and adjacent open canopied forest or non-forested areas. Many of the overstory trees in remnant riparian corridors are in much poorer health than they should be for their age. Relatively young trees (<120 years old) appear to be much older and more decadent than would be expected in a healthy riparian forest.

Fragmentation of riparian habitat adversely affects habitat quality for habitat specialists dependent upon late-successional close canopied riparian forests. Riparian corridors are losing width over time as a result of blow down and mortality. Fragmentation of riparian zones increases the potential for wind damage and insect infestation, and increases the potential for predation by habitat generalists such as the great horned owl upon habitat specialists such as the northern spotted owl.

Where past timber harvest has opened the riparian forest canopy, the cooler micro-climate of the late-successional forest is lost through elimination of the functional multi-layered close canopied forest. This reduces the habitat capability for many late-successional species which inhabit close canopied riparian forests, such as salamanders, furbearers, and the northern spotted owl and encourages dense growth of woody shrubs, such as vine maple and alder. A dense shrub understory restricts animal movement across the landscape and may inhibit foraging opportunity for both ground foragers (deer) as well as aerial foragers (spotted owls, goshawk). Dense shrubs also compete with young conifers for establishment and growth, thus inhibiting and delaying the recruitment and progression of future generations of old-growth close-canopied riparian forest.

There is a 150 foot wide riparian reserve around Iron Canyon Reservoir. This reserve does not support riparian vegetation except in the vicinity of inlet streams. Because of water level fluctuations, riparian vegetation and habitats cannot become established in the draw down zone. Environmental conditions in this zone fluctuate between flooded and dry extremes and are not conducive to the establishment of any permanent populations of riparian dependent plants and animals.

Approximately 37% of the watershed fits into the category of "Riparian Reserve" (see Map 11). By nature, these areas are intertwined with upland forests, and their exposure to fire hazard and the threat of stand replacing wildfire is the same. This is particularly true of Riparian Reserves around intermittent streams or other sites that are normally dry. In many areas, the need to deal with fuels concentrations, both live and dead, will require activities within riparian areas.

Iron Canyon Creek, below the dam, also exhibits degradation of riparian ecosystems and aquatic habitat. The construction of the dam, and the generation of hydroelectric power has resulted in reduced and stabilized stream flows from past levels.

Estimated Stream Flow Rates
in Iron Canyon Creek below Iron Canyon Reservoir
During Significant Storm Events

Before dam

Event	CFS
100 year storm	4000
50 year storm	3300
25 year storm	2600
10 year storm	1800
5 year storm	1300

After dam

Event	CFS
100 year storm	850
50 year storm	790
25 year storm	700
10 year storm	550
5 year storm	350

Present flows are insufficient to recreate or maintain existing pools of pre-reservoir conditions. Gravel replenishment from tributaries above Iron Canyon Reservoir has been completely stopped by Iron Canyon Dam. Although there is some gravel recruitment from tributaries below the dam, this recruitment is not sufficient to maintain spawning habitat. As a result of the lack of replenishment, wide, shallow margins of well-graded sediment which provide valuable spawning and rearing habitat are absent from the stream channel. Even if pools of pre-reservoir conditions existed, the reduced flows prevent flushing of larger sediments which accumulate during the year and the pool would eventually fill.

There are a number of areas within the watershed of heavy dead and downed fuels created by winter storm damage. These fuels include blown over trees and blown out tops, and any other trees or vegetation killed in the fall. These areas are generally found along major ridges, however the damage extends into riparian reserves of some ephemeral/intermittent streams, the Willow Springs fault area, and Iron Canyon Reservoir. In this fuel type, an established wildfire on an average summer day can be expected to produce flame lengths between 4 and 10 feet high, depending on slope and wind. These flame lengths require indirect suppression tactics and increase the potential for crown fires, which are stand replacing. Some riparian reserves with no apparent storm damage are adjacent to the heavy dead fuel areas and are also at risk of damage from wildfire traveling from the heavy fuels into the riparian areas and from possible upslope soil exposure with subsequent sedimentation in the stream..

Current transportation system within the watershed

Some roads originally constructed to support logging operations are no longer needed. Other roads still fill multiple needs like fire suppression, recreation, and other Forest Service administrative uses. Pacific Gas and Electric, California-Oregon Transmission Project, and Sierra Pacific Industries all have cooperative road use and maintenance agreements with the Forest Service. These agreements allow vehicle access to dams, pipelines, powerhouses, powerlines, and private timberland. These agreements appear to be long-term needs.

The total existing road density within the watershed averages 3.7 miles/section (square mile). With both intentional road closures and roads closed due to lack of maintenance, windthrow, crossing failures, etc., open road density (as of July 1995) is approximately 2.9 mile/section. This is nearly double the 1.5 mile/section recommended maximum for maintaining moderate habitat capability for intrusion sensitive species such as black bear, deer, and fisher.

Habitat for Survey and Manage and riparian associated species that occupy riparian ecosystems.

With the exception of the Shasta salamander, no S&M species of amphibians or birds are known or expected to occur in the Iron Canyon Watershed. The Shasta salamander would only be expected to inhabit riparian reserves when they occur in the vicinity of limestone outcrops. Some limestone outcrops are known to exist within the watershed. Very little is known about the S&M mollusks and arthropods. It is not known if any occur within the analysis area.

There are 59 S&M species of wildlife which are either dependent upon or associated with aquatic and riparian ecosystems. This list includes several species of salamanders, frogs, toads, western pond turtle, waterfowl, shorebirds, osprey, bald eagle, peregrine falcon, belted kingfisher, songbirds, shrews, Pacific western big-eared bat, muskrat, raccoon, mink, river otter, and several species of garter snakes. A complete list of these species is found in Appendix C.

Bats

All five species of S&M bats are expected to occur within the Iron Canyon Watershed. Four of the five species require open water or riparian habitat near their den and roost areas. These bats are:

- fringed bat
- long-eared bat
- long-legged bat
- pallid bat

Bats are also discussed on page 3-7 of this analysis.

TES, Candidate, and Riparian Obligate Species

• bald eagle	• tailed frog
• marten	• black salamander
• fisher	• Pacific giant salamander
• American peregrine falcon	• ensatina
• willow flycatcher	• northwestern pond turtle
• northern red-legged frog	• foothill yellow-legged frog

Birds

Bald eagle *(threatened)*

The bald eagle is discussed in the "*TES species within the watershed*" topic earlier in this chapter.

Peregrine falcon *(Endangered)*

There are no known peregrine falcon aeries within the watershed nor are there any known suitable cliffs for nesting. Falcons have been observed foraging within the watershed.

Willow flycatcher *(Sensitive)*

There are no known willow flycatcher sightings in this watershed; however, there are a few willow and alder thickets providing suitable habitat in the vicinity of Iron Canyon Reservoir.

Amphibians

Northern red-legged frog *(Category 2, California Species of Concern)*

No red-legged frog sightings have been recorded within the Iron Canyon Watershed. This watershed may lie just east of the known distribution of this species. This frog inhabits quiet pools of streams, marshes, and occasionally ponds with cold, slow-moving or standing water. Extensive emergent aquatic vegetation is needed to provide cover, and to serve as a substrate for the deposition of egg masses. This species does best in streams and ponds that lack bullfrogs and non-native fishes..

Tailed frog *(California Species of Special Concern)*

A tailed frog sighting is recorded for the Initial Creek drainage in the southern portion of the watershed. This species is restricted to perennial montane streams in steep-walled valleys with dense vegetation. A cold, clean permanent source of water is required as the larvae take 2 to 3 years to transform. The larva prefer smooth rocks in turbulent or swiftly flowing water. The adults require submerged rocks and logs that serve as cover during the day.

Black salamander (*Riparian obligate*)

Black salamanders have been found adjacent to Gap Creek and are believed to occur within other drainages in the analysis area. Suitable habitat for this species is found in mixed deciduous and coniferous forests generally below 2500 feet in elevation. They prefer moist rocks along streams, but may also be associated with moist decaying woody debris. They most frequently occur in streamside seeps that are cool and well-shaded, and are only rarely seen within streams.

Pacific giant salamander (*Riparian obligate*)

Pacific giant salamanders are common Forest-wide and have been found within the Iron Canyon area. This species is highly aquatic occurring in cool, humid forested areas with cold, clear streams, lakes and ponds. Streams are preferred as flowing water is required for egg-laying sites and for larval development. Streams with rocky bottoms are preferred. Adults are seasonally terrestrial, but still require damp, cool, shaded conditions.

Ensatina- intergrade subspecies (*Riparian obligate*)

Ensatinas have been found in the Little Gap Creek and Cedar Salt Log Creek drainages. They live in or near streams in damp forests and riparian areas. This species is generally not found within streams or other bodies of water as it prefers moist, cool crevices under rocks and decaying logs. Large well-decayed logs within damp, shady areas appear to be critical as they are used by all life stages of this species.

Northwestern pond turtle (*Category 2*)

No documented sightings of northwestern pond turtles have been recorded in the watershed, but suitable habitat is present and the likelihood of this species inhabiting the watershed is good. Suitable habitat for this turtle is permanent streams, lakes, or ponds with basking sites and adjacent retreat cover in a wide variety of forest types. The young require shallow margins with an abundance of emergent vegetation in order to escape predators. Adjacent areas with suitable soils and proper exposure are required for nest sites.

Foothill yellow-legged frog (*Category 2*)

No foothill yellow-legged frog sightings have been recorded for this watershed, but there are several records in similar type streams just west of the watershed boundary. This frog is found in or near rocky streams with fast moving water. Exposed rocks are used for basking and submerged rocks and crevices are required for hiding.

Fish

Only the habitat requirements of native fish species likely to be found in the watershed will be addressed. Brook trout and brown trout, though present in Iron Canyon Reservoir, are introduced and populations of these two species are not found in the streams. If not stocked on a regular basis, they would eventually disappear from the area. Golden shiner may be present in the watershed but their presence has not been confirmed. The probability of their occurrence is good as this species is a common live baitfish. Sturgeon, hardhead minnows, tui chub, and hitch are not believed to occur in the Iron Canyon Watershed either because their numbers have declined dramatically or the habitat is not suitable.

Rainbow trout (*Riparian Obligate*)

Rainbow trout require clean, cold lakes or streams. Food producing areas, spawning habitat, and deep pools or other suitable rearing habitat are required by this species. Streams with clean gravels are needed in order for spawning to occur. Within streams, a well-developed riparian canopy is needed for shade and insect drop and, as adults are territorial, adequate cover must be present. A proper combination of cover, living area, and food producing areas is necessary for healthy populations. Rainbow trout are found throughout the watershed.

Sacramento squawfish

This species has broad habitat tolerances and is capable of surviving under a variety of conditions. While typically a stream fish, it does quite well in lake environments. This species prefers deep, well-shaded sand or rock-bottomed pools, with clear water usually above 60 degrees F. Within Iron Canyon Creek, this species probably occurs mostly in the juvenile form and only in the lower most reaches.

Sacramento suckers

These fish are found in a wide variety of waters, from cold rapidly flowing streams to warm, nearly stagnant sloughs. They prefer cold rapidly flowing streams with abundant pools. Rocky bottoms and undercut banks in deep water are frequented by adults, while juvenile suckers prefer shallow, slow-moving water along the stream margins. Suckers are probably only found in the lower most reach of Iron Canyon Creek.

Speckled dace

Speckled dace are capable of inhabiting a variety of aquatic habitats, but prefer cool, rocky-bottomed perennial streams and rivers. They typically inhabit the bottom of rocky riffles or other relatively fast-moving water. Dace are capable of adapting to warm water quite well and do not require the shade of extensive riparian areas. This species probably is found throughout Iron Canyon Creek.

Riffle sculpin

Sculpin are opportunistic bottom feeders. They are most common in headwater streams and are found in a variety of habitats. They prefer cool water and gravel bottoms. Sculpin generally avoid the swifter riffle and inhabit runs and glides that are relatively free of sand and silt. This species is not know to occur above the dam, and is believed to inhabit only the lower most reaches of Iron Canyon Creek.

Mammals

Marten and Fisher *(sensitive)*

These species are discussed in the "*TES species within the watershed*" topic earlier in this chapter.

Plants

The Iron Canyon Watershed has not been inventoried specifically for S&M and riparian associated plant species or their habitats. Until an inventory is completed, it must be assumed that the possibility of these plant species or their habitat exists within the analysis area.

Fungi, Lichens and Bryophytes

There is no existing information on the habitat or species occurrence for riparian fungi, lichens or bryophytes listed in Appendix R (S&M Species) of the LMP. Many are suspected and a few are known to occur on the Forest; therefore, the possibility of their existence in the Iron Canyon Watershed must be considered until further studies can be completed

Survey and Manage Vascular Plants

Detailed information on S&M vascular plants is presented in the "Lack and loss of late-successional forests" section discussed previously in this chapter.

TES and Riparian Associated Vascular Plants

There is one TES, Candidate and riparian associated species which may occur in the Iron Canyon Watershed.

- *Neviusia cliftonii*--Shasta snow-wreath

Shasta snow-wreath

This plant has not been listed as a TES plant by state or federal agencies, but listing has been recommended by the California Native Plant Society. This plant is associated with riparian influence zones on north facing slopes on limestone derived soils.

Compatibility of social uses with LSR objectives.

Topics discussed in this issue include:

- Commodities being produced.
- Natural trout production and present fish stocking levels
- Compatibility of recreation use with LSR objectives

Commodities being produced

Currently the watershed provides hydroelectric power, outdoor recreation opportunities, clean water, timber resources, and Native American resources. Outdoor recreation opportunities include fishing, hunting, camping, boating, hiking and sightseeing. Timber harvest and firewood cutting is occurring on privately owned land within the watershed. Because of the watershed's status as a LSR, no woodcutting is allowed but some illegal woodcutting is occurring on National Forest lands within the watershed.

Natural trout production and present fish stocking levels.

Natural trout production is presently sufficient to maintain local native fish populations and some light fishing pressure within streams, but would not sustain an intensive fishery. Currently, most fishing occurs on Iron Canyon Reservoir, which is stocked annually by the California Department of Fish and Game. Presently, stocking levels are keeping pace with fishing pressure within the reservoir, as evidenced by the yearly carry-over of fish and adfluvial spawning runs of rainbow trout during the spring.

Compatibility of recreation use with LSR objectives

Some of the social activities which may be affecting the late-successional condition include hunting, poaching, woodcutting, off-road vehicle use for fishing access to Iron Canyon Reservoir, and dispersed camping. Most of these activities obviously have an impact on intrusion sensitive species to some degree, but they also impact down and dead material, snag numbers, road maintenance needs, and erosion prone soils. In addition, they introduce a higher fire risk for human caused fires.

Chapter 4

Reference Conditions within the Watershed

The purpose of this chapter is to explain how the existing conditions from Chapter 3 have changed over time as a result of human influence and natural disturbances. This chapter develops a reference for later comparison with current conditions.

The three major issues identified are:

1. Lack and loss of late-successional forests
2. Impacts to riparian and aquatic ecosystems
3. Compatibility of social uses with LSR objectives

Lack and loss of late-successional forests

Topics discussed relative to this issue are:

- Composition and structure of vegetative communities
- Late-successional and old-growth forest habitat
- Fuels/fire conditions within the watershed

Composition and structure of vegetative communities

Prior to 1900

The plant species that contribute to the distinct vegetation of northern California come from diverse sources and times during the Cenozoic Period (Axelrod, 1977). The major regional differences in California forests emerged 8000 to 4000 years ago during the Xerothermic Period. The spreading warm, dry (montane Mediterranean) climate reduced the southern extent of madrone, tanoak, Douglas-fir and yew (Axelrod, 1967). As temperature contrasts increased from the coast to the interior, the surviving vegetation zones were segregated into communities of more local distribution and lower diversity. In the past, moister phases of the Pleistocene, the mixed forests were richer in composition and more continuous in arrangement.

Fire plays a major role in shaping vegetative communities, especially forests, within the watershed. Fires would generally pass through the watershed, or portions of the watershed, at a low to moderate intensity. When climatic conditions (drought), weather, and fuel conditions combined to allow extreme fire behavior, large stand replacing events occurred during the late 1800s. Due to the differing degrees of adaptation and sensitivity of vegetative species and communities to fire, and the difference in fire intensity between wet and dry microclimates, the composition and arrangement of forests varied by location in the watershed.

Riparian zones are inherently wetter than upland areas. As a result, the effect of fire upon the vegetation was correspondingly reduced. Riparian zones north of the present Iron Canyon Dam were extensive, wide, and interconnected. The forests within these zones are believed to have been late-successional old-growth Douglas-fir dominated mixed conifer stands. Northern exposures and moister areas with deep productive soils are also believed to have favored Douglas-fir dominated mixed conifer stands. White fir would have generally been confined to moist locations in the upper elevations of the watershed.

Upland areas, ridgetops, and drier sites, such as southern exposures, tended toward pine dominated mixed conifer forests. These forests were more open than today's forests, more patchy, and less layered. The dominant tree species were sugar pine and ponderosa pine which were well adapted to drier sites with periodic fire regimes.

Hardwoods, such as black oak, canyon live oak, and bigleaf maples were probably more abundant throughout the watershed. There were probably stands of black oak and canyon live oak in the area south of Iron Canyon Dam, just as there are today. These stands were probably burned more often, and hotter, than the conifer dominated communities. In most areas of the watershed, particularly in the pine dominated mixed conifer forests, the forest floor was very open with a conifer and hardwood canopy. Fires maintained this condition, permitting grasses to grow underneath forested areas as well as in openings.

In 1860, the community of Big Bend was established and more settlers of European descent moved into the area. In the next 45 years, before establishment of the Shasta National Forest in 1905, it is believed that portions of the watershed were grazed intensively by sheep and cattle. Ranchers and shepherds burned vast acreage's of forest in the fall of the year to encourage growth of herbaceous forage. This practice resulted in the reduction of large patches of older forests. Hunting and trapping pressures increased with increased settlement and human presence.

<u>1900 to 1940</u>

The presence of grasses, in part as a result of large fires in the 1800s, made the area attractive to ranchers looking to graze livestock. The presence of large numbers of cattle, sheep, and other domestic animals would have affected the composition of ground level vegetative communities and relationships. The aerial photos from 1944 show the riparian zones around Little Gap and Cedar Salt Log Creeks as being more open than riparian zones in other drainages. Deadlum, McGill, and Gap Creek riparian zones remained relatively unaffected by the burns of the late 1880s, and continued providing large patches of late-successional forest.

The fire regime for the watershed changed in this period. Beginning in the 1930s, more aggressive fire suppression policies were implemented, and wildfires were more effectively prevented and extinguished. Exclusion of wildfire from the watershed created conditions favoring the regeneration of fire sensitive and shade tolerant conifer species, such as Douglas-fir, over the regeneration of less fire sensitive and shade intolerant species such as sugar pine and ponderosa pine. Forest fuels accumulated upon the forest floor, increasing the potential intensity of wildfires, and new generations of shade tolerant shrub and brush communities established themselves underneath the canopy. Plant species and communities formerly restricted from drier sites by periodic fires developed widely across the landscape.

1940 to the present

Timber harvesting within the watershed commenced in the 1950s. During the 1960's, several sections of privately owned land were very heavily logged. This land is commonly known as "Watt" land. The land was in the general vicinity of the future location of Iron Canyon Reservoir, and included sections 3, 7, 9, 11, 15, 16, 17, 19, 21, 27, and 29. In 1969 this land came under National Forest ownership, along with the associated environmental problems.

Harvest prescriptions generally centered on individual tree selection, with the intent of releasing understory trees, and to capture mortality. Including private land, these harvests covered about half of the area of the watershed. Logging, and related damage often resulted in opened canopies, and greatly intensified brush competition. Slash was often left untreated, and the fire hazard increased greatly. These forestry practices continued into the mid-1970s when the forest management emphasis shifted to clearcutting forest patches.

Approximately 200 acres of forest were clearcut during the 1980s. Clearcuts were replanted with conifers, primarily ponderosa pine with a mixture of Douglas-fir, sugar pine, and occasionally other conifer species. Brush species also regenerated, and began competing with conifer populations.

Exclusion of fire from this fire maintained regime has resulted in a shift away from the more open forests of the pre-European settlement period. Species composition has changed from pine dominated stands (particularly in upland areas) to Douglas-fir dominated stands. The forest has become a more closed and multi-storied structure with increased demands for available water. This change in stand structure may have also had an impact on the cycling of organic matter and nutrients by altering the distribution of woody biomass across the forest floor, and temporarily changing rejuvenating effects of mineral nutrient release following understory burning. Due to the altered tree species composition, forests are more sensitive to fire than in the past.

Late-successional and old-growth forest habitat

Few records regarding wildlife population estimates, densities, or distribution are known to exist for the Iron Canyon Watershed. Wildlife use of the area, species composition and population trend information are inferred based upon the following:

- habitat changes over time
- climate
- known human influence upon the watershed
- wildlife sighting records from the early 1970s to present

Prior to 1900

Many wildlife species that are believed to inhabit the watershed today were present in the past. In addition, this area probably supported populations of large predators such as grizzly bears and wolves not found in California today.

Species that form large herds (deer and elk) or were far roaming (black bear, grizzly bear, wolverine, mountain lion) were in greater numbers due to large expanses of open forest from which road systems, reservoirs, powerlines, and settlements were largely absent. Native Americans observed how natural fire improved forage for many wildlife species that they in turn depended upon. Periodic fires encouraged the growth of forage, resulting in healthy herds of deer and elk.

Late-successional and old-growth forests and their dependent species were probably less common in upland habitats, due to the effects of periodic fire starts. Northern spotted owls, marten, fisher, goshawk, and other late-successional species were probably limited to denser, multi-layered forests which occurred in riparian zones and upon some north facing slopes. Hardwoods were probably more abundant throughout the watershed. Mast-dependent species, such as bear, western gray squirrel, band-tail pigeon, elk and quail were also probably more abundant than at present. Bald eagles may have foraged in some of the larger streams, but nesting did not occur in the watershed since no large bodies of water were present.

Since little is known about many of the Survey and Manage (S&M) species today, projections are largely speculative for the great gray owl, mollusks, and arthropods. The Shasta salamander probably occurred near limestone outcrops and various species of bats inhabited the older forested riparian zones.

1900 to 1940

Wildlife populations requiring special habitats and sought after for recreational or commercial use began declining with the increased accessibility and settlement in the watershed and surrounding areas. There are no known records indicating original population sizes for wildlife species in the Iron Canyon Watershed. Species that have proliferated in the human altered environment include bullfrogs, European starlings, coyotes, and raccoons.

Aquatic amphibians dependent upon riparian vegetation for reproduction and cover may have been highly impacted by livestock grazing. High impact grazing would have degraded the habitat of many small mammals, reducing their populations, and hence the prey base for raptors (golden eagle, sharp-shinned hawk). The effects of grazing on the small mammal and raptor populations was unknown, though expected to be dramatic at first. Cattle competed with local deer herds for forage and may have degraded important fawning areas, though the extent of their impact on deer populations is unknown.

Exclusion of wildfire from the watershed often resulted in layered understory vegetative conditions. Shrubs, which became established in open canopy conditions, were no longer periodically replaced by fire events. As a consequence they could grow into dense communities that impeded the travel of ground traversing animals, inhibited the establishment of regenerating conifers, and restricted the feeding opportunities of some predators. Shrub dependent species, such as small to medium sized mammals, would have increased as the shrub component established itself, but then declined as the understory matured and ultimately became decadent. Where older shrub communities became established, the difficulty of suppressing wildfires and their potential burning intensity increased, resulting in an increased threat of stand replacing fire events.

<u>**1940 to the present**</u>

Exclusion of fire during this period resulted in a shift from more open forest to a more closed and multi-layered forest in both the uplands and the riparian zones. There was more habitat present for late-successional and old-growth forest species prior to 1960.

By the late 1940's, the Forest Service began regulating cattle grazing on both National Forest and Southern Pacific lands. With the introduction of grazing regulation and periodic resting of the habitat it is believed that aquatic and riparian dependent species populations declined less quickly or stabilized. Some species, however, may have already been locally extirpated.

Logging activities resulted in the elimination of vast acreage's of mature and late-successional forests. Open canopied early/mid seral forests with dense shrub understories resulted. Much of the riparian zone canopies were eliminated through disturbance, especially logging and road building. With the loss of later seral stages, there was increased fragmentation of habitats and less mature trees to provide for the recruitment of large diameter snags and downed logs. These snags and logs are necessary for species such as black bear, fisher, pileated woodpecker, and many amphibians. Primary and secondary cavity nesters and denners, such as the white-headed woodpecker and western bluebird would have been affected by the reduction in snag size. S&M bat species would also have been effected by the loss of roosting and denning habitat. Eighteen percent of the bird species found on the Forest use cavities for nesting. Fragmentation of riparian forest habitat had negative effects upon species such as the northern spotted owl and northern goshawk

Pure oak stands and the oak component of mixed conifer forests became more decadent. The oak component started being eliminated from mixed conifer forest as overtopping and crown closure from conifers occurred. Decadent oak stands lost vigor and started producing fewer acorns. These changes negatively impacted acorn dependent species.

With construction of the reservoir (and subsequent flooding of habitat), establishment of the road system, and increased recreation use, native wildlife populations were negatively impacted. These activities fragmented the forest and eliminated many acres of late-successional forest in both uplands and riparian zones. Aquatic amphibian populations were again impacted when streams and the reservoir were stocked with trout. Riparian dependent and late-successional forest species (northern spotted owl, warblers, heron) were displaced when streamside habitats were used for camping. Populations of generalist wildlife species (crows, jays, raccoons), and those species capable of scavenging and adapting to the presence of recreating humans, increased. Game species, such as bear, deer, grouse, and natural predators such as bears and mountain lions, and furbearer populations such as mink and beaver declined as they were hunted and trapped. Other wide-roaming species sensitive to human disturbance or considered a threat to humans and livestock such as the wolverine and mountain lion, were also negatively impacted.

The filling of Iron Canyon Dam and the stocking of trout in the reservoir has had a positive effect upon bald eagle, osprey, heron, and other species associated with open bodies of water. Prior to the 1970s, neither bald eagles nor osprey had been recorded as nesting in the watershed.

Fire/fuels conditions within the watershed

Prior to 1900

It is well documented that Native American burning practices shaped the landscape in much of the west prior to European settlement. There is, however, some anecdotal evidence from early settlers that suggests there was very little Native American burning in the Iron Canyon Watershed. Most fires were lightning caused. During this period fire return intervals ranged from 8 to 20 years. When climatic (drought), weather, and fuel conditions combined to allow extreme fire behavior, large stand replacing events would have occurred. It is believed that these events occurred on a 300 to 500 year interval. The periodic passage of fire within the watershed would have assisted in keeping fire intensities down by preventing buildups of fuels and would have favored fire adapted vegetative communities.

Newspaper accounts tell of a 150,000 acre plus fire in 1872 that burned from the north slope of the Pit River to the divide between the Pit River and Squaw Creek. This covers the Iron Canyon area. In 1898, another fire burned in the same area where "complete destruction resulted over the area, especially on the higher slopes". This could account for the similar age and size of many timbered stands in the area today.

1900 to 1940

Around the turn of the century large-scale sheep grazing began in the area. Studies of stumps in the area suggest a 13 year fire interval during this period, an accelerated pattern that is attributed to intentional burning by persons with an interest in maximized grazing opportunities. Beginning in the 1920s, fire exclusion practices, originating from new national fire management and land management philosophies were implemented, and wildfires were aggressively prevented and extinguished.

1940 to the present

World War II brought technology to the firefighting arena such as smokejumping and retardant planes. Suppression activities all over the country became increasingly effective during this time. During the 1960's, logging activities became prevalent with resulting roads providing rapid ground access for suppression forces. The result of this history is the occurrence of only two fires over 100 acres in the last 20 years (1974 and 1993) on National Forest land in the Pit River drainage, and none over 100 acres within the Iron Canyon Watershed. This was in spite of an average of one fire start per year in the watershed.

Fire exclusion contributed to stand conditions which were predisposed to damage from winter snow loading and wind events. Major damage of this type occurred in recent years over large areas of the watershed, thus increasing dramatically the dead fuel loading in some areas, and producing conditions ripe for large stand replacing fire events. The location of these fuels concentrations are detailed on the "Dead and Down Fuel Loading" map (Map 9).

Impacts to riparian and aquatic ecosystems

Topics discussed relative to this issue are:

- Riparian and aquatic ecosystems
- Hydrologic reference conditions
- Soil stability and geologic processes
- Transportation system within the watershed

Riparian and aquatic ecosystems

Prior to 1900

Prior to 1900, the native fishes within the Iron Canyon Watershed were used primarily by local Native Americans. The significance of this area as a fishery to the local people was probably minimal as the Pit River was close by and provided a greater diversity of species and opportunity to catch fish. Rainbow trout and Sacramento suckers were probably the most common resident fish in the watershed. Other resident fish species found in the area included the Sacramento squawfish, speckled dace, riffle sculpin, California roach, hardhead minnow, hitch, and tui chubs. The relative abundance of these other species during this period is unknown, but their distribution within the Iron Canyon drainage was probably limited to what is know as Iron Canyon Creek.

Anadromous fish were common in the Pit River. These fish included native salmonids as well as sturgeon and shad. Steelhead were abundant and are believed to have spawned in the Iron Canyon Watershed. Coho salmon may have been present in the Pit River, and to some extent in Iron Canyon Creek; however, they probably were not a common species. Chinook salmon, though common in the Pit River, were most likely casual strays into Iron Canyon Creek, if they entered it at all. White sturgeon, which were also found in the Pit River, probably were not found in the watershed due to the small stream size. By 1879, American shad, an eastern introduction, had become established in the Sacramento River system, and may have been present in the lower Pit River. It is unlikely, though, that they were found in Iron Canyon Creek.

Riparian areas within the watershed had undergone some changes in the Cedar Salt Log and Little Gap Creek drainages. The large fires of the late 1800s probably had only minor direct effects on the riparian habitat surrounding these streams. These fires probably improved range conditions in upland areas, which brought livestock to the area. The subsequent grazing is believed to have resulted in some reduction in habitat quality and quantity in these two drainages. These effects were probably relatively minor compared to the grazing impacts that were to come later. The remaining riparian areas (McGill, Deadlum, and Gap Creeks) appear to have been largely undisturbed. Indications are that riparian areas were generally dense and lush, providing habitat for a wide variety of salamanders and frogs. Amphibian species that are presently found in the drainage today were most likely common during this time period. The California red-legged frog and western pond turtle, both of which were abundant in the valley, may have also been local residents.

1900 to 1940

During this period, the large fires of the late 1800s are believed to have caused better grazing conditions within the watershed. Sheep grazing is believed to have negatively affected riparian areas by reducing the amount and quality of riparian vegetation in the understory, particularly in the Cedar Salt Log and Little Gap Creek drainages in the 1920s and 1930s. The riparian zones in the remaining drainages (McGill, Deadlum, and Gap Creek) are believed to have been largely undisturbed by grazing activities. It was at this time that plans to develop water sources and harness hydroelectric power were being made. These plans would ultimately have a dramatic effect on the area's fish and wildlife populations.

1940 to the present

During this period dramatic changes occurred to the area and to the associated aquatic fauna. The first of these changes was the completion of Shasta Dam in 1943. The dam effectively blocked access to approximately 110 miles of spawning habitat for salmon and steelhead, and an unknown amount of habitat for sturgeon. There are still landlocked sturgeon in the Pit River to this day, but their numbers are estimated to be small. The elimination of the anadromous fish runs changed the ecology of the area by removing an important food source and by genetically isolating the rainbow trout, as steelhead no longer have access to Iron Canyon Creek.

The next big impact was logging and associated road construction that began in the 1950s. Heavy erosion of soil from human disturbed sites resulted in excessive sedimentation within streams. Sedimentation resulted in pool filling, lateral channel scour, channel aggradation, and the reduction of benthic invertebrate production. These profound impacts on the habitat affected existing resident fish populations.

With the construction of Iron Canyon Dam in 1965, a significant portion of the lentic environment was converted to a lotic environment. This reduced habitat for stream dwelling fish and provided the opportunity for the introduction of non-native species. This occurred, in fact, shortly after completion and filling of the reservoir with the introduction of brown trout and brook trout.

The effect of changes during this time period was dramatic on local amphibian populations, primarily through the reduction in quantity and quality of riparian habitat. This reduction in habitat brought about subsequent reductions in the populations of riparian dependent species, particularly in the area of the reservoir, due to permanent flooding.

Hydrologic reference conditions.

Prior to 1940

From the standpoint of hydrology and hydraulics, reference conditions are before recent human disturbance (prior to 1900). Since there are no data available in the Iron Canyon Watershed Analysis area before this time with which to characterize the hydrologic and hydraulic conditions, identification of reference conditions must be based on other available data and observations and by recognition of current conditions which are effects of human disturbance. Reference hydrologic conditions can be represented quantitatively using streamflow, reservoir storage and evaporation data collected since construction of Iron Canyon Dam and using streamflow data from nearby streams and rivers. Reference hydraulic conditions can be estimated by recognizing the effects of human disturbance and "subtracting them out" from the current hydraulic conditions.

Reference hydrologic conditions in the Iron Canyon Watershed Analysis area have been estimated by creating a synthetic natural condition streamflow data file and preparing from these data, standard hydrologic figures including flood-frequency and flow-duration curves and plots of average monthly flow and average daily flow by number of occurrences (dominant discharge). Hydrologic conditions of streams above Iron Canyon Reservoir and tributary to Iron Canyon Creek have not changed substantially from reference conditions. Although construction of roads in watersheds is often associated with increased flood peaks, in the Iron Canyon Watershed Analysis area any increase in flood peaks is most likely offset by increased flood routing by debris dams and is beyond our ability to quantify with all available data.

1940 to the present

Downstream of Iron Canyon Dam, the hydrologic conditions of Iron Canyon Creek have been dramatically affected by the regulation of Iron Canyon Reservoir. Reference hydrologic conditions in Iron Canyon Creek below Iron Canyon Dam have been quantified using the synthetic natural condition streamflow data sets prepared to identify the current hydrologic conditions at locations other than in Iron Canyon Creek. The reference condition flood frequency relationship in Iron Canyon Creek at the stream gage site is shown in the following table.

Flood Frequency Data, Iron Canyon Creek

Location	Area (sq. miles)	2 year	5 year	10 year	25 year	50 year	100 year
Gauge	11.29	560	1250	1800	2600	3200	3900
Mouth	22.49	1030	2200	3100	4500	5500	6600

flows are in cubic feet/second

Reference hydraulic conditions in the Iron Canyon Watershed Analysis have been quantitatively estimated by recognition and "removal" of the effects of recent human disturbance. Upstream of Iron Canyon Reservoir and tributary to Iron Canyon Creek, the most significant effects of recent human disturbance consist of an excess of debris dams filled with fine sediment. Prior to human disturbance the quantity of debris available to the stream channel was likely to have been much smaller; therefore, debris dams were probably much less common. Sediment loads were from slides and bank erosion, both of which provided a balanced supply of fine to coarse sediment sizes. Without the debris dams and high fine sediment loads introduced in recent years, the stream channels most likely had larger differences between the geometry of run reaches and pool reaches. Depths and widths of the run reaches were probably similar to the depths and widths of the present run reaches; however, depths and widths of the pool reaches were most likely greater. Pool ratios may have been greater. Stream banks were probably slightly better defined.

Iron Canyon Creek below Iron Canyon Dam has been most significantly affected by the regulation of Iron Canyon Reservoir. Prior to the construction of Iron Canyon Dam the hydraulic conditions of Iron Canyon Creek were defined by a combination of the available sediment supply and flows ranging from the dominant discharge to infrequent floods. Construction of the dam has cut off the supply of sediment and substantially reduced flows to a single flow of approximately half of the previous dominant discharge. Given the reference condition sediment supply and hydrologic regime, all of Iron Canyon Creek, below Iron Canyon Dam, would most likely have larger pools and a bed consisting of a more uniform gradient of sediment sizes including gravel and some sand. Bed materials would be frequently rejuvenated (loosened and replenished) by floods. Flood plains along the stream most likely consisted of a combination of mature trees and low plants and shrubs, the latter of which would be infrequently removed by floods.

Soil stability and geologic processes within the watershed.

Prior to 1940

In view of the impact of mass wasting within the watershed, a specific inventory was conducted to further determine important factors which contribute to the process. Mass wasting was investigated using a time sequence analysis of aerial photographs of the entire watershed. Specifically, this involved mapping on 1944 black and white, 1983 color infrared, and 1980 color photography.

All landslides depicted upon the 1944 photos were found to be naturally occurring. These invariably took the form of debris slides. The preponderance of these were located along the Pit River, Iron Canyon Creek and its western tributary, and Initial Creek. Most landslides occurred along south or southwest facing slopes. Aspect and slope position are considered primordial influencing factors.

1940 to present

This situation began to rapidly change beginning in the 1950s and 1960s. With the construction of the reservoir and pipeline, and the commencement of logging activities came the construction of a road network. The construction of roads resulted in significant impacts upon water quality. Soil erosion problems from road construction were inevitable because of poor road location, no engineering, steep terrain, weathered subsurface, and the natural instability of some areas. The impacts of soil erosion from area roads was probably greatest during the period from the late 1940s to 1970, although those impacts are still significant today. Refer to the following section for an expanded discussion of the transportation system.

Construction of pipelines has also resulted in negative effects upon the stability of slopes they traverse. In 1977 a break in a pipeline occurred on the hillside above Power House #5. This resulted in massive debris flows and channel scour of affected creeks from the top of the ridge to the Pit River. Restoration activities were initiated after this catastrophe, but the area is still recovering.

The transportation system within the watershed

Prior to 1900

Prior to beginning of settlement at the turn of the century, the transportation system consisted of trails associated with hunting, fishing, and other activities of the inhabitants. These were located primarily near streamcourses and ridge tops.

1900-1940.

With homesteading, grazing, and mining activities came improvements to various trails allowing pack animal access. Gradually, certain routes were upgraded to allow wagon passage. With the arrival of the automobile age and heavy construction equipment came the first crude roads allowing vehicle travel. This occurred as an off-shoot of the development of Northern California in general and Redding in particular. In the 1930s some new trails were built and old ones rejuvenated by the Civilian Conservation Corps, primarily as a fire patrol and defense network for the U.S. Forest Service. By the end of this period, Big Bend was the closest community with improved gravel road access. 1944 aerial photos show very few visible roads in the analysis area.

1940 to the present

World War II brought dramatic advances in technology which were applied to "harnessing" natural resources at the wars end. Among other things, this included dam building and harvesting of timber to supply power and lumber to a rapidly growing post-war population. Road building and tractor logging began in earnest in the 1960s on private timberlands. The "checkerboard" nature of land ownership, a holdover from the railroad grants of the past, necessitated the acquisition of rights-of-way and cooperative agreements for crossing federal land. In 1969, several parcels of logged-over land were acquired (so called Watts land), including the associated roads. Meanwhile, the construction of Iron Canyon Dam and its associated pipelines had resulted in even more and higher standard roads. By the 1970s the Forest Service was able to adopt a timber management program using the road network. The period of the 1960s to the 1980s was also a time when road maintenance was at its peak due to the recurring activities related to land and timber management activities. The road system went into decline following the abatement of timber harvesting at the end of the 1980s. Private logging continues in the watershed, and powerline and hydropower related road use is also still occurring. Most of these are associated with well established roads. Road density in this area increased to approximately two miles per section during the 1960s and 70s.

Compatibility of social uses with LSR objectives

Topics discussed relative to this issue are:

- Commodities being produced.
- Natural trout production and present fish stocking levels.
- Compatibility of recreational use with LSR objectives.

Commodities being produced

Prior to 1900

Livestock was the only significant commodity produced in the Iron Canyon Watershed prior to 1900. There was heavy grazing in the area beginning around 1870 and this is supported by abundant written evidence.

1900 to 1940

Livestock grazing in the Iron Canyon Watershed continued through this period. Several grazing allotments are recorded for the adjacent Squaw Creek drainage beginning in the early decades of the 20th Century. Hundreds of cattle and horses and thousands of sheep were grazed each year on each allotment and it is assumed that similar use occurred in the Iron Canyon Watershed.

1940 to the Present

Grazing began to decline during this period due to the regulation of cattle grazing on both public and private land. The collapse of the wool market in 1946 also contributed to reduced grazing. Grazing continued to decline until it was no longer a significant commodity produced in the watershed.

Timber harvest activities began in the Iron Canyon Watershed in the early 1950s and reached a peak during from 1960 to 1980. No timber harvest has occurred since 1989 when constraints were imposed to protect the spotted owl.

The watershed has provided a source of personal-use firewood for residents of the Big Bend area. The amount removed is assumed to have been proportional to the size of the local population and the development of the road system. Recent owl constraints have eliminated legal firewood cutting activity, although some illegal removal still occurs in the watershed.

The construction of Iron Canyon Dam in 1965 provided major changes in human use of the watershed. A direct output of the dam was the generation of hydroelectric power. The reservoir also began to attract outdoor recreationists for hunting, fishing, and camping.

Natural trout production and present fish stocking levels

Prior to 1900

Prior to 1900, the original native fish assemblage was still largely intact and was used primarily by local Native Americans. The importance of the Iron Canyon Watershed to the local people was probably minimal as the Pit River was nearby and provided a greater diversity and opportunity to catch fish. Anadromous fish were common in the Pit River as there were no barriers to fish migration.

1900 to 1940

During this period, the fishery seems to have changed very little if at all. Though adjacent watersheds were being settled by people of European decent, the effect on the streams in the Iron Canyon drainage was light as the terrain is steep and rugged, and other than hunting and grazing, there was little reason to visit the area.

1940 to the Present

During this period, dramatic changes occurred to the area. The first of these changes was the completion of Shasta Dam in 1943. The dam effectively eliminated anadromous fish runs from the Pit River. The construction of Iron Canyon Dam in 1965 converted a significant portion of the lentic (stream) environment within the Iron Canyon Watershed to a lotic (lake) environment which reduced habitat for stream-dwelling fish and provided the opportunity for the introduction of non-native species. The new dam served to isolate the local rainbow trout population in the upper watershed.

Compatibility of recreational use with LSR objectives

Prior to 1994

Late-Successional Reserves were not established until 1994 with the signing of the ROD. Therefore, activities occurring within the watershed during this period did not legally conflict with LSR objectives.

1994 to the Present

With the signing of the ROD in April of 1994, the watershed was placed entirely within an LSR and management activities were modified to comply with the new Standards and Guidelines.

Current Standards and Guidelines (LMP 4-39; ROD C-16) state that: "Fuelwood gathering will be permitted only in existing cull decks, where green trees are marked by silviculturists to thin (consistent with standards and guidelines), to remove blowdown blocking roads, and in recently harvested timber sale units where down material will impede scheduled post-sale activities or pose an unacceptable risk of future large-scale disturbances. In all cases these activities should comply with the standards and guidelines for salvage and silvicultural activities".

To comply with this direction, the current Forest woodcutting policy has prohibited firewood cutting within this LSR. However, there is abundant evidence that illegal woodcutting continues to occur.

Dispersed recreational uses, including hunting and fishing, generally are consistent with the objectives of the LSR (ROD C-18). However, the number of fishing access roads along the north shore of the reservoir has the potential to create disturbance in areas currently identified as suitable spotted owl habitat.

Chapter 5

Interpretations

The purpose of this chapter is to compare existing, historical, and reference conditions of specific ecosystem elements and to explain significant differences, similarities, or trends and their causes.

The three major issues identified are:

1. Lack and loss of late-successional forests
2. Impacts to riparian and aquatic ecosystems
3. Compatibility of social uses with LSR objectives

Lack and loss of late-successional forests

Topics discussed relative to this issue are:

- Heavy dead and down fuel loading
- Dense understory conditions
- Potential for fire occurrence
- Lack of old-growth and late-successional forests
- Species composition of mixed conifer stands
- Limited presence of large diameter ponderosa pines
- Fragmentation of late-successional stands

Heavy dead and down fuel loading

Ecosystem Condition:

Areas of heavy dead and down fuel loading exist within the watershed (see the "Dead and Down Fuel Loading map (Map 9)) and pose a threat of stand replacing wildfire. Riparian Reserves are intertwined throughout upland forest areas identified as having heavy dead and down fuel concentrations (see the "Riparian Reserves" map (Map 11)) and also need to be treated to effectively reduce the fuel hazard.

Causal Mechanism:

- Winter storm damage
- Overstocked forest stands

Trend:

- During average years, snow damage will continue to occur in understory and chaparral species.
- During heavier than normal snow and high wind events, additional overstory damage and dead/down fuel loading will continue to increase.

Conclusion:

Winter storm damage has created areas of heavy dead and down fuel loading that pose a threat of stand replacing wildfire in existing late-successional forest stands as well as in younger developing stands. There is a need to initiate fuel management activities to reduce fuel loads while still retaining components necessary for the functioning of late-successional and old-growth ecosystems. Due to the amount and arrangement of Riparian Reserves, there is a need to include them in fuel management activities if adequate protection is going to be provided in the watershed. Fuel treatments are appropriate in Riparian Reserves when they contribute to attainment of Aquatic Conservation Strategy objectives (LMP 4-56, 6a & d; ROD C-35, FM-1 & FM-4).

Dense understory conditions

Ecosystem Condition:

Dense understory conditions of shrubs, conifers, and hardwood vegetation are common in the watershed and occur most frequently in stands with "open" canopy types (see table on page 3-1), as well as in some stands with "moderate" canopy types. Such conditions occur over approximately 50% of the watershed.

Dense understory conditions provide a layer of live fuels that creates a fuel ladder into the upper crown canopy (see Fuel Model 6 on page 3-4). This situation increases the potential for wildfire to develop into stand replacing events.

Dense understory conditions retard the development of younger forest stands into suitable late-successional forest. High stocking levels reduce the general health of the forest, slow the growth rates of individual trees, and discourage the development of some desirable forest components, such as oaks.

Causal Mechanism:

- Fire exclusion
- Timber harvest practices

Trend:

- As the overstory develops and the crown canopy closes, the understory will decline and dead and down fuel loading will increase as understory trees are suppressed and die.
- There will continue to be a risk of stand replacing wildfire.
- Forest health, tree vigor, and the growth rate of individual trees will decline.

Conclusion:

Fire exclusion and past timber harvest practices have created conditions that allowed dense understories to develop in areas with "open" canopy types. Dense understories provide a fuel ladder that increases the potential for a ground fire to move into the tree crowns and destroy the stand. These understories also provide a source of additional dead and down fuels as suppressed understory trees die. There is a need in the watershed to reduce the number of both conifer and shrub stems in the understory and create conditions that will reduce the possibility of fire becoming a stand replacing event.

The development of late-successional/old-growth characteristics can be accelerated in overstocked stands by thinning to improve forest health and individual tree vigor. There is a need in the watershed to encourage the development of younger stands and increase the amount of, and reduce the fragmentation of late-successional forest.

Potential for fire occurrence

Ecosystem Condition:

Analyses of fire occurrence from 1973 to 1994 shows that fire starts are concentrated in three areas:

- along the ridge between Coyote Peak and Stump Creek Butte due to lightning.
- along the ridge running north of Bagley Flat due to lightning.
- around Iron Canyon Reservoir due to both lightning and human causes.

The high fire occurrence history around the reservoir is of special concern because of the bowl like topography. Fires that escape initial suppression action in this area have the potential to spread upslope to the north and east into areas of low fire occurrence.

Causal Mechanism:

- Lightning
- Human-caused fire

Trend:

- Lightning-caused fires will continue to occur in the watershed.
- The number of human-caused fires will gradually increase with increased recreational use of the area, especially in the vicinity of Iron Canyon Reservoir.

Conclusion:

Areas with the highest potential for fire occurrence are the ridge top areas that are exposed to lightning starts and the area around Iron Canyon Reservoir that has a high occurrence of human-caused fire starts. The area around the reservoir is of special concern because:

- there is a potential for any fire starts in this area to move rapidly upslope and destroy large areas of late-successional forest.
- the largest concentration of late-successional forest and suitable habitat occurs within this area.
- the risk of fire starts around the reservoir is expected to increase in the future as recreational use of the area increases.

There is a need to emphasize treatment of fuels in those areas with the highest potential for fire occurrence.

Lack of old-growth and late-successional forests.

Ecosystem Condition:

There is a lack of habitat available for TES and S&M species dependent upon late-successional and old-growth forests. There are no known old-growth stands remaining in the watershed. Late-successional forests comprise less than 20% of the watershed's forests, and most of the trees in these stands are less than 100 years old.

Approximately half of the watershed is occupied by younger stands that have the potential to develop into late-successional forests in the future.

Often large downed logs and snags are missing as are large diameter trees from which they could be recruited.

Causal Mechanisms:

- Stand replacing wildfires of the late 1800s
- Past timber harvest
- Design, construction, and maintenance of roads
- Construction and operation of Iron Canyon Reservoir

Trend:

- The amount of late-successional and old-growth forest, and the habitat it represents, is slowly increasing.
- Road density is expected to decrease due to management direction, lack of maintenance, and encroaching vegetation.
- Large downed logs and snags will slowly increase in numbers over time.

Conclusions:

The past fire history and timber harvest practices have created a watershed that is lacking in both old-growth and late-successional forests. Approximately half the watershed is occupied by young stands that have the potential to develop into late-successional forests. There is an opportunity to treat these stands to accelerate their development into late-successional conditions and suitable habitat for dependent species. There is also a need to protect existing late-successional forest within the watershed from loss to wildfire.

There is a need to accelerate the development of individual trees to shorten the time period required to create downed logs and snags of sufficient size to meet the needs of dependent species.

Land uses that eliminate late-successional forest are roads, the reservoir, and facilities related to Iron Canyon Dam (i.e. dam, pipelines, access roads). There is an opportunity to obliterate surplus roads and return them to a vegetated condition.

Species composition of mixed conifer stands

Ecosystem Condition:

With the exclusion of wildfire and past management practices, the forest has developed a more closed and multi-storied structure that has favored a shift away from the mixed conifer forests of the past, to the Douglas-fir dominated forest of the present. Sugar pine and ponderosa pines are unable to regenerate at previous levels.

Casual Mechanism:

- Fire exclusion
- Past timber harvests

Trend:

- Current conditions favor the continued domination of shade tolerant species, such as Douglas-fir, within area forests.
- Current conditions discourage the establishment and development of shade intolerant conifer species such as ponderosa pine and sugar pine.

Conclusion:

The status of the Iron Canyon Watershed as a LSR requires that late-successional environments be enhanced and maintained. The open, patchy pine dominated mixed conifer upland forests of the past are not conducive to the support of many late-successional dependent species such as the northern spotted owl. The current Douglas-fir dominated forests will provide, or are providing, suitable habitat for such species. Significant disruption of the current forests, and elimination of large amounts of potential suitable habitat would be required to return to the reference composition and condition of forests in the watershed. This is not consistent with the goals and objectives of the LSR.

Management practices should be implemented which will increase species variability while maintaining and enhancing late-successional environments.

Limited presence of large diameter ponderosa pines

Ecosystem Condition:

Large diameter ponderosa pine trees used by bald eagles as nest and perch trees are limited. There is a shortage of suitable trees to replace the existing nest trees in the future. Large diameter ponderosa pines adjacent to large bodies of water, such as Iron Canyon Reservoir, are the preferred perching and nest trees of bald eagles.

Causal Mechanism:

- Past timber harvests
- Fire exclusion

Trend:

- Suitable bald eagle nest and perch trees are decreasing in the vicinity of Iron Canyon Reservoir.
- There will be a decrease in the establishment and development of young ponderosa pine under closed canopy conditions.

Conclusion:

Suitable bald eagle nest and perch trees are limited and there is a shortage of suitable replacement trees for the future. There is a need to protect existing suitable nest trees from loss to wildfire. There is also a need to encourage the development of ponderosa pine trees in a range of age and size classes to provide a long term supply of replacement nest trees in close proximity to Iron Canyon Reservoir.

Fragmentation of late-successional stands

Ecosystem Condition:

Late-successional stands in the watershed are highly fragmented and isolated from each other by younger stands that lack late-successional characteristics. Habitat for late-successional species is very limited and generally only found along riparian zones. Human-made features such as roads, pipelines, power line corridors and the reservoir are additional sources of fragmentation.

There is a risk of further fragmentation of late-successional stands due to the potential for stand replacing wildfire in the watershed.

Causal Mechanism:

- Fires of the late 1800s
- Timber harvests
- Road design, construction, and maintenance
- Construction, operation, and maintenance of Iron Canyon Reservoir

Trend:

- Fragmentation will slowly decrease as younger stands continue to develop into late-successional forest and abandoned road-beds become revegetated.
- The risk of further fragmentation due to the potential for stand replacing wildfire will remain.

Conclusion:

Travel and dispersal routes in the watershed have been greatly impacted because of fragmented habitat and poor or non-existent corridors, attributed in part to the stand replacing fires of the late 1800s and past land management activities.

Opportunities exist to advance the linking of existing late-successional fragments in the watershed by accelerating the development of adjacent younger stands. The area immediately north of Iron Canyon Reservoir provides good opportunities for treating adjacent younger stands with the objective of reducing the amount of time it will take for existing late-successional fragments to be linked into a large contiguous block (see the "Late Successional Forest" map (Map 5)).

There is also a need to provide protection from further fragmentation in the watershed from stand replacing wildfire.

There is an opportunity to restore surplus roads to a vegetated condition which will reduce fragmentation.

Impacts to riparian and aquatic ecosystems

Topics discussed relative to this issue are:

- Degradation and loss of aquatic habitat
- Current road density
- S&M and riparian obligate habitat

Degradation and loss of aquatic habitat

Ecosystem Condition:

Aquatic habitat has been degraded and/or lost due to the environmental impacts of previous land management activities. Past timber harvest focused on the removal of large trees, thus reducing or eliminating the presence of this component from the forest. This has in turn resulted, in many cases, in the reduction of multi-layered canopies. It has also resulted in the absence and lack of recruitment of large woody debris, especially logs, into aquatic and riparian ecosystems.

The design, construction, and reduced maintenance of roads have contributed to accelerated soil erosion rates within the watershed, and to fragmentation of aquatic habitat by interrupting fish movement past culverts and some other road structures.

Access roads to recreational facilities at Iron Canyon Reservoir are unsurfaced. Wet weather use has resulted in rutting, and subsequent sediment transport.

Regulated stream flows in Iron Canyon Creek below the dam have eliminated flushing flows that remove fine sediment surplus, maintain pools, and transport spawning gravel

Causal Mechanisms:

- Excessive sedimentation (sedimentation surplus)
- Past logging activities
- Design, construction, and maintenance of roads
- Construction and operation of Iron Canyon Reservoir

Trends:

- Degraded aquatic habitat in Iron Canyon Creek below Iron Canyon Reservoir will not improve without increased stream flows.
- Erosion caused by poor road design and construction, the 1977 pipeline failure, and historic wildfires will continue the process of stabilization.

Degradation and loss of aquatic habitat, *continued*

Conclusions:

Past timber harvest has resulted in the absence and lack of recruitment of large woody debris, especially logs, in aquatic and riparian ecosystems. There is a need to encourage the development of large trees in riparian areas as a source of woody debris. Due to the long time period it takes to develop large trees, there is also a need to protect existing conditions within riparian areas from loss to wildfire.

Sediment surplus in streams continues but is in the process of slow stabilization. Recovery can be stopped, or worsened, by poorly executed land management activities and wildfire. There is a need to identify and correct sediment sources, especially those related to road design and construction. There is also a need to reduce the risk wildfire in the watershed which would result in accelerated soil erosion.

Road maintenance has traditionally been carried out as an activity related to timber sales. Reduced timber sale activity has resulted in reduced road maintenance which can increase sediment movement into streams. There is a need to provide continued maintenance of existing roads or to properly obliterate and/or revegetate them.

Opportunities exist to restore aquatic habitat within Iron Canyon Creek below the dam. Spawning gravel can be artificially introduced into the stream below the dam and pools can be created. However, the effectiveness of such measures is limited unless flushing flows can be reintroduced into this portion of the stream to flush out fine sediments and to transport spawning gravel downstream. Therefore, there is a need to investigate the possibility of modifying current operations at Iron Canyon Dam to provide occasional flushing flows representative of historic floods.

Current road density

Ecosystem Condition:

Roads are a source of fragmentation in both late-successional forests and in riparian areas, and remove otherwise suitable habitat from the land base. Roads can be a source of disturbance to intrusion sensitive animal species.

The road system in the Iron Canyon Watershed was built to support timber harvests and the construction and operation of Iron Canyon Dam. The management emphasis has changed from timber management to managing the area as a LSR.

Recreation use, including fishing, hunting, and camping, has resulted in the proliferation of non-system roads in the vicinity of Iron Canyon Reservoir.

The current road density exceeds management guidelines.

Causal Mechanism:

- Changes in management objectives
- Past timber harvests
- Construction and operation of Iron Canyon Dam and Reservoir
- Recreation access to Iron Canyon Reservoir

Trend:

- Current road density is expected to gradually decrease as unmaintained roads become unusable due to falling trees, bank failure, and encroaching vegetation.
- Due to the designation of the area as a LSR, no significant amounts of new road construction are expected in the future.
- Recreation related road use is expected to increase steadily.

Conclusions:

The existing road density exceeds current management objectives and guidelines. There is a need to reduce the road density to levels consistent with the objectives of the LSR. Opportunities exist to decommission and close roads that are surplus to the needs of the area. There is also a need to reduce the number of non-system fishing access roads around the north shore of Iron Canyon Reservoir, especially in areas that have been identified as suitable late-successional habitat.

S&M and riparian obligate habitat.

Ecosystem Condition:

Significant degradation of riparian habitat occurred from the fires of 1872 and 1898. Approximately 50% of the original riparian habitat in the watershed was permanently lost with the flooding of Iron Canyon Reservoir in 1965, and another 40% is believed to have been removed or seriously degraded by activities such logging, road construction, and poor road maintenance. Approximately 90% of the historic riparian habitat is gone at the present time.

The condition of the remaining riparian habitat is described as fragmented, narrow, and degraded. This condition has made them susceptible to wind damage and insect infestation, and has reduced the habitat capability for many late-successional species which inhabit close canopied riparian forests.

Roads are an additional source of fragmentation in both late-successional forests and in riparian areas, and remove otherwise potentially suitable habitat from the land base. Roads can also be a source of disturbance to intrusion sensitive animal species.

Causal Mechanisms:

- Stand replacing fires of the late 1800s
- Past timber harvests
- Road design, location, construction, and maintenance practices
- Construction, operation, and maintenance of Iron Canyon reservoir, dam, and pipeline

Trend:

- The amount and condition of riparian habitat will slowly improve over time.

Conclusion

Habitat for S&M and riparian obligate species is fragmented, narrow, and degraded. There is a need to accelerate the development of adjacent younger stands to reduce fragmentation, increase corridor widths, and provided additional forest canopy.

There is an opportunity to further reduce fragmentation within riparian corridors by obliterating surplus roads and returning them to the land base through revegetation.

Compatibility of social uses with LSR objectives

Topics discussed relative to this Issue are:

- Firewood cutting
- Off-road vehicle use
- Fishing Activities

Firewood cutting

Ecosystem Condition:

Unauthorized firewood cutting is occurring in the LSR in conflict with management objectives.

This area has been popular for wood cutting for several reasons. First of all, it has abundant dead and down material and snags including desirable firewood species such as oak, Douglas-fir, and cedar. Much of the terrain is flat enough that it can be accessed by driving off of existing roads. Finally, the area is remote enough that law enforcement is difficult. Currently wood cutting is prohibited in the LSR, including the Iron Canyon Watershed.

Causal Mechanism:

- Lack of law enforcement
- Lack of management strategy to provide alternate wood cutting areas

Trend:

- Demand for firewood cutting opportunities will probably continue and even increase as the human population grows

Conclusion:

There is a need to provide firewood for residents of the Big Bend area. Firewood cutting is currently prohibited on all National Forest land near Big Bend but is occurring illegally.

Opportunities may exist within the watershed to provide firewood to local residents as a byproduct of other management activities. There is a need to investigate such opportunities and to develop a wood cutting policy for the area.

Off-road vehicle use.

Ecosystem Condition:

Unregulated off-road vehicle use is occurring in some parts of the watershed and may be in conflict with management objectives. Numerous fishing access roads have been observed in areas identified as suitable late-successional habitat on the north shore of Iron Canyon Reservoir. Suitable habitat can be degraded by disturbance from vehicles during the nesting season. Wet weather use of these fishing access roads causes rutting and sediment transport into riparian zones around the reservoir. Fluctuations in reservoir levels allow vehicle access along the shoreline.

Additional off-road vehicle use is occurring from woodcutters and hunters but tends to be more dispersed and away from riparian areas. Some rutting and sediment transport occurs from vehicle use on established jeep trails during wet weather.

Causal Mechanism:

- Fishing access
- Wood cutting access
- Hunting

Trend:

- This condition is expected to increase with the population as outdoor public recreation is encouraged.

Conclusions:

Off-road vehicle use is expected to increase in the future as recreation use in the watershed increases. Problems associated with the present condition include disturbance in suitable habitat, sediment transport due to wet weather use, and the potential for fire starts.

There is a need to provide regulated fishing access to the north shore of Iron Canyon Reservoir in a manner that is consistent with other management objectives. Opportunities exist to control the number and location of access roads and to locate and design them in a manner that will minimize sediment runoff. Seasonal restrictions on use may be imposed where there is a need to control disturbance during certain parts of the year.

Stand and fuel treatments on gentle terrain can encourage additional off-road vehicle use when they result in open conditions with little debris on the ground. There is a need to consider the effect that any treatments between road 37N78 and the reservoir will have on access for off-road vehicles.

Fishing Activities

Ecosystem Condition:

Iron Canyon serves as a significant recreational fishery. This fishery is artificially maintained and presently meets fish user demand.

Causal Mechanism:

- Presence of Iron Canyon Reservoir
- Stocking of game fish into Iron Canyon Reservoir
- Presence of recreation enhancing improvements

Trends:

- Recreational fishing and associated activities, including boating, camping, etc. will continue to increase as regional population levels increase.
- A corresponding increase in user impacts, including increased risk of wildfires will occur.
- Artificial stocking of Iron Canyon Reservoir will continue at current levels.

Conclusion:

Fish stocking levels are controlled by the California Department of Fish and Game. Unless stocking levels are adjusted, fishing use will eventually exceed the supply.

Few opportunities exist to improve fish habitat in the reservoir.

Opportunities exist to facilitate fishing use by providing regulated access to the north shore of Iron Canyon Reservoir as discussed on page 5-14.

Chapter 6

Recommendations

The purpose of this chapter is to identify those management activities that could move the system towards reference conditions or management objectives, as appropriate. The products of this chapter are:

- A list of recommendations for management.
- A description of the ecosystem conditions and functions from Chapter 5 that would be altered, maintained, or restored.
- The rationale or objective for recommending various management activities.
- A list of recommended research, surveying, and monitoring activities
- A prioritization of recommended management activities.

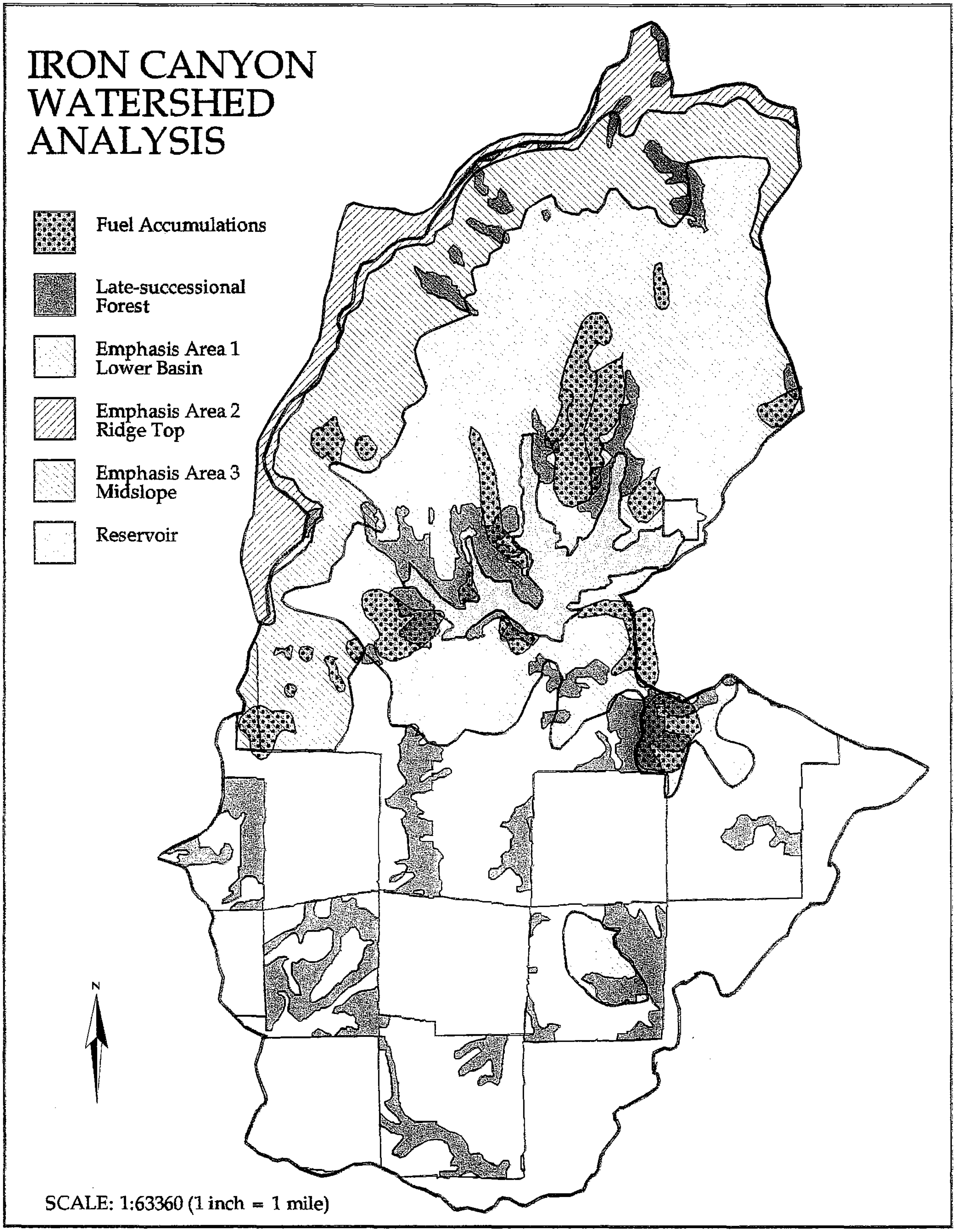
The three major issues previously identified are:

1. Lack and loss of late-successional forests
2. Impacts to riparian and aquatic ecosystems
3. Compatibility of social uses with LSR objectives

Recommendations presented in this chapter fall into two categories:

- Emphasis Areas
    - Lower Basin
    - Ridgetop
    - Midslope
    - Deferred Areas
- Management Practices
    - Road Management
    - Riparian Management
    - Woodcutting Management
    - Fishing Access to Iron Canyon Reservoir
    - Recreational Fishing
    - Surveying and Monitoring Needs

Emphasis Areas are areas within the watershed in which certain management objectives will be emphasized based on topography, vegetation, and fuel conditions. Emphasis areas in the watershed are identified on Map 12.



Map 12. Emphasis Areas

Emphasis Area 1 - Lower Basin

Ecosystem Condition:

- This area has gentle to moderate terrain with slopes generally less than 40% with minor inclusions of steeper areas.
- This area includes most of the moderate and high fuels accumulations identified in the watershed.
- This area has a high potential for fire occurrence due to human activity around Iron Canyon Reservoir.
- This area has the largest blocks of late-successional forest in the watershed. However, these blocks are fragmented and isolated.
- This area has the deepest and most productive soils in the watershed.
- Of the four emphasis areas, the Lower Basin has the highest proportion of the landbase in Riparian Reserves. This is due to the width of the Reserves and the number of streams (see "Riparian Reserves" ,Map 11). The amount and arrangement of streams in this area has been identified as a barrier to effective fuel treatment if all activity is excluded from Riparian Reserves.

Recommendations:

In this area:

- emphasize the protection of existing stands of late-successional forest from wildfire by treating dense live fuel understories and concentrations of dead and down fuel.
- emphasize accelerating the development of stands identified as potential late-successional forest by thinning for growth.
- emphasize reducing fragmentation by accelerating the development of late-successional characteristics in stands that provide linkage between blocks of existing late-successional forest.
- apply low intensity prescribed fire, thinning, and other appropriate fuel treatments within Riparian Reserves wherever soil exposure standards can be met.

Rationale/Objectives:

- Vegetation and fuels treatment are most effective on gentler terrain.
    - ground-based equipment allows more control in implementing prescriptions.
    - less damage occurs to residual vegetation.
    - there is more control of fire intensity during prescribed burning.
    - more treatment options are available.
- The best opportunities for reducing the fragmentation of late-successional habitat occur within this emphasis area.
- This area has the deepest and most productive soils. Growth response to thinning and the accelerated development of stands into late-successional conditions would be the greatest in this emphasis area.
- Effective protection of late-successional habitat in this emphasis area will require treating fuels and vegetation within Riparian Reserves.

Emphasis Area 2 - Ridgetop

Ecosystem Condition:

- This area has gentle to moderate terrain with slopes generally less than 40% with minor inclusions of steeper areas.
- This area has a high potential for lightning-caused fire starts.
- Few areas of late-successional forest occur within this area and there are few opportunities to reduce fragmentation in the near future.
- Due to the ridgetop location, soils in this area tend to be slightly less productive than soils found in the Lower Basin.
- Due to the ridgetop location, this emphasis area has the lowest proportion of the landbase designated as Riparian Reserve

Recommendations:

- In this area, emphasize management of an open stand structure along major ridges where there is high fire risk and hazard.

Rationale/Objectives:

- Vegetation and fuels treatment are most effective on gentler terrain.
    - ground-based equipment allows more control in implementing prescriptions.
    - less damage occurs to residual vegetation.
    - there is more control of fire intensity during prescribed burning.
    - more treatment options are available.
- Fuels management along major ridges is an important strategy to limit the spread of wildfire to other parts of the Late-Successional Reserve.
- There is a high potential for lightning-caused fire starts in this area.

Emphasis Area 3 - Midslopes

Ecosystem Condition:

- This area has steep terrain with slopes generally greater than 40%.
- Soils on these steeper slopes tend to be shallower and less productive than in the Lower Basin and Ridgetop Areas.
- Few areas of late-successional forest occur within this area and there are few opportunities to reduce fragmentation in the near future.
- The proportion of the landbase designated as Riparian Reserve on the midslope areas is intermediate between the other emphasis areas. Streams are more common than in the Ridgetop Area but the Reserve widths are narrower than the major streams in the Lower Basin.

Recommendations:

In this area, emphasize treatments suitable for steep terrain that will reduce the potential for wildfire moving through the area by treating dense live fuel understories. Such treatments would include:

- thinning understory vegetation in areas that can be accessed by harvest equipment with a minimum of damage to the residual trees and a minimum of new road construction.
- prescribed broadcast burning to reduce understory vegetation

Rationale/Objectives:

- ♦ Steep terrain restricts treatment in this area. Treatments would be implemented only as opportunities exist and large blocks of continuous treatment would not be expected to occur.
- ♦ Few areas of existing late-successional forest occur within this area and there are few opportunities to reduce fragmentation.
- ♦ Soils on the steeper slopes would tend to be shallower and less productive and the response to thinning would be the least on the midslope areas.

Emphasis Area 4 - Deferred Areas

Ecosystem Condition:

This includes areas that were deferred from analysis due to poor access and insufficient data. These areas are not displayed on the Emphasis Areas map (Map 12) but would include all land not included in the other three emphasis areas.

Recommendations:

Emphasis in these areas is to:

- ♦ implement Riparian Management Recommendations (page 6-10)
- ♦ collect inventory information for future analysis.

Rationale/Objectives:

- ♦ Riparian Management Recommendations can be implemented without affecting the function of the Late-successional Reserve.
- ♦ Additional data and inventory information should be collected before management recommendations can be made in these areas.

Protection of LSR from Loss to Wildfire

Ecosystem Condition:

- There is a threat of stand replacing wildfire within the watershed.
- Areas of heavy dead and down fuel loading exist within the watershed.
- Dense live fuel understories in the watershed create fuel ladder conditions.
- A high potential for fire occurrence, especially around the reservoir, threatens late-successional forest stands.
- Due to the amount and arrangement of Riparian Reserves (especially in Emphasis Area 1), there is a need to apply fuels treatments within them to adequately protect the watershed.

Recommendations:

- Apply treatments to reduce downed fuels to less than 0.15 tons/acre in diameters less than 20" dbh.
- Follow Forest Standards and Guidelines for retention of snags and downed logs. The goal is to manage for high capability habitat for the northern spotted owl (LMP Appendix G-12).
- Thin understory vegetation to reduce live fuel ladders. Treatment areas will include portions of late-successional forest wherever there is a high risk of stand loss to wildfire (see ROD C-13).
  - In thinning treatments, emphasize the retention and release of healthy ponderosa pine within one mile of the reservoir (see page 6-7: "Bald Eagle Habitat").
- Apply low intensity prescribed fire, thinning, and other appropriate fuel treatments within Riparian Reserves wherever soil exposure standards can be met.
- Require the participation of a hydrologist and/or geologist in the development and implementation of prescriptions applied to Riparian Reserves, especially those areas identified on the "Riparian Reserves" map (Map 11) as unstable areas.

Rationale/Objectives:

- Reduce the possibility of losing large portions of late-successional forest to wildfire and prevent further fragmentation of suitable habitat by:
  - maintaining low fuel loads.
  - maintaining an open understory without degrading foraging habitat.
- Reduce the potential for damaging wildfires in areas of high fire occurrence.
- Support an open stand structure on major ridges rated as high for fire risk and hazard.
- Reduce wildfire hazard on unstable areas without compromising soil stability. Reduce the impacts of sedimentation in streams if wildfire does occur.
- Excluding riparian reserves from fuels treatment does not allow effective fire Treatments must meet Aquatic Conservation Strategy Objectives (ROD B-11).
- Maintain reduced fire hazard over time.

Condition of Late-successional forests

Ecosystem Condition:

- No true old-growth stands currently exist within the watershed.
- Late-successional forests currently comprise less than 20% of the watershed.
- Habitat is lacking for TES and S&M species dependent on late-successional and old-growth forests.
- Overstocked conditions are inhibiting tree growth and the development of late-successional forests.
- Existing late-successional forest stands are fragmented and isolated from each other (see Map 5, "Late Successional Forests").

Recommendations:

- Treat areas where silvicultural opportunities exist to improve forest health, reduce potential for wildfire, and accelerate development of desirable late-successional forest conditions. Treatment areas will include portions of late-successional forest wherever there is a high risk of stand loss to wildfire (see ROD C-13).
- Emphasize the treatment of younger developing stands in Emphasis Area 1 that currently link isolated stands of existing late-successional forest and where accelerated development will reduce the fragmented condition of late-successional forest.
- Follow Forest Standards and Guidelines for retention of snags and downed logs. The goal is to manage for high capability habitat for the northern spotted owl (LMP Appendix G-12).
- Emphasize the retention and development of large healthy ponderosa pine within one mile of the reservoir (see page 6-7: "Bald Eagle Habitat").

Rationale/Objectives:

- Accelerate the development of future late-successional stands by reducing competition and accelerating tree growth in overstocked stands.
- Reduce fragmentation and encourage the development of larger, contiguous stands of late-successional forest by accelerating the growth of younger developing stands that currently link existing stands of late-successional forest.
- Improve habitat conditions where dense understory vegetation detracts from the quality of the habitat.
- Retention of ponderosa pine during thinning will provide a continuing source of nest trees for bald eagles around Iron Canyon Reservoir.

Bald Eagle Habitat

Ecosystem Condition:

- Large diameter ponderosa pine for bald eagle nest trees are limited in the watershed.
- Pine dominated mixed conifer stands have been replaced by Douglas-fir dominated mixed conifer stands.
- Accumulations of dead and down fuel are a threat to the two occupied bald eagle nests around Iron Canyon Reservoir.

Recommendations:

- In all silvicultural treatments within one mile of Iron Canyon Reservoir, favor the retention and release of ponderosa pine to provide future bald eagle nest trees.
- Develop a territory management strategy to enhance and maintain suitable habitat for bald eagles in the vicinity of the Iron Canyon Reservoir. The strategy should plan and prioritize the implementation of:
    - silvicultural options for developing and maintaining suitable roosting and nesting trees for the future.
    - fuels management options to protect current bald eagle nest and roost trees from wildfire.
- Develop a fire plan to protect bald eagle nest and roost sites.

Rationale/Objectives:

- The retention of ponderosa pine in stands near Iron Canyon Reservoir will help provide a continuing source of replacement bald eagle nest trees.
- Development of a long-term fire plan is needed to protect existing bald eagle nest and roost sites the threat of loss to wildfire.

Road Management

Ecosystem Condition:

- Road design and maintenance practices are contributing to a fine sediment surplus within many riparian areas in the watershed.
- The current high road density exceeds management guidelines.
- High road density has removed a portion of the landbase available to provide late-successional forests.
- Roads are a source of fragmentation of late-successional forest in the watershed.
- Roads can be a source of disturbance to intrusion sensitive animal species.
- Culverts and other road structures are a source of fragmentation of aquatic habitat by interrupting fish movement.

Recommendations:

- Ensure that project activities, special use permits, cooperative agreements, and other actions within the watershed enhance or maintain the condition of the LSR by normalizing erosion rates from watershed roads.
- Evaluate opportunities to correct road problems identified in the Iron Canyon Watershed Improvement Needs (WIN) Inventory with emphasis as follows:
  - **High priority** - continued deterioration would result in more sediment being introduced into streams; safety concern; possibility of losing road.
    - 37N95 (site 2) - landslide
    - 37N21Y (site 3)- gullying
    - 37N78 (site 11)- gullying
  - **Moderate priority** - continued deterioration would result in more sediment being introduced into streams; not a safety concern; road is not threatened.
    - 37N95 (site 1) - gullying
    - 37N21Y (site 4) - gullying and landslides
    - 38N60 (site 8) - gullying and landslides
    - 39N60 (site 9) - rutting and gullying
    - 38N60 (site 10) - rutting and gullying
    - 37N60 (site 12) - gullying, needs culvert
    - 38N60 (site 14) - major gullying
    - unnumbered road (site 15) - gullying
  - **Low priority** - not currently introducing large amounts of sediment into streams but could cause greater damage in the future if corrective action is not taken.
    - 37N21A (site 5) - minor gullying and fill failure
    - 38N11 (site 6) - slide in cutslope
    - 38N60 (site 7) - slide in cutslope
    - 38N60 (site 13) - gullying

Additional road problems are identified in the Iron Canyon WIN Inventory. The WIN Inventory is available at the Shasta Lake Ranger District Office.

- Evaluate the following roads for application of an erosion-resistant surface (rock, chip seal, etc.):
  - 37N78A (Stream gauge access road below east end of Iron Canyon Dam)
  - 37N27Y (Deadlum Campground Road)
  - 37N66Y (Hawkin's Landing Road)
  - 37N78 (Iron Canyon Reservoir Road)

    These roads are receiving wet weather use and show evidence of rutting and fine sediment transport into adjacent riparian areas.
- Evaluate the following roads for closure or obliteration:
  - 37N21Y (Section 18)
  - 38N60 (Section 8)
  - 37N37 (Sections 8 & 16)
  - 37N45 (Section 16)
  - 37N45A (Section 16)
  - Non-system road (Section 17)
  - 37N73 (Section 28)
  - 37N33 (Section 28)
  - 37N96 (Section 15)
  - 37N96 (Section 10)
  - 37N29 (Section 10)
  - 38N11F (Sections 9 & 10)
  - Multiple non-system roads between road 37N78 and Iron Canyon Reservoir.
  - Other opportunities that may be identified in the future.

    These are low-use roads that are not needed on a regular basis and are surplus to management needs.

Rationale/Objectives:

- Normalizing fine sediment erosion rates and dealing with road problems will reduce the negative impacts of area roads on riparian and aquatic ecosystems.
- Cooperators and permittees will continue to utilize watershed roads in their commercial operations, and the Forest Service can use this need to help manage road problems.
- The closure or obliteration of surplus roads can restore habitat, reduce fragmentation, and reduce the disturbance to intrusion sensitive species in late-successional forests
- Open road density exceeds the recommended maximum for intrusion sensitive species.

Riparian Management

Ecosystem Condition:

- Poor road design and construction are allowing a fine sediment surplus into streams.
- Aquatic habitat in Iron Canyon Creek below the dam has been seriously degraded by the alteration of stream flows and blockage of the downstream movement of new spawning gravel.
- The hazard of excessive soil erosion exists in the watershed in relation to the danger of large scale wildfire.
- Construction of Iron Canyon Dam and Reservoir has permanently removed approximately 50% of the original riparian habitat in the watershed.

Recommendations:

Downstream from Iron Canyon Dam:

- Provide release flows from Iron Canyon Dam representative of floods. This would require an agreement with P.G. & E to increase peak flows during winter months.
- Restore pools by removal of cobbles. Create pools by careful placement of flow deflectors such as very large boulders and logs.
- Gravel may be placed in selected locations within Iron Canyon Creek below the dam to created spawning habitat. This recommendation will only provide short-term benefits unless it is coupled with the above two recommendations.
- Remove sources of fine sediment.
- Consider Road Management recommendations on pages 6-8/9.

Within the Iron Canyon Reservoir drawdown zone:

- Plant flood tolerant riparian vegetation, such as willow, in stream inlets at Iron Canyon reservoir.

Above Iron Canyon Reservoir:

- Install instream sediment basins.
- Remove sources of fine sediment.
- Continue rehabilitation efforts on borrow pit areas near Iron Canyon Dam.
    - Maintain and repair existing checkdams and other structures.
    - Install new checkdams and other strucrues as needed.
    - Consider thinning precommercial trees on borrow pits and leaving slash on the site as an erosion control measure.
- Install instream structures to develop pool habitat and cover.
- Improve the general vegetative condition of riparian areas to provide shade and the future recruitment of large woody debris.

Rationale/Objectives:

- The improvement of pool habitat, spawning habitat, and food producing areas is needed to restore proper aquatic/riparian ecosystem function.
- Planting of riparian vegetation in the drawdown zone around the reservoir would provide cover for spawning trout, and improve riparian habitat for willow flycatchers and many other riparian associated species.
- Re-introduction of spawning gravel into Iron Canyon Creek below the dam will not provide lasting benefits unless flood flows are also provided to distribute the gravel downstream.
- Due to poor access, little is known about the tributary streams in the lower watershed.

Woodcutting Management

Ecosystem Condition:

- Unauthorized firewood cutting is occurring in the LSR, in conflict with management objectives.
- Law enforcement is difficult due to the remoteness of the area.
- The demand for firewood is expected to continue or increase as population increases.
- Firewood cutting is currently prohibited on all National Forest land near Big Bend.
- Unregulated woodcutting can result in the loss of desired habitat components from some areas in the watershed.

Recommendations:

- Develop a woodcutting policy for the area, including:
    - Law enforcement
    - Restricting woodcutting for wildlife protection
    - Restrict woodcutting time periods for wildlife protection
    - Restrict woodcutting during wet weather conditions
- Investigate providing woodcutting opportunities to local residents on National Forest lands within the LSR, consistent with Standards and Guidelines.

Rationale/Objectives:

- It is desirable to provide woodcutting opportunities to the local community that also assist in meeting LSR objectives.

Fishing Access to Iron Canyon Reservoir.

Ecosystem Condition:

- Resource damage is occurring due to off-road vehicle use for access to the reservoir.
- Numerous fishing access roads have been observed in areas identified as suitable habitat on the north shore of the reservoir.
- Suitable habitat can be degraded by disturbance from vehicles during the nesting season.

Recommendations:

- Maintain and enforce road closures including both existing and future closures.
- Design stand treatments in critical areas to discourage off-road vehicle use. Avoid clear, open stand conditions on gentle terrain that is conducive to off-road vehicles.
- Provide access to reservoir for fishing.

Rationale/Objectives:

- Reduce resource damage caused by sedimentation, compaction, etc.
- Problems with effective road closures are often attributed to failure to maintain existing gates and barriers, or to replace them after use.
- Problems with effective road closures are often attributed to poor location of gates and barricades.

Recreational Fishing

Ecosystem Condition:

- Fish stocking in Iron Canyon Reservoir is adequate to sustain recreational fishing at it's current level.
- Recreational fishing and associated activities are expected to increase as regional population levels increase.
- Opportunities exist to improve spawning habitat around the reservoir.

Recommendations:

- Continue stocking Iron Canyon Reservoir
- Develop spawning habitat in the zone between road 37N38 and Iron Canyon Reservoir.

  (Also see recommendations for planting riparian vegetation in the reservoir drawdown zone on page 6-10.)

Rationale/Objectives:

- Provide attractive fishing opportunities for the public at Iron Canyon Reservoir
- Improve natural fish reproduction of reservoir trout.

Surveying and Monitoring Needs

Riparian Management

- Monitor fine sediments in pools for three consecutive years followed by every five years after implementation of recommendations.
- Collect baseline data for aquatic habitat. Monitor changes in habitat every other year.
- Continue surveying for TES and S&M species.
- Conduct fisheries and amphibian surveys in the lower watershed to evaluate habitat suitability and opportunities for habitat improvement.

Recreational Fishing

- Monitor fishing use with California Department of Fish and Game
- Monitor effectiveness of habitat improvement projects.

Condition of Late-successional Forest

- Conduct snag and downed log surveys in representative vegetation types to determine abundance across the landscape. Record use by wildlife.
- Continue to inventory watershed for nesting bald eagles.
- Continue to inventory watershed to determine occupancy and reproductive status of northern spotted owls.
- Continue to inventory known spotted owl activity centers within the watershed, and the entire LSR to determine how the LSR is functioning in relation to the projections in the ROD.
- Conduct furbearer and goshawk surveys to determine the use of this watershed by those species.
- Conduct surveys to determine the presence of survey and manage species (Shasta salamander, bats, mollusks).

Prioritization of Recommendations

The prioritization of recommendations provides a basis for developing and scheduling specific management activities.

The following criteria were used to prioritize recommendations:

Highest priority	• Recommendations that will reduce the risk of damage or loss to existing late-successional forest within the LSR. • Recommendations that will preserve or enhance the existing condition of late-successional forest within the LSR. • Recommendations that will correct existing problems with riparian and aquatic ecosystems within the watershed. • Recommendations that will preserve or enhance riparian and aquatic ecosystems within the watershed.
Lowest priority	• Other recommendations that are not related to the function of the LSR or riparian and aquatic ecosystems.

Based on the above criteria, recommendations have been prioritized as follows:

Priority 1	**Protect existing late-successional forest from loss to wildfire.** Implement recommendations for thinning understory vegetation and treating fuels in the lower basin and ridgetop areas as described on pages 6-2 and 3. Incorporate recommendations for bald eagle habitat into silvicultural and fuels treatments as described on page 6-7.
Priority 2	**Preserve or enhance the existing condition of late-successional forest.** Implement recommendations to accelerate the development of late-successional forests and reduce fragmentation as described on page 6-6. Incorporate recommendations for bald eagle habitat into silvicultural treatments as described on page 6-7.
Priority 3	**Correct existing problems in riparian and aquatic ecosystems.** Implement recommendations to remove sources of fine sediment transport as described on pages 6-8 and 9.
Priority 4	**Preserve or enhance riparian and aquatic habitat above Iron Canyon Reservoir.** Implement recommendations to improve riparian and aquatic habitat in streams above Iron Canyon Reservoir as described on page 6-10.
Priority 5	**Preserve or enhance riparian and aquatic habitat in Iron Canyon Creek.** Implement recommendations to improve riparian and aquatic habitat downstream from Iron Canyon Dam as described on page 6-10, including the recommendation to restore peak flows.

Priority 6	**Recommendations not related to the function of the LSR or to riparian and aquatic ecosystems.** Implement recommendations for woodcutting, fishing access, and recreational fishing as described on pages 6-11 and 6-12.

Appendix A

Possible Management Practices

Contents

Iron Canyon Watershed Analysis

Possible Management Practices

WA Recommendation	Possible Management Practices	Required Documentation	Linkages	Scheduling
1. Thin/Reduce Down Fuels	Timber Sale(s) plus Slash Piling and Burning.	EA; LSRA	Would include #2a; possible link to #3a, 3b, 3c.	NEPA 4/96; implement 4/97
2. Bald Eagle Enhancement				
a. encourage ponderosa pine	Include in stand prescription.	EA; LSRA	Incorporate into #1.	NEPA 4/96; implement 4/97
3. Road Projects				
a. correct gullying & slides	Road maintenance.	EA/CE; exempt (LSRA	Include in #1 where connected.	NEPA 4/96; implement 4/97
b. closures & obliteration	Gates, barriers, obliteration.	EA/CE; exempt (LSRA)	Possible link to #1 thru KV	8/96 (Jobs-in-the-Woods)
c. surfacing	Road reconstruction.	EA/CE; exempt (LSRA	Include in #1 where connected.	8/96 (Jobs-in-the-Woods)
4. Improve Iron Canyon Creek				
a. increase peak flows	Administrative - coordinate with PG&E, DFG, etc.	EA; exempt (LSRA)	Increases effectiveness of #4b&c	At relicensing
b. restore pools	Remove cobbles; add logs and boulders.	EA; exempt (LSRA)	Similar actions - #4, 5, 6, 9	8/96 (Jobs-in-the-Woods)
c. create spawning habitat	Add gravel to stream.	EA; exempt (LSRA)	Similar actions - #4, 5, 6, 9	8/96 (Jobs-in-the-Woods)
5. Improve Steams Above Reservoir				
a. reduce fine sediment surplus	Install instream sediment basins.	CE; exempt (LSRA)	Similar actions - #4, 5, 6, 9	8/96 (Jobs-in-the-Woods)
b. develop pool habitat & cover	Install instream structures.	CE; exempt (LSRA)	Similar actions - #4, 5, 6, 9	8/96 (Jobs-in-the-Woods)
6. Improve aquatic/riparian habitat in reservoir drawdown zone.	Plant riparian vegetation.	CE; exempt (LSRA)	Similar actions - #4, 5, 6, 9	8/96 (Jobs-in-the-Woods)
7. Develop Woodcutting Policy	Administrative decision.	EA; (LSRA)	(none identified)	Prior to 1997 firewood season
8. Develop Fishing Access/ Discourage Undesired Use	Road construction; reconstruction; obliteration.	EA/CE; exempt (LSRA)	(none identified)	Not a high priority - implement when practical
9. Develop Spawning Habitat Around the Reservoir				
a. spawning habitat in inlets	Add gravel to streams.	EA; exempt (LSRA)	Similar actions - #4, 5, 6, 9	8/96 (Jobs-in-the-Woods)
b. provide cover for trout	Plant riparian vegetation.	CE; exempt (LSRA)	Similar actions - #4, 5, 6, 9	8/96 (Jobs-in-the-Woods)

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: Timber Sale

Main Activities:
- thinning
- slash treatment (piling and burning, biomass removal, etc.)

Related Activities:
- favor retention of ponderosa pine near reservoir (incorporate into prescriptions).
- correct gullying and slides through road maintenance on those roads used for timber sale activities.
- road reconstruction (surfacing) on roads used for timber sale activities.
- road closures and obliteration that fall within project boundary.
- stream improvement activities that fall within project boundary.

Required Documentation: EA; BE; Interim LSR Assessment (REO review required).

Scheduling:

NEPA should be done in FY 1996 to be covered by an Interim LSRA. There is no definite direction at this time on whether or not implementation must begin in FY 1996.

Funding:

Thinning, slash treatments, road maintenance would all be covered by the timber sale. Road surfacing would be covered by purchaser credit or with recreation KV funds for roads into the campgrounds. Road closures and obliteration and any stream improvement projects that occur within or adjacent to the timber sale could be covered by KV funding.

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

WA Priorities:

This project implements most ofl the recommendations listed as Priorities 1 and 2 (highest) in the WA. It will implement some recommendations listed as Priorities 3 and 4 (medium) wherever these activities occur with in the timber sale area. No recommendations listed as Priorities 5 and 6 (lowest) would be implemented.

Proposed Projects (cont.)

Project: Watershed Improvement Projects

Main Activities:
This project would include all watershed improvement projects that would not be implemented during the timber sale or supported by KV funds generated by the timber sale. It includes:

- correct road problems (e.g. gullying and slides) that contribute to fine sediment surplus in streams
- surface roads identified in the WA as contibuting to fine sediment surplus in streams
- restore pools
- create spawning habitat
- install instream sediment traps
- implement erosion control measures on borrow pit areas near Iron Canyon Dam.
- create spawning habitat by adding gravel to streams
- plant riparian vegetation

Related Activities: none

Required Documentation: EA/CE; BE; LSR Assessment (exempt from REO review).

Scheduling:

If these activities are to be supported by Shasta County Jobs-in-the-Woods funds, projects must be implemented by 8/1/96. Contracts exceeding $25,000 require a 110 day processing period; therefore, the size of projects may be a consideration for meeting the 8/1/96 deadline. The availability of planting stock may be a factor in scheduling thhe planting of riparian vegetation.

Funding:

This project includes those activities that would not be supported by KV funds generated by the timber sale. Funds are currently available through the Jobs-in-the Woods program for projects that can be implemented by 8/1/96. Additional appropriated funding is available for soil and water improvement from NFSI finds.

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

WA Priorities:

Activities included in this project are listed as Priorities 3, 4 and 5 (medium to low) in the WA.

Proposed Projects (cont.)

Project: Woodcutting Policy

Main Activities:

This project would investigate providing woodcutting opportunities for the local community consistent with Standards and Guidelines/ A woodcutting policy would be developed for the watershed including:

- restricted areas for wildlife protection (around nests, etc.)
- restricted time periods for wildlife protection (nesting season, etc.)
- restictions during wet weather

Related Activities: Law enforcement problems could be included.

Required Documentation: EA/CE; BE; Interim LSR Assessment (REO review required).

Scheduling:

It would be desireable to complete this project by January 1997 so that the new policy could be in place for the 1997 woodcutting season. Allow time for new woodcutting maps to be printed.

Funding: unknown

LMP Consistency:

There is some concern that fuelwood gathering in LSRs is not consistent with the LMP and ROD (see LMP 4-39 and ROD C-16). Consistency seems to be a matter of interpretation.

WA Priorities:

This project is listed as Priority 6 (lowest) in the WA.

Proposed Projects (cont.)

Project: Fishing Access at Reservoir

Main Activities:
- Identify road locations that will provide fishing access consistent with other resource objectives.
- Design and construct roads to minimize sediment transport towards reservoir and to be consistent with other resource objectives.

Close or obliterate all other non-system roads around the reservoir.

Related Activities: none

Required Documentation: EA/CE; BE; LSR Assessment (exempt from REO review).

Scheduling:

Scheduling would depend on funding. Jobs-in-the-Woods would require implementation by 8/1/96. KV funding would delay project until after timber sale. Conflicts with timber sale activities need to be considered. It may be best to delay implementation until completion of timber sale.

ding: Jobs-in-the-Woods; KV recreation money

LMP Consistency:

This project is consistent with the LMP by reducing road density in the area and relocating roads to locations with fewer impacts.

WA Priorities:

This project is listed as Priority 6 (lowest) in the WA.

Proposed Projects (cont.)

Project: Restore Peak Flows to Iron Canyon Creek

Main Activities:

This project would develop an agreement with PG&E to increase peak flows from Iron Canyon Dam during winter months. Coordination with Calif. Dept. of Fish and Game is desireable. Increased flows would maintain pool and spawning habitat and would improve the effectiveness of other stream improvement projects recommended for Iron Canyon Creek.

Related Activities: none

Scheduling: This recommendation would not be implemented until relicensing of the dam.

Funding: unknown

LMP Consistency: This project is consistent with the LMP.

WA Priorities:

This project is listed as Priorities 3 and 4 (medium) in the WA.

Appendix B

Hydrology Input

Contents

Appendix B

Iron Canyon Watershed Analysis
Hydrology/Hydraulics

Chapter II, Characterization

Iron Canyon Creek is a tributary to the Pit River, part of the Sacramento River system in Northern California. The Iron Canyon watershed is located approximately 40-miles northeast of Redding and 5-miles northwest of the community of Big Bend. The Iron Canyon Watershed Analysis includes the watersheds of Iron Canyon Creek and small unnamed tributaries to the Pit River located to the east of the mouth of Iron Canyon Creek. The Iron Canyon Watershed Analysis covers 26.1-square miles of steep mountain forest. The watershed analysis area is located in the Shasta National Forest between the northerly end of the Sierra Nevada Range and the Trinity Alps. Elevations in the watershed analysis area range from 1420-feet MSL at the mouth of Iron Canyon Creek to 4555-feet MSL at the top of Dutchman Peak. The watershed analysis area is situated along a belt of high precipitation located between Castella in the Sacramento River Canyon and Montgomery Creek on State Highway 299-East. Average annual precipitation in the watershed analysis area is approximately 70-inches.

Iron Canyon Creek drains a basin of 22.5-square miles and is the primary watercourse in the Iron Canyon Watershed Analysis area. The Iron Canyon Creek basin is approximately 3.5-miles wide and 7-miles long and drains to the south. Approximately 20-percent of the land in the Iron Canyon Creek basin is privately owned. The remainder of the basin is federally owned forest lands. The privately owned lands are located in the south half of the basin. Present land use in the basin includes timber harvesting and recreation, transportation and power generation. Recreational activities consist primarily of camping, fishing and boating on a reservoir. Transportation facilities include a partially paved road through the upper half of the basin and used for transportation of timber through the basin. Facilities related to power generation include hydraulic conduits and Iron Canyon Reservoir, a significant impoundment expressly built for power generation.

Iron Canyon Reservoir has a maximum capacity of 24,200 acre-feet and a surface area of approximately 450-acres when full. The reservoir was first filled in 1965. The water surface elevation of the reservoir is 2665-feet MSL when full and 2565-feet MSL when empty. The reservior is operated throughout its range of storage. Inflows to the reservior include a diversion from the McCloud River and local inflows. The diversion from the McCloud River has averaged approximately 800-CFS since 1974. Local inflows from the 11.2-Square Miles of drainage basin upstream of Iron Canyon Dam average approximately 70-CFS. Outflows from Iron Canyon Reservoir include diversion to the James B. Black powerhouse on the Pit River, minimum releases to the lower reach of Iron Canyon Creek and reservoir evaporation. The diversion to the James B. Black powerhouse has averaged approximately 860-CFS since 1974. Minimum releases downstream of Iron Canyon Dam have averaged 5.5-CFS during the same time period. Evaporation accounts for an equivalent loss of approximately 2.2-CFS.

Local inflows to Iron Canyon Reservoir are from Cedar Salt Log Creek, Deadlun Creek, Gap Creek, Little Gap Creek, McGill Creek, one unnamed creek and several small areas draining directly into the reservoir. Characteristics of the tributaries providing inflow to Iron Canyon Reservoir (full reservoir assumed) are tabulated in Table 1.

TABLE 1
Iron Canyon Reservoir Tributary Characteristics

Tributary	Area (Sq.Mi.)	Aspect	High Elev. (feet MSL)	Length (mi)	Width (mi)
Cedar Salt Log Creek	2.40	South	4555	2.4	1.5
Deadlun Creek	1.57	South	4320	3.2	0.7
Gap Creek	0.90	Southeast	4050	1.7	0.6
Little Gap Creek	0.53	South	3790	1.5	0.5
McGill Creek	2.35	South	4250	3.0	0.8
Unnamed creek	0.85	Southeast	4250	1.5	0.5

Below Iron Canyon Dam, tributaries to Iron Canyon Creek include Initial Creek, an unnamed west tributary and an unnamed south tributary. Characteristics of these tributaries are tabulated in Table 2.

TABLE 2
Iron Canyon Creek Tributary Characteristics

Tributary	Area (Sq.Mi.)	Aspect	High Elev. (feet MSL)	Length (mi)	Width (mi)
Initial Creek	1.63	East	4400	2.2	1.0
Unnamed, west	3.67	Southeast	3960	3.5	1.5
Unnamed, south	1.70	East	4400	2.6	0.8

The Iron Canyon Watershed Analysis area not in the Iron Canyon Creek basin consists of small unnamed tributaries and slopes draining southeast directly into the Pit River. These tributaries and slopes comprise an area of approximately 3.6-square miles. Lengths of these tributaries range from a few hundred feet to approximately 1.5-miles. Widths range between 0.2 times the length to 0.5 times the length. Elevations range from 1480-feet MSL at the Pit River to 3530-feet MSL on Oak Mountian. Approximately 45-percent of the land in this portion of the Iron Canyon Watershed Analysis area is privately owned. The remainder is federally owned forest land. Present land use includes power generation and recreation along the Pit River

Iron Canyon Watershed Analysis
Hydrology/Hydraulics

Chapter III, Current Conditions

Present hydrologic and hydraulic conditions in the Iron Canyon Watershed Analysis area are a result of water use, human disturbance and natural disturbance. Although water use has only been significant since construction of the James B. Black hydroelectric project and Iron Canyon Reservoir in 1965, the effects of this project on hydrologic and hydraulic conditions in the lower half of the Iron Canyon Watershed Analysis area have been unequaled in recent history. Human disturbance affecting hydrologic and hydraulic conditions throughout the watershed analysis area include road construction and maintenance, timber harvest, timber management and fire suppression. Natural occurrences which are capable of significantly affecting hydrologic and hydraulic conditions in the watershed area include wildfires, landslides, windthrow, floods and droughts. Current hydrologic conditions including diversion to and from Iron Canyon Reservoir, reservoir storage and downstream releases are well defined by continuous records of flow and reservoir elevation. Local inflows to Iron Canyon Reservoir have not been measured however can be estimated from available data. Quantitative data representing hydraulic conditions in stream channels within the watershed analysis area are not available therefore current hydraulic conditions have been identified by observations of channels in numerous locations.

Effects of Water Use and Development

Water use in the Iron Canyon Watershed Analysis area, including Iron Canyon Reservoir, diversion of water to the reservoir from the McCloud River and diversion of water from the reservoir to the James B. Black powerhouse on the Pit River, has dominated the hydrologic characteristics of the major waterway in the basin. Data available with which to define current hydrologic conditions within the watershed analysis area include the U.S.G.S. streamflow and reservoir storage records shown in Table 3.

TABLE 3
U.S.G.S. Stream Gage and Reservoir Storage Records

Gage Number	Gage Name	Start Year	End Year[1]
11363910	James B. Black Powerhouse	1966	1993
11363920	Iron Canyon Reservoir near Big Bend	1974	1990
11363930	Iron Canyon Creek below Iron Canyon Dam	1966	1993
11367720	McCloud-Iron Canyon Diversion Tunnel	1966	1993
11365500	Squaw Creek above Shasta Lake	1945	1980[2]
11367500	McCloud River near McCloud	1932	1993

Notes: 1) Latest year for published data, some gages are still in service.

2) Average daily flow records stop in 1966, peak flow records continue.
Gage records for James B. Black powerhouse, Iron Canyon Reservoir, Iron Canyon Creek and McCloud-Iron Canyon Diversion Tunnel are provided to the U.S.G.S. by Pacific Gas and Electric Company (PG&E). Additional records for Iron Canyon Reservoir consisting of daily reservoir storage through 1993 are available from PG&E and have been used in this analysis.

Hydrologic conditions in the watershed analysis area can be defined by peak flow analysis and duration (daily flow) analysis. The peak flow analysis consists of identifying flood frequency relationships of the streams in the watershed area. The duration analysis identifies the current condition average monthly flows, flow-duration relationships and the dominant flow (flow which occurs most frequently).

Below Iron Canyon Dam the current condition flood frequency relationship is reasonably well defined by the U.S.G.S. gage record "Iron Canyon Creek below Iron Canyon Dam". The flood frequency relationship for current conditions of Iron Canyon Creek below Iron Canyon Dam was identified by using these data in a Log Pearson type III analysis with a skew factor of 0.0. This flood frequency relationship is shown in Figure 1. The length of record for this analysis is considered short for defining the more unusual flood flows however given the degree of regulation of Iron Canyon Creek below Iron Canyon Dam, this flood frequency curve should be considered representative. It is important to recognize that the two largest flows in Iron Canyon Creek during the time span of this record are due to management activities including draining the reservoir for inspection and penstock repair. Ignoring these events would yield a much lower flood frequency curve.

Tributaries above Iron Canyon Reservoir are not affected by the reservoir and therefore cannot be represented by the flood peaks in Iron Canyon Creek below the dam. The flood frequency relationships for these tributaries and the Iron Canyon Creek tributaries below Iron Canyon Dam were estimated by regional analysis and using the U.S.G.S. Sierra Region Equation. Log Pearson type III flood frequency analyses were conducted for the Squaw Creek and McCloud River gage sites and adjusted to account for differences in basin areas, elevations and mean annual precipitation using the exponents in the Sierra Region Equation. The Sierra Region Equation was also applied directly to develop a flood frequency relationship for an arbitrary specific location in the watershed analysis area. The arbitrary specific location selected for this analysis is the present Iron Canyon Creek gage site (assuming no reservoir). The results of these analyses were three flood frequency curves for the specific location in the watershed area. Of these flood frequency relationships, the relationship developed and adjusted from the McCloud River was the lowest being approximately one third the magnitude of the flood frequency relationship developed and adjusted from the Squaw Creek data. The flood frequency relationship produced by direct application of the Sierra Region Equation is approximately 10- to 20-percent higher than the flood frequency relationship developed from the Squaw Creek data. These flood frequency curves are shown in Figure 2. Because of the proximity and hydrologic similarity of Squaw Creek to the Iron Canyon Watershed Analysis area, the flood frequency relationship developed and adjusted from the Squaw Creek data should be considered the most representative for the specific location selected. Flood frequency relationships for all of the unregulated stream locations in the watershed analysis area were then adjusted from the flood frequency relationship developed for the arbitrary specific location using the area adjustment of the Sierra Region Equation. Current flood frequency relationship data for the major unregulated streams are tabulated in Table 4.

The current condition flood frequency relationship for Iron Canyon Creek at the mouth is a function of both the regulation of Iron Canyon Creek by the reservoir and the unregulated area contributing to Iron Canyon Creek below the reservoir. The flood frequency relationship at the mouth of Iron Canyon Creek was developed by estimating the contribution to the flood flows by the unregulated area using the methodology described above and adding to these flows an assumed contribution from the reservoir. The assumed contribution from the reservoir was limited to a range of 10- to 50-percent of the flow from the equiprobable flood to account for flood routing through the reservoir (it is not reasonable to assume the flood peak immediately below the dam contributes to a coincident peak at the mouth of Iron Canyon Creek). The current flood frequency relationship data for Iron Canyon Creek are also tabulated in Table 4.

TABLE 4
Current Condition Flood Frequency Data

Location	Area (Sq Mi)	Q-02	Q-05	Q-10	Q-25	Q-50	Q-100
Cedar Salt Log Creek	2.40	140	350	520	770	960	1180
Deadlun Creek	1.57	100	250	370	550	690	850
Gap Creek	0.90	60	160	240	350	450	560
Little Gap Creek	0.53	40	100	160	230	290	370
McGill Creek	2.35	140	350	510	750	940	1170
Iron Canyon Creek (gage)	11.29	12	350	530	660	800	900
Unnamed west	3.67	210	500	730	1070	1300	1600
Initial Creek	1.63	100	260	380	560	710	880
Unnamed south	1.70	110	270	400	580	730	910
Iron Canyon Creek (mouth)	22.49	570	1300	1900	2800	3500	4400

As with the flood frequency analysis, the current condition flow-duration curve, average monthly flows and dominant flow in Iron Canyon Creek below the reservoir is well defined by the U.S.G.S. gage record "Iron Canyon Creek below Iron Canyon Dam". A flow duration curve, average monthly flows and a plot of average daily flows vs number of occurrences (identifying the current condition dominant flow) were prepared using the average daily flow data at the gage and are shown in figures 3, 4 and 5 respectively.

Also as with the flood frequency analysis the current condition duration analysis for tributaries to Iron Canyon Reservoir and Iron Canyon Creek cannot be represented by the Iron Canyon Creek gage. The duration analysis products for these tributaries have been prepared using a synthetic streamflow record for an arbitrary point in the watershed analysis area. By selecting the U.S.G.S. gage site on Iron Canyon Creek below the dam as the arbitrary point in the watershed analysis area, the data available for Iron Canyon Reservoir including diversion data to and from the reservoir and releases from the reservoir can be used for better defining the synthetic average daily flow record. Average annual diversion to and from the reservoir along with average annual release from the reservoir were computed from the average daily flow records at the U.S.G.S. gages for the period from 1974 through 1993. Average annual evaporation was estimated from pan evaporation records for Fall River Mills and assuming a reservoir surface area of 400-acres (full reservoir surface area is approximately 450-acres). The average annual inflow to Iron Canyon Reservoir was then computed by subtracting the average annual flow diverted into the reservoir from the sum of the average annual diversion out of the reservoir, the average annual release, the average annual evaporation and the difference in reservoir storage between the beginning of the period (October 1, 1973) and the end of the period (September 30, 1993) expressed in CFS. The resultant average annual inflow to Iron Canyon Reservoir during this period was 67.4-CFS. This computation is shown in tabular form in Table 5.

TABLE 5
Iron Canyon Reservoir Water Balance

Water Balance Component	Equivalent Average Annual Flow (CFS)
Diversion to James B. Black Powerhouse	859.3
Release to Iron Canyon Creek	5.5
Evaporation from reservoir	2.2
Difference in reservoir storage	+ 0.1
Diversion from McCloud River	-799.7
Average Annual Inflow to Iron Canyon Reservoir:	67.4

This average annual inflow to Iron Canyon Reservoir was adjusted to account for the relatively short term of record using data from the U.S.G.S. gage "McCloud River near McCloud". The average annual flow of the McCloud River was computed for the years 1974 through 1993 and divided by the average annual flow of the McCloud River computed for the years 1932 through 1993. The resulting term of record correction, 1.03, applied to the average annual inflow to Iron Canyon Reservoir produces a more representative average annual inflow to the reservoir of 69.4-CFS.

The average daily flow record for Squaw Creek above Shasta Lake was selected for adjustment to represent Iron Canyon Creek because of the proximity and hydrologic similarity of Squaw Creek to Iron Canyon Creek. The average annual flow in Squaw Creek for the period of record was computed and divided into the computed average annual inflow to Iron Canyon Reservoir. The resulting coefficient, 0.302, was used as a factor with which to multiply the average daily flows in the Squaw Creek record to produce a long term average daily flow record of Iron Canyon Creek at the U.S.G.S. gage site (without effects of reservoir). defined by the U.S.G.S. gage record "Iron Canyon Creek below Iron Canyon Dam". A flow duration curve, average monthly flows and a plot of average daily flows vs number of occurrences were then prepared using the representative average daily flow data are shown in figures 6, 7 and 8 respectively. Similar statistics for tributaries and at any location along a tributary can be derived from these figure by a direct adjustment for differences in area between the area of interest and the area above the U.S.G.S. gage site (11.2 square miles).

Hydraulic impacts (flow characteristics and channel characteristics) of the reservoir are limited to the reach of Iron Canyon Creek below Iron Canyon Dam. Typical hydraulic conditions below reservoirs include changes in channel geometry and bed material composition. Changes in channel geometry usually consist of channel enlargement due to the lack of replenishment of bed materials below the reservoir (the reservoir traps all moving bed material) and sometimes channel instability. Changes in bed material composition usually consists of a removal of the more readily transportable bed materials over time.

Current hydraulic conditions in Iron Canyon Creek below Iron Canyon Dam have been identified based on observation because of a lack of existing quantitative data. Iron Canyon Creek below Iron Canyon Dam does not appear to have the typical channel enlargement expected below most reservoirs. The lack of channel enlargement at this site is most likely due to the extreme degree of regulation of Iron Canyon Creek combined with sediment sources due to other human disturbance (described in the next section) immediately below the dam. No significant channel instability due to the regulating effects of the reservoir was observed. Present channel geometry observed below Iron Canyon Dam consists of mild runs and shallow pools. Typical pools are one to two feet deep and 10- to 20-feet wide. Typical run geometry is about half the pool dimensions. Observed pool ratio (by length along the channel) is approximately 25- to 35-percent. Streambanks are moderately well defined. Bed materials immediately below Iron Canyon Dam consist of rock and cobbles overlain by sand and silt in areas of low velocity. Near the confluence of Initial Creek, Iron Canyon Creek bed materials consist only of rocks and cobbles. The current pool ratio, pool geometry and bed material composition (excepting the fines from human disturbance) are most likely a direct result of the regulating effects of the reservoir.

In summary, the hydrologic characteristics (streamflows) of tributaries to Iron Canyon Reservoir and Iron Canyon Creek are essentially unaffected by water use in the Iron Canyon Watershed Analysis area. The hydrologic characteristics of Iron Canyon Creek below Iron Canyon Dam, however, have been very substantially changed by water use in the watershed analysis area. The current hydrologic characteristics of both affected and unaffected streams and tributaries have been quantified using standard hydrologic figures. These figures are useful for documentation of current conditions, comparison with reference conditions (described in the following chapter) and for evaluation of current environmental conditions. Hydraulic conditions including pool ratio, pool geometry and bed material composition in Iron Canyon Creek below Iron Canyon Dam have also been affected by water use in the watershed analysis area. Due to the lack of quantitative hydraulic data, these hydraulic characteristics have been documented by observation.

Impacts From Other Human Disturbances

Human disturbance in the basin including road construction and maintenance, dam and hydroelectric conduit construction and maintenance, timber harvesting, forest management, and limited early ranch activities have contributed to the current hydrologic and hydraulic conditions in the watershed analysis area. Quantitative data with which to characterize the current hydraulic conditions (flow characteristics and channel geometry) are not available therefore the current hydraulic conditions are documented based on observations. Descriptions of the human disturbances and their general and observed effects on hydrologic and hydraulic conditions are described in the following paragraphs.

- Road Construction: Road construction in remote forest areas is typically associated with increased sediment load to streams, stream aggradation and slightly increased flood peaks. Above Iron Canyon Reservoir significant volumes of fine sediment were observed in the stream channels. Several specific sources of fine sediment as a direct cause of road construction and maintenance were observed. Roadside drainage appears to be the most significant source of fine sediment in the stream channel. Observed rill erosion and significant tree failure exposing root wads along non-serviceable roads both contribute to the fine sediment load in the streams. Current bank erosion due to a complete bridge failure of several years ago was observed to be contributing to the fine sediment load in the upper reaches of McGill Creek. Downstream of Iron Canyon Dam, similar fine sediment loads were observed in the upper reaches of the unnamed west tributary to Iron Canyon Creek. Fine sediment was absent in Iron Canyon Creek and Initial Creek near the confluence of the two streams. It is reasonable to assume that most small tributaries to Iron Canyon Creek below Iron Canyon Dam have high fine sediment loads if roads are present.

  Although road construction in remote areas is often associated with slightly increased flood peaks, there is no quantitative data or observations which can be made to confirm the possibility of increased flood peaks in the Iron Canyon Watershed Analysis area. More significant than the argument that flood peaks may be increased by the construction of roads in the watershed area is the flood peak attenuating effect of debris dams and increased sediment loads which have been observed throughout the watershed area.

  A significant volume of road oil was observed in a dry gully tributary in the upper reaches of Deadlun Creek which may significantly affect water quality during periods of flow.

- Dam Construction and Maintenance: Effects of construction of Iron Canyon Dam and the hydroelectric conduit are the same as for road construction. The worst case of fine sediment load observed due to construction and maintenance is adjacent to the streamgage access road immediately downstream of the dam. At this location rill erosion which has transformed to gully erosion is presently contributing significant loads of fine sand and silt to the Iron Canyon Creek channel. Hydrologic effects related to construction of the dam and hydroelectric conduit are described in the previous section.

- Timber Harvest: Effects of harvesting timber on the hydrologic and hydraulic characteristics of streams are related to the construction of roads (described in the previous paragraphs), methods used for harvesting timber and management of unused timber harvest products. Most of the Iron Canyon Watershed Analysis area has been logged in the recent past (since 1960). Observed current effects of timber harvest activities on hydraulic conditions include debris dams due to in substantial part to the high quantity of unused timber harvest products in and adjacent to streams and skid roads contributing to the fine sediment load. Effects of timber harvest on hydrologic conditions consist of increased routing and slightly attenuated flood peaks due to the debris dams.

- Forest Management: Forest management practices affect hydrologic and hydraulic conditions both directly and indirectly. Logging, planting practices and fire suppression have resulted in a dense growth of small to medium height shrubs and trees. This dense growth of small to medium height shrubs and trees contributes to the small debris load in stream channels. Additionally, small to medium height shrubs and trees located adjacent to stream channels can increase flood elevations and decrease channel stability. Substantial growth of this type was observed near stream channels and in flood plains in the watershed analysis area. Considerable small debris was observed in and around stream channels throughout the watershed analysis area. Although numerous debris dams were observed, little significant channel instability was observed. Considerable potential for channel instability exists in locations of low channel slope, alluvial bed and bank materials and high debris and fine sediment loads.

  Indirect effects of forest management practices on hydrologic and hydraulic conditions include the increased potential of a hot fire resulting in hydrophobic soil conditions. In such an event, if unmitigated, flood peaks and sediment loads due to increased flood peaks would be substantially higher resulting in greater bank instability. No indirect effects of forest management practices were quantified or observed.

- Ranch Activities: Hydraulic effects of ranch activities, specifically grazing, consist of degradation of streambanks and in extreme cases, channel instability. Limited grazing was present in the Iron Canyon Watershed Analysis area until recently (approximately 5-years ago?). No hydraulic effects of these past ranch activities were distinctly observed in the watershed analysis area. Any hydraulic effects of the past ranch activities have likely been minor and are currently dwarfed by the presence of effects of other more significant human influences.

Impacts From Natural Disturbances

Natural disturbances within the Iron Canyon Watershed Analysis area which affect hydrologic and hydraulic conditions include fire, floods, drought, landslides and windthrow. Like impacts from human disturbance, quantitative data for evaluation of impacts from natural disturbances are not available therefore current hydraulic conditions are based on observations. Descriptions of natural disturbances and their general and observed effects on hydrologic and hydraulic conditions are described in the following paragraphs.

- Fire: The effects of fire on hydrologic and hydraulic conditions vary depending as a function of the heat of the fire. Ground fires and cool burning fires have little effect on hydrologic and hydraulic conditions. Long term effects of infrequent ground fires include reduced debris loads in the stream channels. Hot fires can produce hydrophobic soil conditions. These conditions produce higher flood peaks and sediment loads resulting in greater bank instability. No direct hydrologic or hydraulic effects of historic or recent fires were observed. High fuel loads due to past forest management practices have increased the possibility hydrophobic soil conditions in the event of a fire.

- Floods: The occurrence of floods are a quantifiable hydrologic condition which affects hydraulic conditions. The effects of infrequent floods on hydraulic conditions vary greatly as a function of the magnitude of the flood and other conditions within the watershed and stream channel. In general, infrequent floods tend to rectify the condition of the stream channel with the channel defining factors including sediment load, debris load and channel confining factors. As such, infrequent floods can be considered the "trigger" which allows a stream to respond to conditions in the watershed. Effects of recent floods of moderate magnitude were observed in the Iron Canyon Watershed Analysis area upstream of Iron Canyon Reservoir and in tributaries to Iron Canyon Creek. These effects include high fine sediment and debris loads in the channels. The recent floods were likely to be of a magnitude in the range of 5- to 20-years in recurrence. These sediment and debris loads are a reflection of past forest management practices. No substantial channel instability was observed. More unusual floods, such as a 100-year flood, would likely trigger channel instability in areas of low channel slope (these areas are where the increased sediment loads will ultimately be deposited).

- Drought: Like floods, droughts are a quantifiable hydrologic condition which affects hydraulic conditions. Unlike floods, the effects of droughts on hydraulic conditions are relatively consistent and include reduced sediment loads (without reduced sediment load potential), increased debris load potential and channel incision in alluvial reaches. High debris loads observed in the stream channels may have been due in part to the drought period ending this past water year.

- Landslides: The effects of landslides on hydraulic conditions vary greatly with the type and magnitude of the landslide. Effects of landslides which impede stream channels range from increased sediment loads to major temporary changes in channel configuration. Very unusual landslides will alter stream channels for extended periods of time. Unlike most sources of sediment resulting from human influence, sediment loads resulting from landslides contain a full range of sediment sizes. Although the present stream channels have most likely been significantly influenced by landslides in the recent past, any effects of these landslides were hidden by other channel influences in the locations observed.

- Windthrow: The effects of windthrow on hydraulic conditions vary as a function of forest condition. In all forest conditions, windthrow increases the debris loads in stream channels however the size, quantity and frequency of debris loads vary with the maturity of the forest adjacent to the stream channels. Considerable small debris was observed in and adjacent to the stream channels however not all of the debris observed was from windthrow. The observed effects of the high small debris loading included substantial numbers of small to medium sized debris dams in all streams above Iron Canyon Reservoir and tributary to Iron Canyon Creek.

Current hydraulic conditions in the Iron Canyon Watershed Analysis area are indicative of a combination of natural and human influences. Stream channels throughout the watershed analysis area are generally singular, straight or mildly meandering, shallow, wide and with relatively distinct banks. Pools are shallow and represent approximately 25- to 35-percent of channel length. Above Iron Canyon Reservoir and tributary to Iron Canyon Creek, stream channels have high debris loads resulting in numerous small to medium size debris dams. These debris dams have filled with fine sediment. Below Iron Canyon Dam, Iron Canyon Creek has few debris dams. Bed materials observed in Iron Canyon Creek range from fine sand and silt below Iron Canyon Dam (from local erosion) to rocks and cobbles with no sand or gravel near the confluence of Initial Creek. Human disturbance has contributed significantly to the high debris and sediment loads.

Iron Canyon Watershed Analysis
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Chapter IV, Reference Conditions

From the standpoint of hydrology and hydraulics, reference conditions are the hydrologic and hydraulic conditions before recent human disturbance (prior to 1900). Since there are no data available in the Iron Canyon Watershed Analysis area before this time with which to characterize the hydrologic and hydraulic conditions, identification of reference conditons must be based on other available data and observations and by recognition of current conditions which are effects of human disturbance. Reference hydrologic conditions can be represented quantitatively using streamflow, reservoir storage and evaporation data collected since construction of Iron Canyon Dam and using streamflow data for nearby streams and rivers. Reference hydraulic conditions can be estimated by recognizing the effects of human disturbance and "subtracting them out" from the current hydrologic conditions.

Reference hydrologic conditions in the Iron Canyon Watershed Analysis area have been estimated by creating a synthetic natural condition streamflow data file and preparing from these data, standard hydrologic figures including flood-frequency and flow-duration curves and plots of average monthly flow and average daily flow by number of occurrences (dominant discharge). Hydrologic conditions of streams above Iron Canyon Reservoir and tributary to Iron Canyon Creek have not changed substantially from reference conditions. Although construction of roads in watersheds is often associated with increased flood peaks, in the Iron Canyon Watershed Analysis area any increase in flood peaks is most likely offset by increased flood routing by debris dams and is beyond our ability to quantify with all available data. Downstream of Iron Canyon Dam, the hydrologic conditions of Iron Canyon Creek have been dramatically affected by the regulation of Iron Canyon Reservoir. Reference hydrologic conditions in Iron Canyon Creek below Iron Canyon Dam have been quantified using the synthetic natural condition streamflow data sets prepared to identify the current condition hydrologic conditions at locations other than in Iron Canyon Creek. The reference condition flood frequency relationship in Iron Canyon Creek at the stream gage site is shown on Figure 2 and is tabulated along with the flood frequency data for Iron Canyon Creek at the mouth in Table 6. Other reference conditions in Iron Canyon Creek at the stream gage site below Iron Canyon Dam are quantified in Figures 6,7 and 8. Descriptions of the data, assumptions and analysis from which these reference condition relationships were derived are included in Chapter III, "Current Conditions". Reference conditions at any location within the watershed analysis area can be estimated from Figures 6,7 and 8 by a direct area adjustment from the area above the gage site (11.2 square miles).

TABLE 6
Reference Condition Flood Frequency Data

Location	Area (Sq Mi)	Q-02	Q-05	Q-10	Q-25	Q-50	Q-100
Iron Canyon Creek (gage)	11.29	560	1250	1800	2600	3200	3900
Iron Canyon Creek (mouth)	22.49	1030	2200	3100	4500	5500	6600

Reference hydraulic conditions in the Iron Canyon Watershed Analysis have been qualatatively estimated by recognition and "removal" of the effects of recent human disturbance. Upstream of Iron Canyon Reservoir and tributary to Iron Canyon Creek, the most significant effects of recent human disturbance consist of an excess of debris dams filled with fine sediment. Prior to human disturbance the quantity of debris available to the stream channel was likely to be much smaller therefore debris dams were probably much less common. Sediment loads were from slides and bank erosion both of which provided a balanced supply of fine to course sediment sizes. Without the debris dams and high fine sediment loads introduced in recent years, the stream channels most likely had larger differences between the geometry of run reaches and pool reaches. Depths and widths of the run reaches were probably similar to the depths and widths of the present run reaches however depths and widths of the pool reaches were most likely greater. Pool ratios may have been greater. Stream banks were probably slightly better defined.

Iron Canyon Creek below Iron Canyon Dam has been most significantly affected by the regulation of Iron Canyon Reservoir. Prior to the construction of Iron Canyon Dam the hydraulic conditions of Iron Canyon Creek were defined by a combination of the available sediment supply and flows ranging from the dominant discharge to infrequent floods. Construction of the dam has cut off the supply of sediment and substantially reduced flows to a single flow of approximately half of the historic dominant discharge. Given the reference condition sediment supply and hydrologic regime, Iron Canyon Creek below Iron Canyon Dam would most likely have larger pools and a bed consisting of a more uniform gradient of sediment sizes including gravel and some sand. Bed materials would be frequently rejuvinated (loosened and replenished) by floods. Floodplains along the stream most likely consisted of a combination of mature trees and low plants and shrubs, the latter of which would be infrequently removed by floods.

IRON CANYON WATERSHED ANALYSIS
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Chapter V, Interpretation

Riparian Ecosystems, Above Iron Canyon Reservoir and Tributary to Iron Canyon Creek

Between 1900 and now, a considerable surplus of fine sediment and small debris has entered the stream channels in the Iron Canyon Watershed Analysis area above Iron Canyon Reservoir and tributary to Iron Canyon Creek. The sediment surplus can be attributed to road construction and maintenance, timber harvesting, construction and maintenance of Iron Canyon Dam and hydroelectric facilities and possibly ranch activities prior to 1960. At the present time, only road, dam and hydroelectric facility maintenance activities continue to supply sediment to the channels. All construction activities, timber harvesting and ranching activities have ceased within the watershed analysis area. The excess of small debris can be attributed to timber harvesting, planting and fire management all of which have increased the supply of small trees and shrubs. Presently, only fire management activities continue.

Above Iron Canyon Reservoir and tributary to Iron Canyon Creek, management activities which continue to adversely affect aquatic habitat and riparian ecosystems consist of road maintenance and fire management activities. Road maintenance including surfacing with fine gravel coupled with the condition of road drainage facilities continues to supply an excess of fine sediment to the stream channels. The volume of fine sediment reaching stream channels as a result of road maintenance is decreasing slowly as the length of maintained roads is reduced. Abandon roads also continue to supply fine sediment to the stream channels at a decreasing rate as they revegetate. These rates of reduction, however, are relatively minor and coupled with the volume of fine sediment stored in the small stream channels, a substantial fine sediment surplus continues to exist.

Current fire management activities consist of fire prevention and fire suppression efforts. Years of fire suppression coupled with timber harvest and planting activities have produced the high quantity of young trees and high undergrowth which in turn produce the high small debris loads in the streams. These high debris loads are not likely to decrease with the present fire management program.

The impact of small debris and fine sediment in the stream channels has been very significant on the aquatic habitat and riparian ecosystems above the reservoir and tributary to Iron Canyon Creek. Stream channels have changed from a pool and riffle geometry to a fine sediment filled debris dam and short riffle geometry with very little gravel visible. Although not observed at present, there is a significant potential for channel instability (horizontal channel movement due to aggradation) present in the reaches of channel with low slopes (such as the lower reaches of McGill Creek). Most of the streams above Iron

Canyon Reservoir and tributary to Iron Canyon Creek are in need of rehabilitation if reference conditions are to be desired. Opportunities exist to improve the stream channels. These opportunities include the following:

1) Surface roads with larger, harder gravel.

2) Build small sediment basins and channel road drainage to these basins where possible.

3) Install drop culverts where road drainage is causing gullying and sediment basins are not feasible.

4) Physically remove debris and fine sediment from stream channels.

5) Construct and maintain sediment and debris traps at selected locations along streams.

6) Close, partially restore and revegetate non vital and abandon roads.

7) Physically remove sources of small debris from near stream channels.

8) Manage fires to prevent a surplus of small debris.

Although most of these suggested rehabilitation activities can be implemented within two years, substantial improvement to the stream channels (as measured by reduction of fine sediment and small debris) is likely to take much longer.

Riparian Ecosystems, Iron Canyon Creek (Below Iron Canyon Dam)

Since construction of Iron Canyon Dam, Iron Canyon Creek has experienced a substantial loss of pool and riffle geometry and gravel beds. Both losses can be attributed to Iron Canyon Dam trapping all moving bed material and regulating downstream flow. The Both activities (sediment trapping and regulated downstream flow) continue. The regulated downstream flow, specifically the lack of flood flows, has allowed the pool areas to substantially fill with cobble size materials from tributaries. Gravel and fine bed materials which were once in Iron Canyon Creek have been washed out and replenishment of these materials from tributaries is far from adequate to maintain the stream channel. The lack of pool and riffle geometry and gravel beds will continue for as long as flood flows are suppressed and no other restoration activities are implemented. In addition to the loss of pool and riffle geometry and gravel beds, in some locations of limited extent Iron Canyon Creek has a surplus of fine sediment. This fine sediment is transported to Iron Canyon Creek from tributaries which have a sediment surplus. The sediment surplus in the tributaries is described in the previous section.

The impacts of Iron Canyon Dam and Reservoir on the Iron Canyon Creek channel have been very significant on the aquatic habitat and riparian ecosystems below the reservoir.

The tremendous magnitude of the changes in hydrologic conditions below Iron Canyon Dam can be identified by comparing the hydrologic figures representing the current condition (Figures 1,3,4 and 5) with the comparable figures representing the reference condition (Figures 2,6,7 and 8). In response to these changes in hydrologic conditions, channel geometry has changed from a pool and riffle geometry with shallow gravel bar areas to a very uniform shallow wide channel with rocks and cobbles, and in some short reaches, overlain with fine sediments. Iron Canyon Creek below Iron Canyon Dam is in need of rehabilitation if reference condition are to be desired. Opportunities exist with which to improve the Iron Canyon Creek stream channel. These opportunities include:

1) Periodically release flows representative of prior flood flows.

2) Remove cobbles from pond areas.

3) Import and distribute gravel within the Iron Canyon Creek channel.

4) Implement restoration opportunities described in the previous section on the tributaries to Iron Canyon Creek.

Late Successional Forest

Hydrologic impacts from stand replacing wildfire include increased runoff, bank erosion and channel instability all resulting from hydrophobic soil conditions. Although some of these consequences of stand replacing wildfire can be mitigated after such a fire, with the exception of releasing occasional flood flows from Iron Canyon Reservoir, there are no practical hydrologic or hydraulic measures which can be implemented to mitigate the threat of stand replacing wildfires. Releasing occasional flood flows from Iron Canyon Reservoir may be helpful in controlling the growth of low level brush and small trees in the floodplain. Reduced low level growth in the floodplain may reduce the opportunity for ground fires to escalate into stand replacing wildfires.

IRON CANYON WATERSHED ANALYSIS
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Chapter VI, Recommendations

Present Condition: Fine Sediment Surplus

Several opportunities are available for reducing the quantities of fine sediment reaching the streams above Iron Canyon Reservoir and tributary to Iron Canyon Creek. Fine sediment reduction alternatives can be divided into general catagories of road management (including maintenance of road drainage) and stream management. Road management fine sediment reduction alternatives include surfacing roads with gravel, outsloping roads, constructing small sediment basins in road drainage channels, installation of drop culverts and closing and stabilizing unneeded roads. Stream management fine sediment reduction alternatives include constructing instream sediment basins, physical removal of small debris and removal of the sources of fine debris. These alternatives are each described in greater detail in the following paragraphs.

Road Management

Surface Roads With Gravel: Much of the fine sediment reaching stream channels is from the surface of the present road system. If these roads are surfaced with competent gravel instead of the fine materials presently observed, in addition to a reduction of material reaching the stream channels from the roads (larger material is less transportable), road surface materials reaching the streams would be beneficial instead of detrimental.

Advantages:	Can be incorporated into existing road maintenance program. Minimal new cost if part of existing road maintenance. Gravel which reaches streams considered a benefit to habitat.
Disadvantages:	High cost if done all at once. Gravel must be imported. Traffic/Transportations concerns with use of gravel for surface? No immediate effect in stream.

Outslope Roads: The conventional practice of sloping roads in to the cut slope and providing distinct drainage channels concentrates flow and increases the transport of fine sediment from the road surface to the streams. Where road geometry allows, by sloping the roads out from the cut banks, water draining from the road surface is not concentrated and the ability of the water to transport fine sediment to the stream channels is substantially reduced.

Advantages:	May be incorporated into existing road maintenance program.

Reduces flood peaks in drainage channels and streams.

Disadvantages: Moderate cost.
Other road geometry concerns limit areas of use.
No immediate effect in streams.

Construct Small Sediment Basins in Road Drainages: Where road drainage facilities cannot be avioded and where topography allows, small servicable sediment traps can be constructed to capture the fine sediments from road surfaces and bank erosion before it is transported to the stream channels. Typical basins would consist of a low, wide area adjacent to the road and near but not in the stream flood plain. Such facilities would have low flow velocities during storms and as a consequence much of the fine sediment would settle out before reaching the stream channels. The sediment basins would be sized based on the area and condition of road and road cut being drained, the volume of transported fine sediment anticipated, the magnitude of the selected "design" storm and the available area in which to build the sediment basins. The basins would require cleaning (removal of accumulated fine sediment) on a periodic basis until the source of the fine sediment is stabilized. Access for basin maintenance should not be a problem since they would be located adjacent to existing roads.

Advantages: Near immediate reduction of fine sediment to stream channels.
Minimal cost in some locations.
No new access required.

Disadvantages: Use limited by topographic conditions.
Periodic cleaning required for smaller basins.

Drop Culverts: In some locations road drainage channels drop steeply to stream channels. These steep road drainage channels often have considerable potential for bank and bed erosion and result in addition of fine sediment to the stream channel. Replacing steep open road drainage channels with drop culverts (made for this very purpose) will eliminate the fine sediment reaching stream channels from bank and bed erosion of steep road drainage channels.

Advantages: Near immediate reduction of fine sediment to stream channels.
No new access required.

Disadvantages: Costly and labor intensive installation.

Close and Stabilize Unneeded Roads: Roads which are no longer required for transportation or access in the watershed analysis area continue to supply fine sediment to the stream channels by the mechanisms described above. If closed and stabilized (using the previously described fine sediment reduction methods and/or regrading and planting) the fine sediment reaching stream channels from no longer required roads will be minimized.

Advantages: Low initial and ongoing cost.
No new access required.

Disadvantages: No immediate effect in stream channels.

Stream Management

Instream Sediment Basins: Where stream and basin topography allow sediment traps can be built at selected locations in streams. These sediment traps would consist of large artificial ponds to capture fine sediment from the stream. Pond size would be determined by the slope, geometry and hydraulics of the stream reach entering the pond and the interval between pond cleaning (removal of accumulated fines). Access for pond cleaning will be required if the pond is designed to be cleaned and reused.

Advantages: Immediate effect in stream channels.
Artificial pond provides habitat prior to filling.
Reduced risk of catastrophic sediment problems (aggradation).

Disadvantages: High cost.
New access roads may be required.
Maintenance (cleaning) may be required.
Restoration may be required after stream channels recover.

Remove Small Debris: Large volumes of small debris are presently creating debris dams and holding fine sediment from moving downstream. Removal of these small debris dams will allow fine sediment to move through the system.

Advantages: Immediate effect in stream channels.

Disadvantages: Labor intensive and potentially costly.

Does not remove fine sediment.
Substantial risk of downstream aggradation if not combined with fine sediment reduction measures.

Remove Source of Fine Debris: Substantial quantities of brush and small trees near the stream channel are providing a continuing source of fine debris in the channel. This fine debris creates small debris dams which retard the movement of fine sediment through the system. Removal or reduction of the source of fine debris will reduce the creation of small debris dams and allow fine sediment to move through the system.

Advantages: Provides for a longer term of enhanced fine sediment movement in streams.

Disadvantages: Labor intensive and potentially costly.
Does not remove fine sediment.

Present Condition: Aquatic Habitat

Several opportunities are available for guiding the streams in the watershed back to a more desirable aquatic habitat. Like the recommendations for the fine sediment surplus condition, these opportunities can be divided into the general catagories of road management and stream management. Since excessive volumes of fine sediment are responsible for much of the loss of aquatic habitat, all of the recommendations for reduction of fine sediment also apply here. Additional habitat improvement alternatives which are applicable specifically to Iron Canyon Creek below Iron Canyon Dam include releasing flows representative of floods, restore and/or create ponds and gravel supplementation. These are described in the following paragraphs.

Road Management

All alternatives described for the fine sediment surplus present condition apply.

Stream Management

All alternatives described for the fine sediment surplus present condition apply.

Release Flows Representative of Floods: The channel geometry of Iron Canyon Creek below Iron Canyon Dam is defined most substantially by the hydrology of Iron Canyon Creek. The present chute like geometry (lack of pond and riffle environment) is a result of a nearly constant 3- to 4-CFS release from Iron Canyon Reservoir for the past 30-years coupled with the trapping of gravel by Iron Canyon Dam. Releasing flows representative of the historic floods will help restore the pond and riffle geometry which most likely existed in the stream prior to construction of the dam.

Advantages: Least "physical" method of restoring habitat.
May provide immediate improvement in aquatic habitat.
Provides much needed mixing of bed materials.
Coupled with gravel supplementation, will distribute beneficial bed materials.

Disadvantages: Requires participation of PG&E.
Potentially very costly.
Requires study to establish economically beneficial flows.
Single treatment will not maintain habitat.
May temporarily affect the Pit River at the mouth or Iron Canyon Creek.

Restore and/or Create Ponds: The lack of periodic flood flows have caused the loss of ponds in Iron Canyon Creek below Iron Canyon Dam. Ponds can be restored by removal of cobbles which have filled pond reaches during the past 30-years. Ponds can also be created by careful placement of flow constrictions such as very large boulders and logs.

Advantages: Provides immediate improvement to aquatic habitat.

Disadvantages: Requires disturbance of stream channel.
Potentially labor intensive and costly.
Not permanent without maintenance (physical or flow).

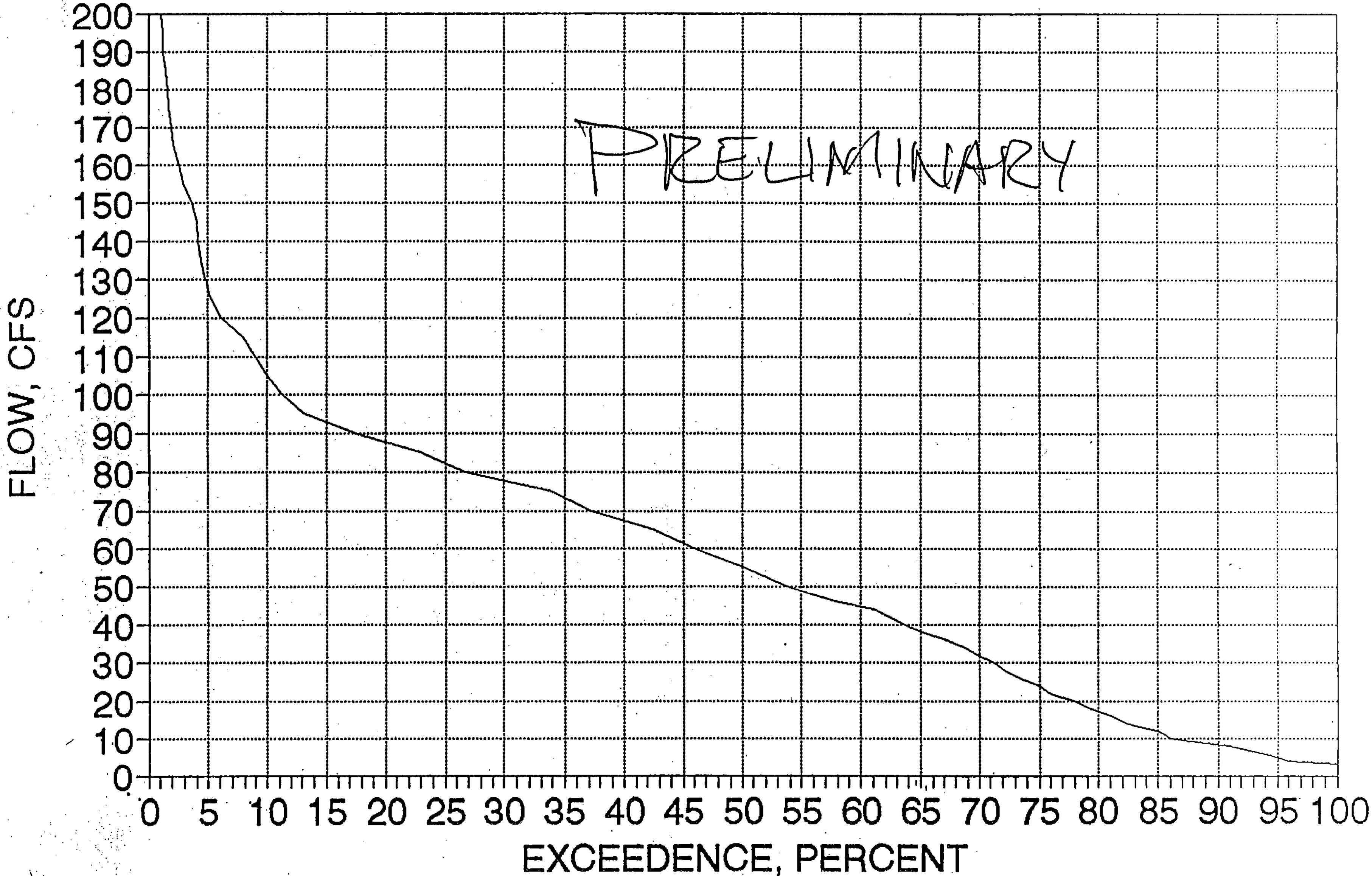
Gravel Supplementation: Gravel size bed materials below Iron Canyon Dam have been washed out of Iron Canyon Creek since the construction of the dam. Gravel may be placed in selected locations within Iron Canyon Creek to improve the aquatic habitat.

Advantages: Provides immediate improvement to aquatic habitat.
Can provide lasting improvement when coupled with the above two alternatives.

Disadvantages: Potentially costly.
May require new access.
Short term without above two alternatives.

Along with any alternative or combination of alternatives for either of these present conditions, the size and quantity of pools and the size and quantity of fine sediments should be monitored to establish the performance of the alternatives.

IRON CANYON WATERSHED ANALYSIS
Natural Condition Flow Duration Curve



1PRELIMINARY NATURAL CONDITION IRON CANYON CREEK FLOW DURATION CURVE

M[illegible]) SELECTED: OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP

AVERAGE MONTHLY FLOW DATA

YEAR	AVG	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1974	112.6	93.8	144.0	179.0	516.6	70.0	172.0	91.0	16.0	19.0	12.8	6.5	20.6
1975	19.8	3.3	3.3	3.3	3.2	19.0	6.6	3.4	6.0	50.0	36.0	53.0	51.5
1976	36.9	3.3	3.4	3.2	4.0	12.0	35.0	50.0	32.0	8.0	24.0	152.0	115.0
1977	53.9	52.0	31.0	44.0	46.0	46.0	47.0	89.0	88.0	44.0	63.0	25.0	72.0
1978	81.8	67.0	63.0	56.0	155.0	219.0	75.0	14.0	41.0	80.0	78.0	76.0	67.0
1979	64.7	73.0	56.0	37.0	39.0	75.0	107.0	98.0	66.0	66.0	53.0	60.0	48.0
1980	77.8	70.0	58.0	67.0	92.0	149.0	60.0	59.0	78.0	98.0	64.0	73.0	69.0
1981	66.5	70.0	73.0	50.0	64.0	91.0	96.0	94.0	68.0	79.0	50.0	45.0	20.2
1982	72.5	9.5	31.4	88.0	86.0	119.0	91.0	163.0	35.0	82.0	78.0	44.0	49.0
1983	41.4	56.0	56.0	34.0	64.0	136.0	91.9	27.0	6.5	4.3	6.5	8.7	13.0
1984	31.5	17.0	42.0	92.0	39.0	11.0	17.4	8.6	16.9	38.0	40.0	26.0	28.0
1985	21.3	22.0	20.4	8.0	8.1	9.0	8.1	10.0	51.5	67.0	22.0	4.0	25.0
1986	34.9	16.0	12.0	9.0	9.0	128.0	34.0	14.0	59.0	46.0	42.0	13.0	45.0
1987	44.0	8.6	34.9	5.0	20.0	32.0	52.0	78.0	80.0	76.0	38.0	59.0	45.0
1988	70.6	34.0	26.0	33.0	59.0	78.0	78.0	103.0	115.0	90.0	77.0	78.0	77.0
1989	101.9	93.0	92.0	89.0	83.0	84.0	120.0	121.0	155.0	119.0	92.0	87.0	86.0
1990	95.7	87.0	101.0	93.0	86.0	94.0	114.0	119.0	65.0	130.0	85.0	87.0	89.0
AVERAGE	60.4	45.6	49.8	52.4	80.8	80.6	70.9	67.2	57.6	64.5	50.7	52.8	54.1

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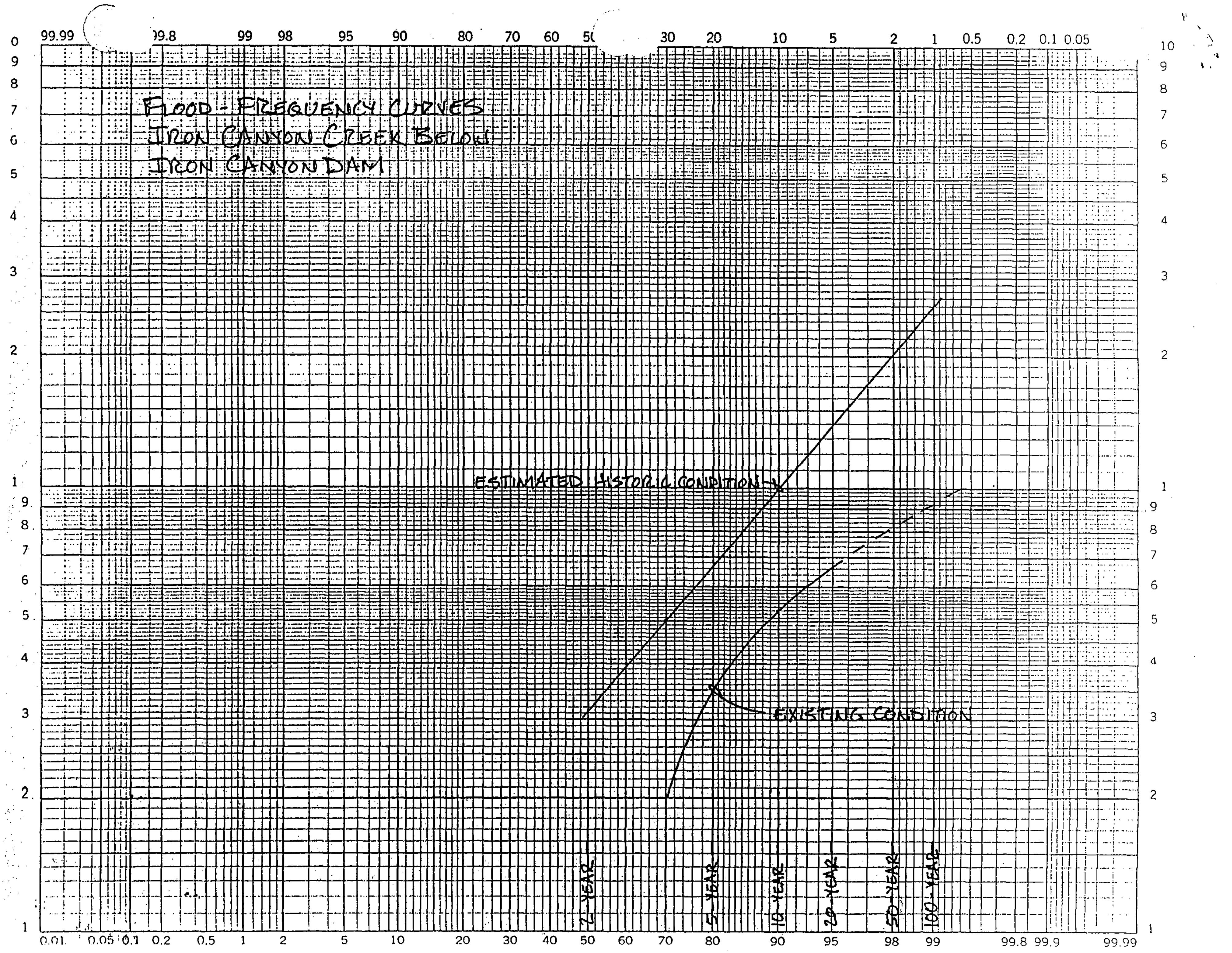
FLOW DURATION CURVE DATA

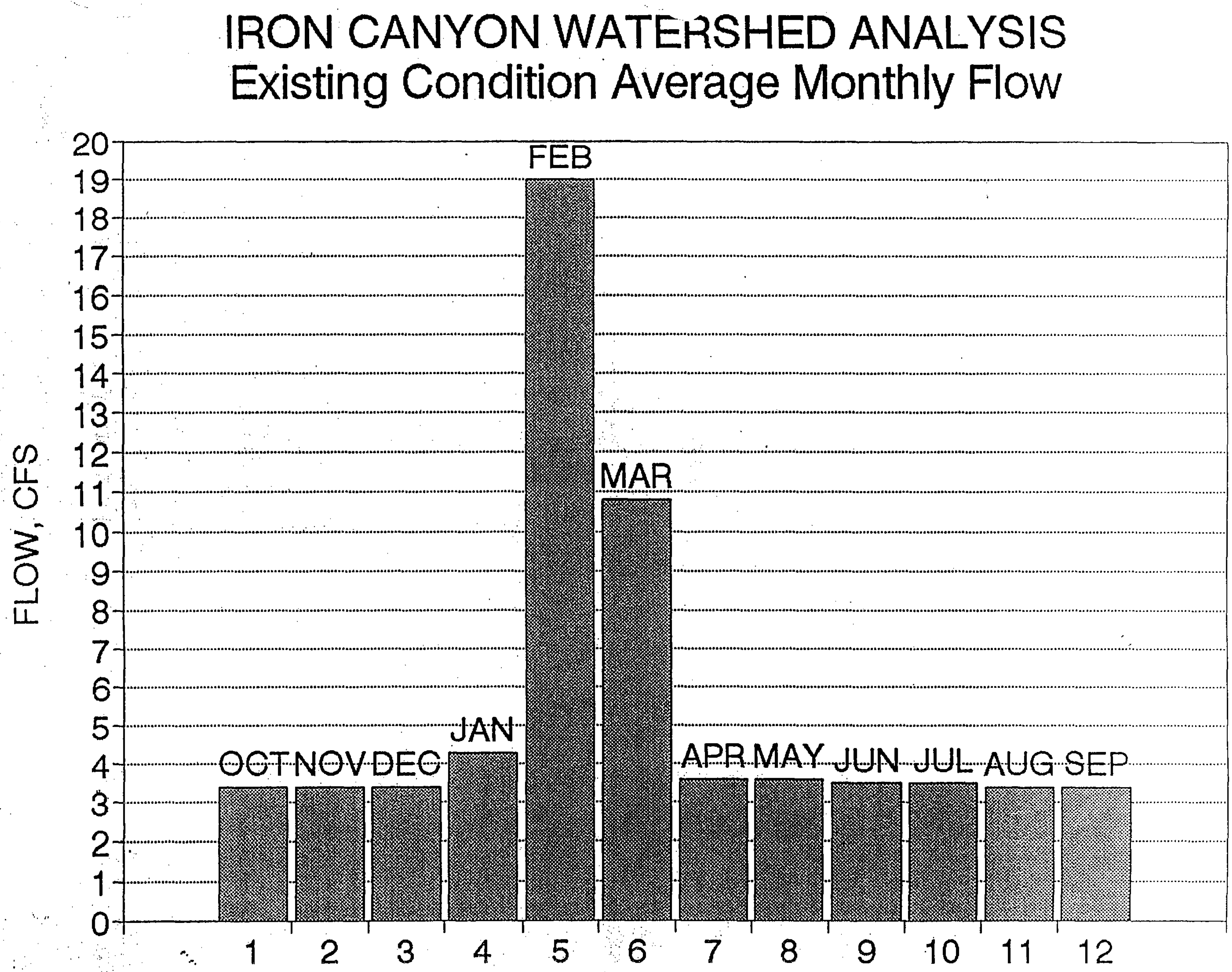
CLASS	FLOW	TOTAL	ACCUM	PERCT
	0	0	6209	100.00
	1	0	6209	100.00
	2	0	6209	100.00
3	3	254	6209	100.00
4	4	81	5955	95.91
5	5	63	5874	94.60
6	6	103	5811	93.59
7	7	54	5708	91.93
8	8	209	5654	91.06
9	9	101	5445	87.70
10	10	32	5344	86.07
11	11	44	5312	85.55
12	12	84	5268	84.84
13	13	76	5184	83.49
14	14	35	5108	82.27
15	15	29	5073	81.70
16	16	112	5044	81.24
17	18	91	4932	79.43
18	20	120	4841	77.97
19	22	62	4721	76.03
20	24	105	4659	75.04
21	26	76	4554	73.35
22	28	61	4478	72.12
23	30	87	4417	71.14
24	32	55	4330	69.74
25	34	105	4275	68.85
26	36	124	4170	67.16
27	38	97	4046	65.16
28	40	70	3949	63.60
29	42	90	3879	62.47
30	44	203	3789	61.02
31	46	134	3586	57.75
32	48	110	3452	55.60
[illegible]	50	237	3342	53.83
	55	250	3105	50.01
	60	221	2855	45.98
	65	321	2634	42.42
[illegible]	70	224	2313	37.25
38	75	429	2089	33.64
39	80	232	1660	26.74
40	85	344	1428	23.00
41	90	270	1084	17.46
42	95	117	814	13.11
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]



FLOOD-FREQUENCY CURVES
IRON CANYON CREEK BELOW
IRON CANYON DAM
ESTIMATED HISTORIC CONDITION
EXISTING CONDITION
2-YEAR
5-YEAR
10-YEAR
20-YEAR
50-YEAR
100-YEAR

IRON CANYON WATERSHED ANALYSIS
FLOOD FREQUENCY RELATIONSHIPS

LOCATION	AREA	Q-02	Q-05	Q-10	Q-25	Q-50	Q-100
HISTORIC CONDITION:							
USGS Gage Site	11.29	310	680	1000	1550	2000	2600
Mouth of Watershed	22.49	569	1197	1736	2672	3424	4420
HISTORIC AND PRESENT CONDITON:							
Unnamed West	3.67	115	271	407	638	832	1094
Unnamed South	1.70	59	144	220	347	457	605
Initial Creek	1.63	56	139	213	336	442	586
Cedar Salt Log Creek	2.40	79	191	290	456	598	789
McGill Creek	2.35	78	188	285	449	588	776
Deadlun Creek	1.57	55	135	206	326	429	569
Gap Creek	0.90	33	85	132	210	278	371
Little Gap Creek	0.53	21	55	87	138	184	247
Reservoir Local	2.69	88	210	317	499	653	862
PRESENT CONDITION:							
USGS Gage Site	11.29	12	350	530	660	800	900
Mouth of Watershed	~~11.35~~	314	718	1110	1755	2328	3061



IRON CANYON WATERSHED ANALYSIS
Existing Condition Average Monthly Flow
FLOW, CFS
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
1
2
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4
5
6
7
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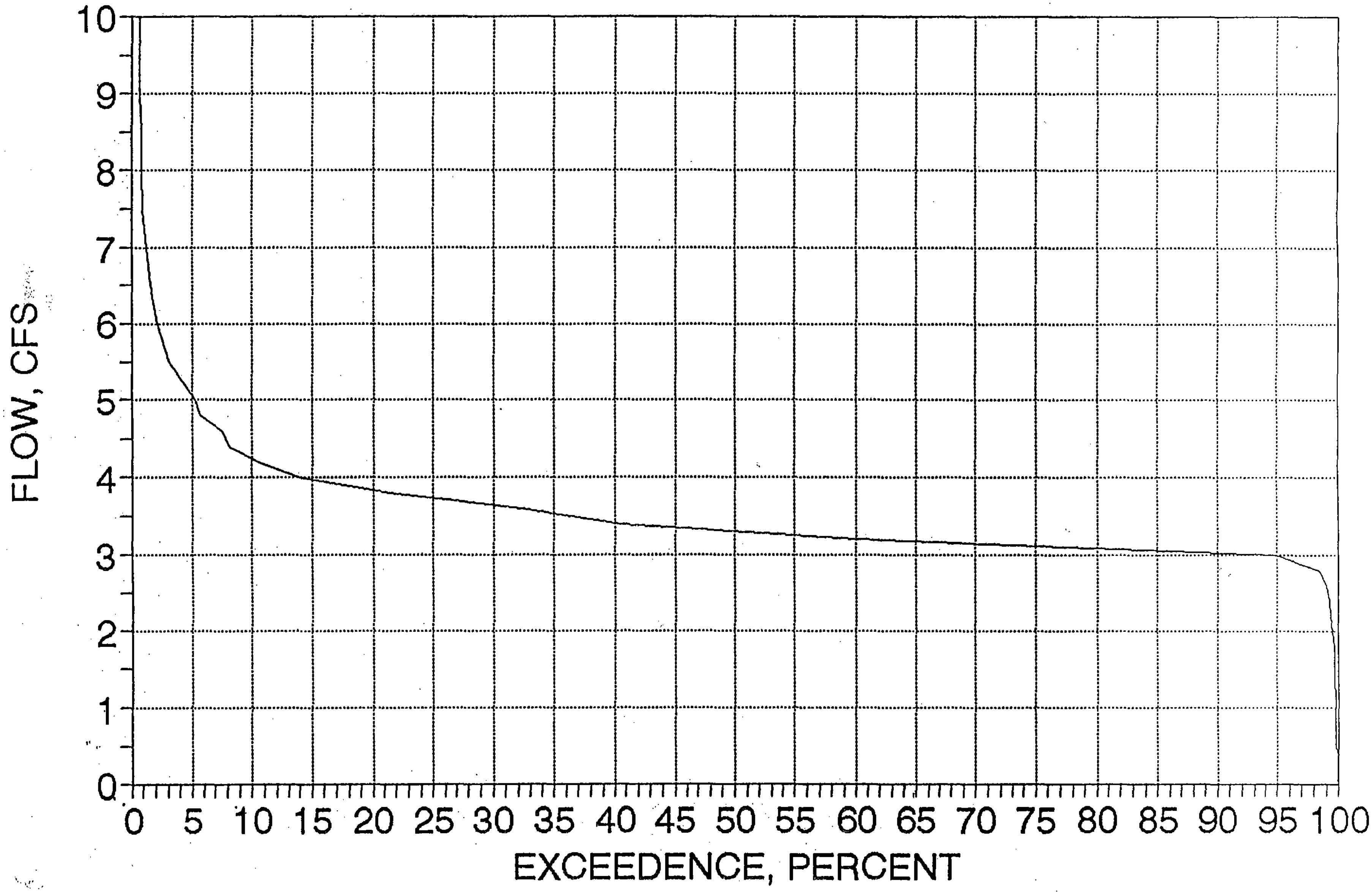
9
10
11
12

IRON CANYON WATERSHED ANALYSIS
Existing Condition Flow Duration Curve



1EXISTING CONDITION IRON CANYON CREEK BELOW IRON CANYON RESERVOIR

F S) SELECTED: OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP

RESERVOIR DRAINED F/ INSR.

AVERAGE MONTHLY FLOW DATA

YEAR	AVG	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1967	4.1	3.6	5.2	3.7	3.4	2.5	6.9	4.1	3.4	3.6	3.8	3.8	5.3
1968	4.0	4.3	3.6	3.4	4.0	4.7	3.7	4.8	4.7	3.7	3.6	3.6	3.5
1969	4.2	4.2	3.6	3.4	5.2	3.6	3.4	5.0	5.0	4.9	4.6	4.2	4.0
1970	3.4	3.5	3.1	3.2	5.2	3.1	3.1	3.2	3.2	3.2	3.2	3.2	3.2
1971	12.3	3.2	3.2	3.3	21.6	101.8	3.1	3.1	3.1	3.1	3.2	3.1	3.1
1972	3.1	3.1	3.1	3.2	3.3	3.2	3.1	3.1	3.1	2.7	3.1	3.1	3.1
1973	3.3	3.2	3.1	3.2	3.2	3.1	3.1	3.3	3.5	3.5	3.6	3.4	3.4
1974	3.2	3.1	3.2	3.1	3.9	3.1	3.3	3.2	3.1	3.1	3.1	3.1	3.1
1975	3.1	3.1	3.1	3.1	3.1	3.1	3.2	3.1	3.1	3.1	3.1	3.1	3.1
1976	3.0	3.1	3.1	3.1	3.1	3.0	2.9	2.9	2.9	2.9	2.9	2.9	3.0
1977	3.2	3.3	3.3	3.3	3.2	3.1	3.1	3.1	3.1	3.1	3.1	3.2	3.3
1978	44.4	3.1	3.1	3.1	3.4	327.1	196.4	3.1	3.1	3.1	3.1	3.1	3.1
1979	3.1	3.2	3.2	3.2	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
1980	3.1	3.0	3.0	3.0	3.2	3.5	3.0	3.1	3.1	3.1	3.1	3.1	3.0
1981	3.0	3.2	3.2	3.2	3.2	3.0	3.0	3.0	3.0	2.9	2.9	3.0	3.0
1982	3.2	3.0	3.1	3.6	3.1	3.3	3.1	3.5	3.1	3.1	3.1	3.1	3.1
1983	3.1	3.1	3.1	3.0	3.1	3.2	3.3	3.1	3.1	3.0	3.1	3.1	3.1
1984	3.3	3.2	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.1	3.3
1985	3.3	3.3	3.3	3.4	3.3	3.3	3.3	3.3	3.3	3.4	3.2	3.0	3.2
1986	3.6	3.4	3.4	3.4	3.5	4.6	3.5	3.5	3.5	3.5	3.8	3.6	3.5
1987	3.4	3.5	3.5	3.4	3.4	3.4	3.6	3.6	3.4	3.3	3.3	3.2	3.1
1988	3.6	3.7	3.7	3.2	2.8	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.8
1989	4.7	3.9	3.9	3.7	3.9	4.6	6.7	3.8	4.6	5.8	5.6	5.0	4.5
1990	4.5	4.2	4.1	4.4	4.7	5.2	5.2	5.5	5.5	4.1	3.9	3.7	3.7
1991	3.8	3.7	3.7	3.7	3.8	3.7	4.0	3.9	4.2	4.2	4.1	3.7	3.6
1992	3.9	3.7	3.7	3.7	3.8	4.0	3.8	3.8	4.1	4.1	4.1	3.8	3.7
1993	3.9	3.8	3.7	3.9	4.3	4.2	4.5	3.8	3.8	3.8	3.8	3.8	3.7
AGE	5.4	3.4	3.4	3.4	4.3	19.0	10.8	3.6	3.6	3.5	3.5	3.4	3.4

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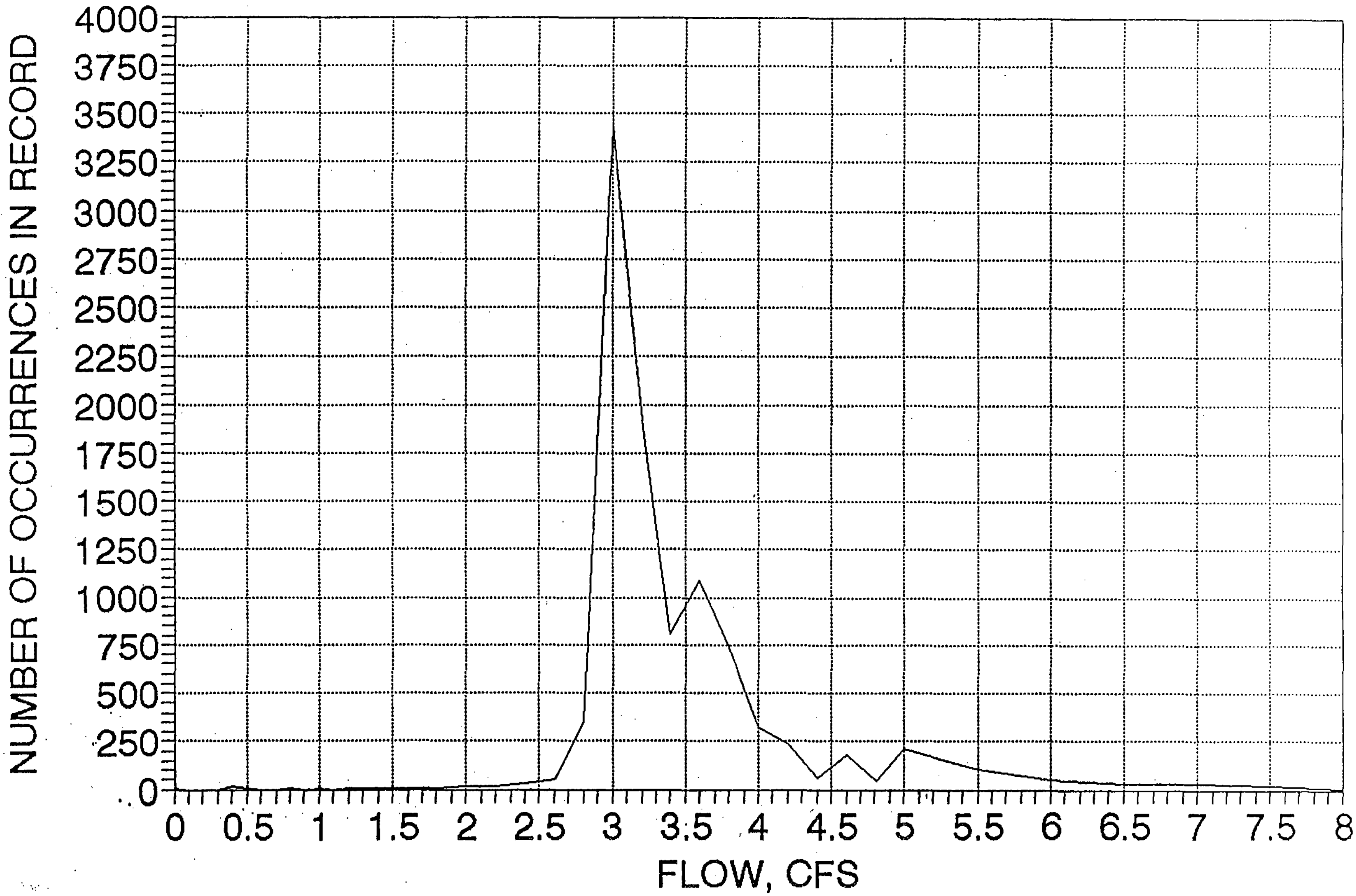
PENSTOCK FAILURE

FLOW DURATION CURVE DATA

CLASS	FLOW	TOTAL	ACCUM	PERCT
0	0	19	9862	100.00
1	1	24	9843	99.81
2	2	461	9819	99.56
3	3	7993	9358	94.89
4	4	844	1365	13.84
5	5	319	521	5.28
6	6	77	202	2.05
7	7	43	125	1.27
8	8	9	82	.83
9	9	6	73	.74
10	10	1	67	.68
11	11	4	66	.67
12	12	0	62	.63
13	13	0	62	.63
14	14	1	62	.63
15	15	3	61	.62
16	16	4	58	.59
17	18	1	54	.55
18	20	1	53	.54
19	22	0	52	.53
20	24	0	52	.53
21	26	0	52	.53
22	28	0	52	.53
[illegible]	30	0	52	.53
	32	0	52	.53
	34	0	52	.53
	36	1	52	.53
	38	0	51	.52
28	40	0	51	.52
29	42	0	51	.52
30	44	0	51	.52
31	46	0	51	.52
32	48	0	51	.52

IRON CANYON WATERSHED ANALYSIS
Existing Condition Dominant Discharge



Appendix C

List of Wildlife Species Possibly Occurring in the Iron Canyon Watershed.

HABITAT TYPES

- DFR: Douglas-fir
- MCN: Mixed Conifer
- MHC: Montane Hardwood-Conifer
- MCH: Mixed Chaparral
- MRI: Montane 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)
- 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)

NT Neotropical Migratory Birds

Wildlife Species Possibly Occurring in the Iron Canyon Watershed
and Associated with Habitat Types DFR, MCN, MHC, MCH, MRI, and RIV.
Canopy Closure 0-100% and Seral Stage seedling to mature (<1" to 24" DBH)

GUILD(S)	WHRI	COMMON NAME	STATUS	NT
AQFA	A004	PACIFIC GIANT SALAMANDER		
	A026	TAILED FROG	CSC	
	A043	FOOTHILL YELLOW-LEGGED FROG	C2,CSC	
	B373	AMERICAN DIPPER		
AQSL	A006	ROUGH-SKINNED NEWT		
	A032	WESTERN TOAD		
	A039	PACIFIC TREEFROG		
	A040	RED-LEGGED FROG	C2,CSC	
	A046	BULLFROG		
	B006	PIED-BILLED GREBE		
	B010	WESTERN GREBE / CLARK'S GREBE		
	B051	GREAT BLUE HERON		
	B079	MALLARD		
	B094	LESSER SCAUP		
	B149	AMERICAN COOT		
	R004	NORTHWESTERN POND TURTLE	C2, CSC, FS	
AQUAT	B105	COMMON MERGANSER		
	B110	OSPREY	CSC	✔
	B113	BALD EAGLE	FE, CaE	
	B170	SPOTTED SANDPIPER		
	B293	BELTED KINGFISHER		✔
	B343	CLIFF SWALLOW		✔
	M112	BEAVER		
	M163	RIVER OTTER		
C/C	B108	TURKEY VULTURE		✔
	B126	GOLDEN EAGLE	CSC	✔
	B129	PEREGRINE FALCON	FE, CaE	✔
	B341	NORTHERN ROUGH-WINGED SWALLOW		✔
	B343	CLIFF SWALLOW		✔
	B344	BARN SWALLOW		✔
	M021	LITTLE BROWN MYOTIS		
	M023	YUMA MYOTIS		
	M025	LONG-EARED MYOTIS	S&M	
	M026	FRINGED MYOTIS	S&M	
	M027	LONG-LEGGED MYOTIS	S&M	
	M028	CALIFORNIA MYOTIS	C2, CSC	
	M029	SMALL-FOOTED MYOTIS		
	M032	BIG BROWN BAT		
	M037	TOWNSEND'S BIG-EARED BAT	C2, CSC	
	M038	PALLID BAT	CSC, S&M	
	B319	GRAY FLYCATCHER		✔
CHAP	B404	WATER PIPIT		✔
	B482	GREEN-TAILED TOWHEE		✔
	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		
	M117	DEER MOUSE		
	M157	LONG-TAILED WEASEL		
	R046	RUBBER BOA		

	R048	RINGNECK SNAKE		
	R049	SHARP-TAILED SNAKE		
	R058	COMMON KINGSNAKE		
	R059	CALIFORNIA MOUNTAIN KINGSNAKE		
HDWD	B116	COOPER'S HAWK	CSC	✔
	B251	BAND-TAILED PIGEON		✔
	B296	ACORN WOODPECKER		
	B303	DOWNY WOODPECKER		
	B358	PLAIN TITMOUSE		
	B362	WHITE-BREASTED NUTHATCH		
	B417	HUTTON'S VIREO		
	B418	WARBLING VIREO		✔
	M077	WESTERN GRAY SQUIRREL		
LATE	B051	GREAT BLUE HERON		
	B117	NORTHERN GOSHAWK	C2, CSC, FS	✔
	B134	BLUE GROUSE		
	B270	NORTHERN SPOTTED OWL	FT	
	B304	HAIRY WOODPECKER		
	B305	WHITE-HEADED WOODPECKER		
	B308	PILEATED WOODPECKER		
	B309	OLIVE-SIDED FLYCATCHER		✔
	B317	HAMMONDS' FLYCATCHER		✔
	B346	STELLER'S JAY		
	B356	MOUNTAIN CHICKADEE		
	B357	CHESTNUT-BACKED CHICKADEE		
	B361	RED-BREASTED NUTHATCH		
	B363	PYGMY NUTHATCH		
	B364	BROWN CREEPER		✔
	B375	GOLDEN-CROWNED KINGLET		✔
	B390	VARIED THRUSH		✔
	B415	SOLITARY VIREO		✔
	B438	HERMIT WARBLER		✔
	B539	RED CROSSBILL		
	B546	EVENING GROSBEAK		
	M012	TROWBRIDGE'S SHREW		
	M030	SILVER-HAIRED BAT	S&M	
	M034	HOARY BAT		
	M079	DOUGLAS' SQUIRREL		
	M080	NORTHERN FLYING SQUIRREL		
	M151	BLACK BEAR		
	M154	AMERICAN MARTEN	CSC, FS	
	M155	PACIFIC FISHER	C2, CSC, FS	
	M159	WOLVERINE	C2, CaT	
	M177	ELK		
OPEN	B108	TURKEY VULTURE		✔
	B126	GOLDEN EAGLE	CSC	✔
	B140	CALIFORNIA QUAIL	CSC	
	B141	MOUNTAIN QUAIL	C2	
	B264	WESTERN SCREECH OWL		
	B265	GREAT HORNED OWL		
	B276	COMMON NIGHTHAWK		✔
	B277	COMMON POORWILL		✔
	B281	VAUX'S SWIFT	CSC	✔
	B289	CALLIOPE HUMMINGBIRD		✔
	B354	COMMON RAVEN		
	B366	ROCK WREN		✔
	B489	CHIPPING SPARROW		✔
	B505	SONG SPARROW		✔
	B509	GOLDEN-CROWNED SPARROW		
	B512	DARK-EYED JUNCO		✔

	B524	BREWER'S BLACKBIRD		✔
	B538	HOUSE FINCH		
	B542	PINE SISKIN		✔
	B543	LESSER GOLDFINCH		✔
	M021	LITTLE BROWN MYOTIS		
	M025	LONG-EARED MYOTIS	S&M	
	M026	FRINGED MYOTIS	S&M	
	M028	CALIFORNIA MYOTIS	C2, CSC	
	M032	BIG BROWN 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		✔
	B127	AMERICAN KESTREL		✔
	B158	KILLDEER		✔
	B199	COMMON SNIPE		
	B262	COMMON BARN OWL		
	B333	WESTERN KINGBIRD		✔
	B341	NORTHERN ROUGH-WINGED SWALLOW		✔
	B344	BARN SWALLOW		✔
	B389	AMERICAN ROBIN		✔
	B404	WATER PIPIT		✔
	B411	EUROPEAN STARLING		
	B495	LARK SPARROW		✔
	B521	WESTERN MEADOWLARK		✔
	B537	CASSIN'S FINCH		✔
	M018	BROAD-FOOTED MOLE		
	M072	CALIFORNIA GROUND SQUIRREL		
	M081	BOTTA'S POCKET GOPHER		
	M084	WESTERN POCKET GOPHER		
	M113	WESTERN HARVEST MOUSE		
	M133	MONTANE VOLE		
	M136	LONG-TAILED VOLE		
	R036	WESTERN SKINK		
	R051	RACER		
	R057	GOPHER SNAKE		
OPEN-SHRUB	B287	ANNA'S HUMMINGBIRD		✔
	B318	DUSKY FLYCATCHER		✔
	B326	ASH-THROATED FLYCATCHER		✔
	B360	BUSHTIT		
	B376	RUBY-CROWNED KINGLET		✔
	B377	BLUE-GRAY GNATCATCHER		✔
	B382	TOWNSEND'S SOLITAIRE		✔
	B407	CEDAR WAXWING		✔
	B408	PHAINOPEPLA		✔
	B425	ORANGE-CROWNED WARBLER		✔

	B426	NASHVILLE WARBLER		✔
	B435	YELLOW-RUMPED WARBLER		✔
	B436	BLACK-THROATED GRAY WARBLER		✔
	B471	WESTERN TANAGER		✔
	B477	LAZULI BUNTING		✔
	B483	RUFOUS-SIDED TOWHEE		✔
	B504	FOX SPARROW		✔
	B510	WHITE-CROWNED SPARROW		✔
	B536	PURPLE FINCH		✔
	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		
	A039	PACIFIC TREEFROG		
	A043	FOOTHILL YELLOW-LEGGED FROG	C2,CSC	
	B115	SHARP-SHINNED HAWK	CSC	✔
	B129	PEREGRINE FALCON	FE, CaE	✔
	B138	TURKEY		
	B293	BELTED KINGFISHER		✔
	B299	RED-BREASTED SAPSUCKER		✔
	B302	NUTTALL'S WOODPECKER		
	B311	WESTERN WOOD-PEWEE		✔
	B315	WILLOW FLYCATCHER	FS, SE	✔
	B320	WESTERN FLYCATCHER		✔
	B321	BLACK PHOEBE		
	B338	PURPLE MARTIN	CSC	✔
	B339	TREE SWALLOW		✔
	B340	VIOLET-GREEN SWALLOW		✔
	B369	HOUSE WREN		✔
	B370	WINTER WREN		
	B385	SWAINSON'S THRUSH		✔
	B386	HERMIT THRUSH		✔
	B430	YELLOW WARBLER		✔
	B460	MACGILLIVRAY'S WARBLER		✔
	B461	COMMON YELLOWTHROAT		✔
	B463	WILSON'S WARBLER		✔
	B467	YELLOW-BREASTED CHAT	CSC	✔
	B475	BLACK-HEADED GROSBEAK		✔
	B506	LINCOLN'S SPARROW		✔
	B528	BROWN-HEADED COWBIRD		✔
	M001	VIRGINIA OPOSSUM		
	M003	VAGRANT SHREW		
	M010	WATER SHREW		
	M029	SMALL-FOOTED MYOTIS		
	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	B105	COMMON MERGANSER		
	B110	OSPREY	CSC	✔
	B113	BALD EAGLE	FE, CaE	
	B127	AMERICAN KESTREL		✔
	B263	FLAMMULATED OWL		✔

	B264	WESTERN SCREECH OWL		
	B267	NORTHERN PYGMY OWL		
	B270	NORTHERN SPOTTED OWL	FT	
	B274	NORTHERN SAW-WHET OWL		
	B281	VAUX'S SWIFT	CSC	✓
	B294	LEWIS' WOODPECKER		✓
	B296	ACORN WOODPECKER		
	B299	RED-BREASTED SAPSUCKER		✓
	B300	WILLIAMSON'S SAPSUCKER		✓
	B302	NUTTALL'S WOODPECKER		
	B303	DOWNY WOODPECKER		
	B304	HAIRY WOODPECKER		
	B305	WHITE-HEADED WOODPECKER		
	B307	NORTHERN FLICKER		✓
	B308	PILEATED WOODPECKER		
	B326	ASH-THROATED FLYCATCHER		✓
	B338	PURPLE MARTIN	CSC	✓
	B339	TREE SWALLOW		✓
	B340	VIOLET-GREEN SWALLOW		✓
	B356	MOUNTAIN CHICKADEE		
	B357	CHESTNUT-BACKED CHICKADEE		
	B358	PLAIN TITMOUSE		
	B361	RED-BREASTED NUTHATCH		
	B362	WHITE-BREASTED NUTHATCH		
	B363	PYGMY NUTHATCH		
	B380	WESTERN BLUEBIRD		✓
	B381	MOUNTAIN BLUEBIRD		✓
	B411	EUROPEAN STARLING		
	M077	WESTERN GRAY SQUIRREL		
	M079	DOUGLAS' SQUIRREL		
	M080	NORTHERN FLYING SQUIRREL		
T/R	B366	ROCK WREN		✓
	B367	CANYON WREN		
	M066	YELLOW-BELLIED MARMOT		

Appendix D

Threatened, Endangered, and Sensitive Species Analysis

This appendix contains answers to questions posed in Appendix C (pages C7-12), "Endangered Species Act and Other Species Considerations", contained in the June 13, 1994 letter on "FY 1994-96 Watershed Analysis Guidelines", signed by Regional Forester Ronald Stewart.

APPENDIX D

Threatened, Endangered and Sensitive Species Analysis

August, 1995

This appendix contains answers to questions posed in Appendix C, pages C7-12, "Endangered Species Act and Other Species Considerations", contained in the June 13, 1994 letter on "FY 1994-96 Watershed Analysis Guidelines", signed by Regional Forester Ronald Stewart.

Northern Spotted Owl

1. Are spotted owl activity centers located within the watershed? Yes

a. If so, how many and in what ROD land allocations are they located?

Three spotted owl activity centers are located within the watershed. All of the activity centers (110, 112 and 115) are within LSR RC-335 and CHU CA-4.

b. Which of these are currently above "take" thresholds and which are below?

At the 0.7 mile radius level, all three territories are below the incidental take threshold. All three territories have less than 500 acres of suitable habitat. At the home range 1.3 mile radius level, all three owl pairs have less than the 1336 acres required to preclude incidental take allowance.

	Suitable Habitat	
Owl#	.7 circle	1.3 circle
110	298 acres	648 acres
112	240 acres	680 acres
115	70 acres	673 acres

c. When were the activity centers located?

Owl#	year located
110	1986
112	1991
115	1991

d. Describe the reproductive history.

Owl	Status	status verified	young verified
110	Single	1986	n/a
	Pair	1992	no data
112	Pair	1991	2 young 1991
	Single	1992	no reproduction
115	Single	1991	no reproduction

2. Has a 100 acre core area been designated around each activity center located in matrix lands?

No. There are no matrix lands within the Iron Canyon Watershed.

3. How many acres of nesting, roosting, and foraging (NRF) habitat are there in the watershed?

Only nesting and roosting (NR) habitat has been defined and tracked for the Forest. This NR habitat is known as suitable owl habitat. There are 2,015 acres of suitable owl habitat in the watershed.

a. What percentage of the watershed is this?

Suitable habitat exists in approximately 16 percent of the watershed. An additional 64 percent of the watershed is forested and capable of becoming suitable habitat. Thus 80 percent of the watershed is either currently suitable or capable of becoming suitable in the future.

b. Which of these stands have been surveyed to protocol? (2 years)

Approximately 40 percent of this watershed was surveyed during the late 1980's as part of the preparation for the Dutchman Peak, Lil Bagley, Coyote Peak and McGill Timber sales. These were not 2-year protocols. The single owl in ST-110 was located during these efforts.

The entire watershed was surveyed to protocol during 1991 only, as part of the surveys of HCA-42. This was before the 2-year protocol was mandatory. A second year survey was never completed.

From 1976 to 1989 District biologists or private individuals conducted non-protocol surveys within an additional 25 percent of the watershed. Many of these records are anecdotal and incomplete in nature.

Surveys areas	Years (2-Yr protocol)	Years (1-yr TS protocol)
Dutchman Peak TS		1989
McGill TS		1989
Coyote Peak TS		1989
LilBagley TS		1989

c. Which were not?

None of the watershed has been surveyed to a comprehensive 2-year protocol.

4. What is the amount of nesting, roosting and foraging habitat in each ROD land allocation within the watershed?

Only nesting and roosting habitat has been defined and tracked for the Forest. This NR habitat is known as suitable owl habitat. The entire watershed is LSR. There are approximately 2,015 acres of suitable habitat in the 12,791 acre watershed.

5. Does any portion of the watershed contain LSRs?

Yes, the entire watershed (12,791 acres) comprises the eastern one-sixth of LSR RC-335, which encompasses approximately 88,509 acres.

a. What percent of the total watershed is this?

The entire watershed is LSR, or 100 percent.

b. What are the current totals of NRF habitat and capable habitat in the LSR?

Suitable habitat within the watershed portion of the LSR is 2015 acres. There are an additional 8145 acres (64 per cent of the watershed) of capable habitat in the watershed. Acres of suitable habitat plus acres of capable forested habitat total 80 percent of the watershed.

The entire 88,509 acre LSR (RC-335) contains 27,668 acres of suitable habitat and 38,948 acres of capable habitat.

6. What is the amount of dispersal habitat (11-40 and above) in each ROD land allocation within the watershed?

The entire watershed is LSR. Generally dispersal habitat is discussed in terms of the amount of dispersal habitat present to allow for dispersal across the landscape between LSRs.

Dispersal habitat is defined as conifer stands with 13"+ DBH, 40%+ canopy closure, plus Black oak and mixed hardwood stands. Information on the amount of 11-40 is being obtained.

The amount of dispersal habitat in the watershed is 4328 (34% of the total watershed or 37% of the capable forested areas in the watershed).

7. Is the distance between LSRs (those over 10,000 acres) greater than 4 miles?

No. CD-44 (Draft Recovery Plan designation) lies approximately 2 miles northeast of RC-335. CD-45 lies approximately 3 miles east-southeast of RC-335 and CD-38 provides a linkage to the larger CD-31 to the west.

a. If so, then what is the amount of dispersal habitat on Federal lands for all 1/4 townships between the LSRs? (50/11/40)

Information is not obtainable at present. This information will be provided as part of a higher level Forest/province analysis.

b. What percent of the total Federal lands in these 1/4 townships is this?

Information is not available for this analysis.

c. How much (percent and total) of the dispersal habitat is in Riparian Reserves, Administratively Withdrawn (which provide long-term protection), Congressionally Reserved, 100 acre cores, and smaller (<10,000 acres) LSRs?

This information is not know at present. A higher level analysis at the Forest/province level will provide this information.

d. Is this total greater than 50 percent?

Unknown

e. Describe, if present, the natural barriers to dispersal.

Areas expected to be avoided by dispersing owls include the 514 acre reservoir and some of the sparse younger stands in the northern portion of the watershed which would be suitable habitat for predators of the spotted owl, including the red-tail hawk. Sparse stands would also not provide a cooler microclimate for the heat-sensitive species.

Some of the live oak stands in the southern portion of the watershed may be too dense to permit spotted owl movement. This may also be the case in some of the riparian corridors which have been previously harvested, enabling growth of dense understory shrubs, which may inhibit spotted owl movement.

f. Is connectivity, or dispersal habitat, sufficient to allow movement?

Unknown. Habitat fragmentation, urban development, and checkerboard ownership may hinder dispersal to surrounding LSRs.

8. How much critical habitat has been designated within the watershed?

The entire 12,791-acre Iron Canyon Watershed is located within Critical Habitat Unit CA-4.

a. How much of this total overlaps with LSRs?

The entire watershed is both LSR and CHU.

b. For areas that do not overlap, how much is currently NRF habitat?

Not applicable. See 8a.

And how much is capable?

Not applicable. See 8a.

c. How many activity centers are located in this non-overlap area of CHU?

Not applicable. See 8a.

d. How many territories are currently above "take"? How many below? (use acres established by FWS for .7 and 1.3 mile radius)

Not applicable. See 8a.

e. What role does this non-overlap critical habitat play in this watershed in relation to the reasons for the designation of the CHU?

Not applicable. See 8a.

Bald Eagle

1. Are occupied bald eagle activity areas (nesting, foraging, winter roosts, or concentration areas) located within the watershed?

a. If so, what type? b. How many?

Two pairs of bald eagles (104-1 and 104-2) have been recorded as nesting within the watershed. The nest sites are located on the shoreline of Iron Canyon Reservoir. Both nests are located on National Forest Land administered by the Shasta Lake Ranger District.

Iron Canyon Reservoir has supported bald eagles since the mid-1970s. The first nesting record is from 1977, but it appeared at that time that eagles had been using that nest for several years. There was only one known bald eagle nest on Iron Canyon Reservoir until 1991 when a second active nest was located.

The first nest is located on a peninsula of late-successional forest between Little Gap Creek and the west tributary of Cedar Salt Log Creek in NESE Sec. 20, T37N, R1W. This nest territory is located in the western portion of the reservoir. This nest has been occupied and active since 1977 until the last two years (1994 and 1995). Eagles have been observed in the vicinity of the nest and perched near the dam, but no nest activities have been recorded.

The second nest was discovered in 1993 and is located in the eastern portion of Iron Canyon Reservoir between Deadlum Creek and McGill Creek in NENE Sec.21, T37N, R1W, approximately one mile northeast of the western nest. This nest has been active since its discovery.

c. In what ROD land allocations are they located?

Both nests are located within Late-Successional Reserve. The primary and secondary zones are also within LSR.

d. Describe reproductive history based on monitoring data.

Eagle	Pair Verified	Young Verified
Ca-Sh-27-BE (ST) (104-2)	1977-1995	
	1977	0
	1978	0
	1979	1
	1980	2
	1981	2
	1982	2
	1983	0
	1984	1
	1985	0
	1986	?
	1987	1
	1988	0
	1989	0
	1990	2

	1991	1
	1992	2
	1993	2
	1994	0
	1995	0
Ca-Sh-27-BE(ST)-2(104-1)	1993	0*
	1994	1
	1995	1

e. Has a final site-specific protection/management assessment been developed for each site?

A territory management plan was written for the original nest in 1981. A second assessment was performed in 1993 after discovery of the second nest.

f. Does this watershed analysis corroborate the findings of the management assessment?

Yes. The plan prohibits activities which would adversely affect either nesting eagles or their habitat. This analysis has identified issues to protect and enhance nesting bald eagles and their habitat. Treatment to improve forest health in the vicinity of the second nest and human access restrictions into the primary zone during the critical nesting period have been identified as issues.

2. Has an assessment been made as to whether there are potential bald eagle activity areas (nesting, foraging, winter roosts, or concentration areas) located within the watershed?

Yes

a. If so, what type?

Iron Canyon Reservoir is the primary nesting, roosting and foraging area within the watershed. In addition, we have discovered that both immature and adult eagles fly between McCloud Reservoir to the north and both Iron Canyon Reservoir and the Pit River drainage, along the southeast boundary of the watershed. It is believed that nesting eagles at Iron Canyon Reservoir travel to the Pit River to forage as well. Iron Canyon Reservoir is stocked with rainbow trout annually by CDFG. No other potential bald eagle nest areas have been identified in the watershed.

b. How many?
One. The Pit River, along the southeastern boundary of the watershed, is also used as a primary foraging area.

c. What ROD land allocations are they located?
The Pit River is a large perennial, fish-bearing stream. It is within a Riparian Reserve.

d. Have these areas been surveyed to protocol to determine they are unoccupied? No

3. Describe historical bald eagle occurrence and nesting within the watershed.

See question 1.

4. What is the status of the watershed as it relates to the Recovery Plan? (target territories, including beyond watershed boundaries)

The Pacific Bald Eagle Recovery Plan does not specifically address the contribution of Iron Canyon Reservoir toward meeting Recovery Plan objectives. It does not show in either the Shasta-Trinity or Pit River portions of the plan.

a. Does the watershed and the surrounding area meet objectives of the Recovery Plan?

Yes. The watershed is in Zone 24 (Shasta/Trinity) and Zone 25 (Pit River) of the Pacific States Recovery Plan. The main threats previously listed for this zone are shooting, logging, mining, and recreational disturbance. The proposed management direction is to protect nest and wintering areas, evaluate nest habitat for the long term, and public education. This zone is rated at the percent occupancy level according to the California Department of Fish and Game update of September 7, 1994. The Forest currently exceeds the target nesting pair levels recommended in the February 7, 1985 memo regarding population levels for states recovery goals.

b. If not, then are there capable eagle activity areas located within the watershed?

N/A. The Shasta-Trinity National Forests exceed the Recovery Plan objectives.

c. If capable activity areas are present, what type are they?

N/A. It is believed that available and capable habitat is occupied. Eagle nest densities and numbers in both Zones 24 and 25 exceed the goals as outlined in the Recovery Plan.

1). How many? None

2). In what ROD land allocations are they located? N/A

d. What type of project or enhancement could develop sites into potential or occupied sites?

Improving forest health in the vicinity of Iron Canyon Reservoir and along major streams and the Pit River would ensure availability of suitable nest and perch trees over the long term. Currently, suitable nest and perch trees are becoming decadent and the need for suitable recruitment trees is evident.

5. If present, describe significant habitat within the watershed that is not under Federal ownership.

All significant habitat is under Federal ownership. There is one 40 acre parcel under private ownership along the eastern shore of the reservoir, but this ownership is not a risk at present.

Amphibians

1. Have any amphibian inventories been done on a project or watershed level?

Yes. Fisheries surveys were conducted on most of the streams in the watershed north of Iron Canyon Reservoir in the late 1970's. Incidental amphibian sightings were recorded. An Ecological Unit Inventory is being conducted in this watershed during 1995. Preliminary data are available for selected streams in the northern portion of the watershed. No surveys have been done south of Iron Canyon Reservoir.

a. What species does the literature suggest may be present?

The home range of the following frogs and salamanders extends into the watershed:

Pacific giant salamander
rough-skinned newt
ensatina
western toad
tailed frog
western toad
Pacific tree frog
northern red-legged frog (S)
foothill yellow-legged frog
bullfrog

2. Are sensitive species and ROD Table C-3 species present or based on best information, is there a possibility they can occur in the watershed?

One of the Table C-3 salamanders is suspected to occur in the watershed or vicinity: the Shasta salamander may inhabit small (less than 10 acres), scattered limestone formations within the watershed.

The northern red-legged frog and foothill yellow-legged frog are listed as category 2 species, and may become listed as Sensitive species. There is no confirmation of the northern red-legged frog's presence in or near the vicinity of the watershed. Foothill yellow-legged frogs have not been sighted within this watershed but its occurrence may be likely.

3. Have intensive or extensive inventories been conducted in adjoining drainages/sub-watersheds?

Sierra Pacific Industries has conducted some inventories on private lands to the west and the south.

a. If so, can those inventories be extrapolated to this watershed? N/A

4. Are endemic species known to occur in the general geographic region?

None are known to occur in the vicinity

5. Are exotic species known or suspected to be in the watershed? (e.g. bullfrogs)

Bullfrog populations are a possibility, though there are no known observations.

Peregrine Falcon

1. Are any cliffs located within the watershed? (rock wall >50 feet) No.

2. Are any cliffs present that are historic (pre-1975) or traditional (post-1975) peregrine eyries?

There are no historic cliff eyries.

3. For past projects near historic cliffs, have mitigation measures for habitat been considered? N/A

a. At these historic cliffs, have surveys to protocol been accomplished for at least 2 years prior to the activities? N/A

4. For traditional cliffs, have surveys/monitoring been conducted to determine nest site occupancy and reproductive status? N/A

b. Has a draft or final site specific management plan been created? N/A

1). Is this plan based on site specific and PNW sub-population nesting ecology? N/A

5. Have the cliffs located been rated or monitored for falcon potential or presence? N/A

6. If cliffs are un-rated, have surveys been accomplished to protocol? N/A

7. Describe site habitat variables within a 3 mile radius of historic and traditional nest sites. (cliff parent material, distance to water/riparian, vegetative habitat, seral stages, human activities) N/A

Gray Wolf

Not applicable. Species not in the State or province.

Grizzly Bear

Not applicable. Species not in the State or province.

Marbled Murrelet (Zone 1 & 2)

Not applicable. The watershed is beyond the Zone 2 boundary.

Abbreviations and Glossary

ABBREVIATIONS

ac.	acres
CFS	cubic feet per second
dbh	diameter at breast height
EA	Environmental Assessment
est.	estimate
LMP	Land and Resource Management Plan (Shasta-Trinity National Forests)
LSR	Late Successional Reserve
n/a	not applicable
NR	nesting and roosting (habitat)
ROD	Record of Decision (from "Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl")
S&M	Survey and Manage
TES	Threatened, Endangered, and Sensitive
WIN	Watershed Improvement Needs (inventory)

GLOSSARY

Abiotic - The non-living material components of the environment such as air, rocks, soil, plant litter, and water.

Accelerated Erosion and Sediment Yield - The increase in erosion and sediment yield above natural levels as caused by human activities.

Aggradation - The up building performed by a stream in order to establish or maintain uniformity of grade or slope.

Alluvial - Deposited by a stream or running water.

Aquatic Ecosystem - A water based ecosystem (see ecosystem). An interacting system of water with aquatic organisms (plants and animals).

Anadromous - Fish that swim from the ocean up streams to spawn.

Beneficial Uses - The range of items directly associated with the flow and distribution of water through a watershed. The uses of the waters of the state that may be protected against quality degradation, including but not necessarily limited to domestic, municipal, agricultural, and industrial supply; power generation; recreation; esthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources of preserves.

Benthic - aquatic related.

Best Management Practice (BMP) - A practice or a combination of practices, that is determined by a State (or designated area-wide planning agency) after problem assessment, examination of alternative practices, and appropriate public participation to be the most effective, practicable (including technological, economic, and institutional considerations) means of preventing or reducing the amount of pollution generated by nonpoint sources to a level compatible with water quality goals.

Biodiversity - see Biological Diversity

Biological Diversity - The variety of life and its processes, including the variety in genes, species, ecosystems, and the ecological processes that connect everything in ecosystems.

Biomass - The total mass (weight, volume) of living organisms in a biological system. The above-ground portions of shrubs and trees, excluding material that meets commercial sawlog specifications.

Biome - A major portion of the living environment of a particular region characterized by its distinctive vegetation and maintained by local conditions of climate.

Bioregion - A system of related, interconnected ecosystems.

Biota - All the species of plants and animals occurring within an area or region.

Biotic - All the plants and animals and their life processes within the planning area.

Biotic Community - Any assemblage of populations living in a prescribed area or physical habitat: an aggregate of organisms which form a distinct ecological unit.

Candidate Species - A species of plant or animal being considered for listing as a federally endangered or threatened species.

Canopy - The more or less continuous cover of leaves and branches collectively formed by the crowns of adjacent trees in a stand or forest.

Canopy Closure - The degree to which the canopy (forest layers above one's head) blocks sunlight or obscures the sky. It can only be accurately determined from measurements taken under the canopy as openings in the branches and crowns must be accounted for.

Catastrophic event - A large-scale, high-intensity natural disturbance that occurs infrequently.

Cemented (embedded)- Under general stream dynamics, fine sediment gets trapped in the interstitial spaces between rocks, especially on spawning sites or riffles. Natural, seasonal flushing flows cleanse trapped fines from the riffle areas allowing little accumulation. However, either a natural or man-made event may add such an excessive amount of fine sediment that natural flows cannot flush the fines from the riffles. Overtime the riffles "harden" or become cemented thereby making them unsuitable for spawning.

Channel (streamcourse) - An open outlet either naturally or artificially created which periodically or continuously contains moving water, or which forms a connecting link between two bodies of water. River, creek, run, branch, anabranch, and tributary are some of the terms used to describe natural channels. Natural channels may be single or braided.

Climax Community - The final or stable biotic community in a successional series which is self-perpetuating and in dynamic equilibrium with the physical habitat.

Colluvium - Any loose and incoherent mass of soil material and/or rock fragments deposited by rainwash, sheetwash, or slow continuous downslope creep, usually collecting at the base of gentle slopes or hillsides.

Community - An aggregation of living organisms having mutual relationships among themselves and to their environment.

Corridor - Route that permits the movement of species from one Ecoregion, Province, landscape or ecosystem to another.

Corridor, Landscape - The landscape elements that connect similar patches through a dissimilar matrix or aggregation of patches.

Crown - The upper part of a tree or other woody plant carrying the main branch system and foliage above a more or less clean stem.

Crown diameter - The diameter of a tree's crown.

Crown Scarp - The outward-facing scarp, bordering the upper portion of a landslide.

Cubic feet per second - the amount of water, in cubic feet, passing a given spot in a stream each second.

Cumulative Effects Analysis - An analysis of the effects on the environment which results from the incremental impact of a proposed action when added to other past, present, and reasonable foreseeable future actions, regardless of what agency or person undertakes such other actions.

Cumulative Watershed Analysis - An analysis of Cumulative Watershed Effects, described below.

Cumulative Watershed Effects - Impacts occurring away from the site of primary development which are transmitted through the fluvial system. The impacts occur through both increases in peak stream flows and through increased sediment levels. The effects generally are concentrated within stream channels which can lead to bank undercutting, channel aggradation, degradation and inner gorge mass wasting.

Debris Torrents - A mass wasting process which results from a debris slide or avalanche entering and flowing down a steep gradient stream channel. As the mass entrains more water, it scours and transports large quantities of organic material and sediment. This material is generally deposited as the channel gradient decreased or a significant obstruction is met. Torrents generally contribute to secondary mass wasting along the margins of the scoured channel.

Debris Slide/Avalanche - A mass wasting process characterized by a relatively shallow failure plane, which generally corresponds to the soil/bedrock interface. The distinction between an avalanche and a slide is that a slide moves slower, and retains more of a coherent slide mass. An avalanche generally fails rapidly, with the slide mass disaggregating, and sometimes flowing, depending on the water content.

Decadence - exhibition of symptoms of decline or decay of overall health or vigor.

Desired Future Condition - Objectives for physical and biological conditions within the watershed. They may be expressed in terms of current conditions, ecosystem potential, or social expectations. They describe the conditions that are to be achieved and are phrased in the present tense.

Diorite - A plutonic rock intermediate in composition between acidic and basic.

Dispersal Habitat - habitat that supports the life needs of an individual animal during dispersal. Generally satisfies needs for foraging, roosting, and protection from predators.

Disturbance - A discrete event, either natural or human induced, that causes a change in the existing condition of an ecological system.

Diversity - The distribution and abundance of plant and animal species and communities in an area.

Dormant Mass Wasting Feature - A landform which can be defined as originating through mass wasting. There are different degrees of dormancy, from a feature which has been active less than 50 years ago, to one which has been dormant for over one thousand years.

Drainage Area - The drainage area of a stream at a specified location is that area, measured in a horizontal plane, which is enclosed by a drainage divide.

Ecological Unit - A mapped landscape unit designed to meet management objectives, comprised of one or more ecological types.

Ecological Classification - A multi-factor approach to categorizing and delineating, at different levels of resolution, areas of land and water having similar characteristic combinations of the physical environment (such as climate, geomorphic processes, geology, soil, and hydrologic function), biological communities (such as plants, animals, microorganisms, and potential natural communities), and the human dimension (such as social, economic, cultural, and infrastructure).

Ecological Processes - see Ecosystem Functions

Ecology - The science of the interrelationships between organisms and their environments.

Ecoregion - A continuous geographic area in which the environmental complex, produced by climate, topography, and soil, is sufficiently uniform to develop characteristics of potential major vegetation communities.

Ecosystem - The complex of a community of organisms and its environment functioning as an ecological unit in nature.

Ecosystem Functions - The major processes of ecosystems that regulate or influence the structure, composition and pattern. These include nutrient cycles, energy flows, trophic levels (food chains), diversity patterns in time/space development and evolution, cybernetics (control), hydrologic cycles and weathering processes.

Ecosystem Processes - see Ecosystem Functions

Ecosystem Management - Using an ecological approach to achieve the multiple-use management of national forests and grasslands by blending the needs of people and environmental values in such a way that national forests and grasslands represent diverse, healthy, productive, and sustainable ecosystems. The careful and skillful use of ecological, economic, social, and managerial principles in managing ecosystems to produce, restore, or sustain ecosystem integrity and desired conditions, uses, products, values, and services over the long-term.

Ecosystem Sustainability - The ability to sustain diversity, productivity, resilience to stress, health, renewability, and/or yields of desired values, resource uses, products, or services from an ecosystem while maintaining the integrity of the ecosystem over time.

Ecotone - A transition between two or more biotic communities.

Ecotype - A locally adapted population of a species which has a distinctive limit of tolerance to environmental factors: a genetically uniform population of a species resulting from natural selection by the special conditions of a particular habitat.

Edaphic - Resulting from or influenced by factors inherent in the soil or other substrate.

Endangered Species - A species which is in danger of extinction.

Endemic - Restricted to a specified region, locality, or attribute of the environment.

Environment - The complex of climatic, soil and biotic factors that act upon an organism or ecological community and ultimately determine its form and survival.

Environmental Change - A shift in the rate or timing of a physical process or a shift in state of physical or biotic character.

Erosion - The group of processes whereby earthy or rock material is worn away, loosened or dissolved and removed from any part of the earth's surface. It includes the processes of weathering, solution, corrosion, and transportation. Erosion is often classified by: the eroding agent (wind, water, wave, or raindrop erosion); the appearance of the erosion (sheet, rill, or gully erosion); the location of the erosional activity (surface, or shoreline); and/or by the material being eroded (soil erosion or beach erosion).

Erosion Hazard Rating - A relative (not absolute) rating of the potential for soil loss due to sheet and rill erosion from a specific site. Commonly used to address erosion response expected from a given land management activity. Ratings are the result of a cumulative analysis of the following factors: soil, topography, climate, and vegetative and protective cover.

Eyrie - A raptor's cliff nest, such as a peregrine falcon.

Exotic Species - Non-native species which occur in a given area as the result of deliberate or accidental introduction of the species from a foreign country.

Fault Zone - A fault that is expressed as a zone of numerous small fractures.

Fauna - All animals, including birds, mammals, amphibians, reptiles, fish and invertebrates (clams, insects, etc.).

Fire Regime - The characteristic frequency, extent, intensity, severity, and seasonality of fires in an ecosystem.

Fragmentation - Breaking up of contiguous areas into progressively smaller patches of increasing degrees of isolation.

Fuel Loading - The amount of combustible material present per unit of area, usually expressed in tons per acre.

Fuels - Any material capable of sustaining or carrying a forest fire, usually natural material, both live and dead.

Gap Analysis - Process to determine distribution and status of biological diversity and assess adequacy of existing management areas to protect biological diversity.

Geologic (or Geomorphic) Province - An area of regional areal extent that is distinguished from adjacent areas by unique bedrock and structural characteristics.

Guild - A group of species that have similar habitat requirements. Can also be known as an assemblage.

Habitat element (component) - A component of wildlife habitat. Snags and hardwoods are examples.

Habitat Type - The collective land area in which one vegetation type is dominant or will come to be dominant as succession advances.

Habitat Connections - A network of habitat patches linked by areas of like habitat. The linkages connect habitat areas within the watershed to each other and to areas outside the watershed. These connections include riparian areas, mid-slopes, and ridges.

High intensity (fire) - A wildfire event with severe ecological impacts; usually but not always of high severity.

Home Range - The geographic area within which an animal travels to carry out its activities.

Impact - A negative environmental change. The value judgement of "negative" is generally construed to mean that conditions or processes are moving away from desired states.

<u>Inpool Cover</u> - Cover for fish within pools provided by undercut banks, submerged vegetation, and submerged objects. Examples include logs, rocks, floating woody material, water depth, and water turbulence.

<u>Integrated Resource Management</u> - The simultaneous consideration of ecological, physical, economic, and social aspects of lands, waters, and resources in developing and carrying out multiple-use, sustained-yield management.

<u>Island Arc</u> - A chain of islands rising from the deep-sea floor and near to the continents.

<u>Issue</u> - Refers to a topic, a subject, a category, or a value which is registered by a person as something in which they have a high level of interest. Used synonymously with the term "concern". Identification of issues can occur through formal solicitation, content analysis of publication and periodicals, or informal communications.

<u>Jurassic</u> - A period of geologic time covering the span of time between 190 to 135 million years ago.

<u>Key Questions</u> - Questions that Watershed Analysis attempts to answer. These are the interdisciplinary team's expectations for the analysis.

<u>Landscape</u> - The mixture of topographic, vegetative, and biologic attributes within an area. An area composed of interacting and interconnected patterns of habitats, that are repeated because of the geology, land forms, soils, climate, biota, and human influences throughout the area. Landscape structure is formed by patches, connections, and the matrix. Landscape function is based on disturbance events, successional development of landscape structure, and flows of energy and nutrients through the structure of the landscape.

<u>Landscape Connectivity</u> - The spatial contiguity within the landscape. A measure of how easy or difficult it is for organisms to move through the landscape without crossing habitat barriers.

<u>Landscape Ecology</u> - The study of spatial and temporal interactions and exchanges across heterogeneous landscapes, the influences of spatial heterogeneity on biotic and abiotic process, and the management of spatial heterogeneity.

<u>Landscape Unit</u> - A continuous geographic area with fairly consistent landform and vegetation communities.

<u>Lentic</u> - A still water aquatic system as in pond or lake.

<u>Linkage</u> - Route that permits movement of individual plant (by dispersal) and animals from a Landscape Unit and/or habitat type to another similar Landscape Unit and/or habitat type.

Lithology - The description of rocks on the basis of such characteristics as color, mineralogy, and grain size.

Lotic - A running water aquatic system as in a stream or river.

Mass wasting - A general term for the dislodgement and downslope transport of soil and rock material under the direct application of gravitational body stresses. In contrast to other erosional processes, the debris removed by mass wasting is not carried within, on or under any other medium. Mass wasting includes many processes, including relatively slow displacement, such as creep, or rapid movement such as rock falls, debris avalanches, or debris torrents.

Melange - A mappable body of rock characterized by the inclusion of fragments and blocks of all sizes, both exotic and native, embedded in a fragmented and generally sheared matrix of more tractable material.

Microclimate - The climate of a particular site or small area, as a cave, forest, or habitat.

Microsite - A rock outcrop, snag, seep, stream pool, and other environmental features small in scale but unique in character.

Montane - Pertaining to or inhabiting mountains.

Monitoring - To watch, observe, or check, especially for a specific purpose, such as to keep track of, regulate, or control.

Multi-aged stand - A forest stand that has more than one distinct age class arising from specific disturbance and regeneration events at various times.

Multi-layered Canopy - Forest stands with two or more distinct tree layers in the canopy; also called multi-storied stands.

Natural Range of Variability- The spectrum of conditions possible in ecosystem composition, structure, and function considering both temporal and spatial factors.

non-system road(s)- forest roads which are not maintained or serviced regularly, and that are not considered part of the official road network.

Obligate - Restricted to one particular attribute of habitat or life cycle.

Peak Streamflows - The highest level of streamflow in response to a rainstorm or period of snow melt.

Peridotite - A coarse grained, ultramafic plutonic rock composed chiefly of olivine.

Phyllite - A metamorphosed rock, intermediate in grade between slate and mica schist.

Physical Process - The rate and timing of the interaction of biotic and abiotic ecosystem components.

Plant Association - A potential natural plant community of definite floristic composition and uniform appearance. The lowest level of potential natural community classification.

Pool/riffle ratio - The ratio of surface area or length of riffles in a given stream reach.

Population - A group of individuals of a species living in a certain area. They have a common ancestry and are much more likely to mate with one another than with individuals from another area.

Potential Natural Community - The biotic community that would be established if all successional sequences of its ecosystem were completed without additional human-caused disturbances under present environmental conditions. Grazing by native fauna, natural disturbances such as drought, floods, wildfire, insects, and disease, are inherent in the development of potential natural communities which may include naturalized non-native species.

Plutonic - Igneous rocks formed at great depth.

Pool Frequency - The number (occurrence) of pools or a certain size pool within a general or selected stream reach.

Proposed Species - Any species that is proposed in the Federal Register to be listed as threatened or endangered.

Province - A continuous geographic area wherein species composition, both plant and animal, is more homogeneous than between adjacent areas.

Range of Variability (Natural Variability, Historic Variability) - The spectrum of conditions possible in ecosystem composition, structure, and function considering both temporal and spatial factors.

Rehabilitation - Returning of land to productivity in conformity with a prior land use plan, including a stable ecological state that does not contribute substantially to environmental deterioration and is consistent with surrounding aesthetic values.

Resilience - The ability of an ecosystem to maintain diversity, integrity and ecological processes following disturbance.

Restoration - The process of restoring site conditions as they were before a land disturbance.

Riparian Ecosystem - Ecosystems transitional between terrestrial and aquatic ecosystems. Streams, lakes, wet areas and adjacent vegetation communities and their associated soils which have free water at or near the surface.

Riparian Reserve - The area which encompasses streams, lakes, and wetlands and is designed to protect aquatic and riparian functions and values. The Riparian Reserve is a function of site characteristics, physical processes linked to the area, and the type and timing of activity proposed.

River Basin - An area, defined by physical boundaries, in which all surface water flows to a common point. River basins are associated with large river systems and are typically 1000s of square miles in size.

River Basin Analysis - The collection and organization of aquatic and fisheries issues and processes or condition, at a scale greater than watershed analysis.

Schist - A strongly foliated rock, formed by metamorphism, that can be readily split into thin flakes or slabs due to the well developed parallelism of the minerals present.

Sediment - Fragmental material that originates from weathering of rocks and is transported by, suspended in, or deposited by water or air or is accumulated in beds by other natural agencies.

Sensitive Species - A species not formally listed as endangered or threatened, but thought, by a Regional Forester in the USDA Forest Service, , to be at risk.

Seral - A biotic community which is a developmental, transitory stage in an ecologic succession.

Seral Stage - A biological community viewed as a single developmental or transitional stage in an ecological succession.

Serpentinite - A rock high in iron-magnesium content. Commonly green, greenish yellow, or greenish gray and often veined or spotted with green and white.

Shear Zone - A tabular zone of rock that has been crushed and brecciated by many parallel fractures due to shear strain.

Shrub - An upscale term for brush.

Site - An area described or defined by its biotic, climatic, and soil condition as related to its capacity to produce vegetation; an area sufficiently uniform in biotic, climatic, and soil conditions to produce a particular climax vegetation.

Soil Map Units - Groupings of soils that are too intricately mixed to be mapped discretely at the scale of soils survey mapping being conducted.

Soil Series - Soils of discrete, relative uniform and repeatable character.

Spawning Sites - Gravelled areas within a stream system having the appropriate attributes, i.e., dissolved oxygen, water depth, water velocity, water temperature, substrate composition, and cover that are selected as suitable for spawning by adult fish.

Species Richness - A component of community species diversity that is expressed by simple ratios between total number of species and importance values (such as numbers, biomass, productivity)

Stochastic - Random or uncertain variation.

Stand - A community of trees occupying a specific area sufficiently uniform in composition, age arrangement and condition distinguishable as a silvicultural of management unit. Typically, stand sizes vary from about 5 to over 30 acres on National Forest System lands.

Stand replacing wildfire - a wildfire that kills nearly 100% of the stand involved.

Stratification - The delineation of areas within a watershed which will respond relatively uniformly to a given process or set of conditions.

Stream Order - A method of numbering streams as part of a drainage basin network. The smallest unbranched mapped tributary is called first order, the stream receiving the tributary is called second order, and so on. It is usually necessary to specify the scale of the map used. A first-order stream on a 1:62,500 map, may be a third-order stream on a 1:12,000 map. Tributaries which have no branches are designated as of the first order, streams which receives only first-order tributaries are of the second order, larger branches which receive only first-order and second-order tributaries are designated third order, and so on, the main stream being always of the highest order.

Streamside Management Zone - A designated zone along streams and wetlands which acts as an effective filter and absorbtive zone for sediment; maintains shade; protects aquatic and terrestrial riparian habitat; protects channel and streambanks; and keeps the floodplain surface in a resistant, undisturbed condition to limit erosion by floodflows.

Succession - An orderly process of biotic community development that involves changes in species, structure and community processes with time. It is reasonably directional and therefore, predictable.

Suitable Habitat - An area of forest vegetation with the age-class, species of trees, structure, sufficient area, and adequate food source to meet some or all of the life needs of the northern spotted owl.

Sustainability - The ability to sustain diversity, productivity, resilience to stress, health, renewability, and/or yields of desired values, resource uses, products, or services from an ecosystem while maintaining the integrity of the ecosystem over time.

Tectonic - Regional assembling of structural features or the forces involved there in, by crustal dynamics of the earth's surface.

Terrestrial - Living primarily on land rather than in water.

Terrestrial Ecosystem - An interacting system of soil, geology, topography with plant and animal communities.

Threatened Species - A species which is likely to become an endangered species.

Threshold of Concern (TOC) - Used in cumulative watershed effects analyses to describe the point (in terms of percent equivalent road area) where the risk of watershed degradation is significant if mitigation measures are not employed.

Transient Snow Zone - The area between 2,500 and 5,000 feet elevation subject to rain-on-snow events during winter months.

Translational-Rotational Landslides - This type of mass wasting feature is characterized as having a planar failure surface which generally parallels the ground surface (translational), or a failure surface which is circular about an imaginary axis located above the ground surface (rotational). In practice, there is a gradation between the two features; different portions of a landslide complex can either be translational or rotational in character. These types of features generally have low to moderate movement rates.

Ultramafic - Said of an igneous rock having a silica content lower than that of a basic rock.

Underburning - The prescribed use of fire beneath a forest canopy.

Understory - The lower layer of trees and shrubs under the forest canopy.

Valley Inner Gorge - A zone with slopes adjacent to stream channels, having slope gradients greater than 65%, which are separated from the upslope area by a distinctive break in slope. Valley inner gorges are formed by mass wasting and therefore are noted for their instability.

Viability - The likelihood of continued existence in an area for some specified period of time.

Watershed - A region or area bounded peripherally by a water parting feature and draining ultimately to a particular watercourse or body of water. There are many watersheds within a river basin. Watershed areas range from 20 to 200 square miles in size.

Watershed Analysis - Development and documentation of a scientifically based understanding of the processes and interactions occurring within a watershed in order to make more sound management decisions.

Watershed Product - Terrestrial ecosystem components that move in the fluvial system: water, sediment, chemicals, organic debris, and heat.

Weir - An obstruction placed across a stream thereby causing the water to pass through a particular opening.

Wetland - An area at least periodically wet or flooded: an area where the water table stands at or above the land surface.