

Redband Trout Conservation Agreement

Shasta-Trinity National Forest

1998

CONSERVATION AGREEMENT

Upper McCloud River Redband Trout

Oncorhynchus mykiss ssp.



Non Discrimination Statement

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotope, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410, or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Table of Contents

I. PURPOSE	1
II. INVOLVED PARTIES/SIGNATORIES TO THIS AGREEMENT	2
III. AUTHORITY.....	3
IV. OBJECTIVES OF THIS CONSERVATION AGREEMENT	3
V. DURATION OF THIS AGREEMENT	3
VI. BACKGROUND.....	4
VII. GOVERNING DOCUMENTS AND EXISTING POLICIES	6
VIII. STATUS AND DISTRIBUTION OF THE SPECIES	8
IX. PROBLEMS FACING THE SPECIES	15
X. CONSERVATION ACTIONS THAT WILL BE CARRIED OUT.....	24
XI. MONITORING	33
XII. MITIGATION PLAN AND PROTOCOL FOR FUTURE ACTIVITIES.....	34
GLOSSARY.....	37
REFERENCES.....	40
APPENDIX A: Aquatic Conservation Strategy.....	42
APPENDIX B: Forest Practice Rules and Regulations	50
APPENDIX C: California Water Code and California Department of Fish and Game	60
APPENDIX D: Completed Habitat Surveys and Genetic Studies for McCloud River Redband Trout	68

I. PURPOSE

This Conservation Agreement has been prepared to provide for genetic integrity, secure populations and long-term viability of the upper McCloud River redband trout (McCloud redband) while respecting existing land uses, resource uses, and private property rights and while providing for angling and other recreational opportunities. The purpose of this document is to provide specific direction that will conserve this species and reduce or remove the threats that could cause it to be listed as threatened or endangered. This will be done through an adaptive management process of implementing, monitoring and adjusting conservation measures by the Upper McCloud River Redband Trout Core Group (Redband Core Group). The Redband Core Group is a collection of agency and private landowner representatives charged with the management and protection of the McCloud redband trout. The group was established in 1994 when the trout was recommended for elevated listing status. The goal of the Redband Core Group is to minimize or remove threats in order to promote the recovery of McCloud redband and reduce the likelihood that McCloud redband would require listing under the Endangered Species Act of 1973, as amended.

Signatories to this Conservation agreement agree to implement the conservation and monitoring actions specified herein. The threats listed in this strategy do not necessarily reflect the views of all signatories to this agreement.

II. INVOLVED PARTIES/SIGNATORIES TO THIS AGREEMENT

RECEIVED
DEC 01 1998
SACRAMENTO
FISH & WILDLIFE OFFICE

II. INVOLVED PARTIES/SIGNATORIES TO THIS CONSERVATION AGREEMENT

United States Department of the Interior
U.S. Fish and Wildlife Service - Sacramento Fish
and Wildlife Office

Represented by: 
(Wayne White, Field Supervisor)

3310 El Camino Avenue, Suite 130
Sacramento, California 95821-6340

United States Department of Agriculture
U.S. Forest Service
Shasta-Trinity National Forest

Represented by: 
(Sharon Heywood - Forest Supervisor)


2400 Washington Avenue
Redding, California 96001

The Resources Agency
California Department of Fish and Game

Represented by: 
(Donald B. Koch - Regional Manager)

601 Locust Street
Redding, California 96001

John Hancock Mutual Life Insurance Company
By Hancock Natural Resource Group Inc. Its
Investment Manager

Represented by: 
(Wayne Marion - Manager of Wildlife Resources)
Post Office Box 687
McCloud, California 96057-0687

Sierra Pacific Industries

Represented by: 
(Herb Baldwin - District Manager)

Post Office Box 496014
Redding, California 96049-6014

Mr. Bob McIntosh
Private Landowner

Represented by: 
(Bob McIntosh - Landowner)

Post Office Box 598
McCloud, California 96057-0598

The Hearst Corporation

Represented by: 
(Brennan Zepke - Hearst Corporation)

Post Office Drawer 295
Mt. Shasta, California 96067-0295

Siskiyou County Board of Supervisors

Represented by: 
(Kaye Bryan - Board Chairperson)

311 Fourth Street
Yreka, California 96097

III. AUTHORITY

The authorities for these agencies and other groups to enter into this voluntary Conservation Agreement derive from the following: the Endangered Species Act of 1973, as amended; and a National Memorandum of Understanding which exists between the USFS, the United States Department of the Interior Fish and Wildlife Service (USFWS), Bureau of Land Management (BLM), National Park Service (NPS), and the United States Department of Commerce National Marine Fisheries Service (NMFS).

The National Memorandum of Understanding (MOU # 94-SMU-058) among the participating agencies is for conservation of species that are tending toward Federal listing as threatened or endangered under the Endangered Species Act. Implementation of this agreement will be through existing Federal and State authorities such as the Clean Water Act, California Forest Practices Act, National Forest Management Act (NFMA), Federal Land Policy and Management Act (FLPMA) and National Environmental Policy Act (NEPA).

IV. OBJECTIVES OF THIS CONSERVATION AGREEMENT

- A. To maintain and enhance habitat for the McCloud redband
- B. To maintain genetic viability of the McCloud redband
- C. To provide specific direction for how each of the involved parties will contribute to the above
- D. To gain the mutual cooperation and commitment of all parties involved for the protection and conservation of the McCloud redband
- E. To minimize or remove threats in order to promote the recovery of McCloud redband and reduce the likelihood that McCloud redband would be listed under the Endangered Species Act of 1973, as amended

V. DURATION OF THIS AGREEMENT

The duration of this Conservation Agreement is for five years following the date of the last signature. Annually, the parties involved will review the Agreement and its effectiveness to determine whether it should be revised. By the fifth year, the Conservation Agreement must be reviewed and either modified, renewed, or terminated.

Any party may withdraw from this Agreement on sixty (60) days written notice to the other parties.

In February of every year during the Agreement the California Department of Fish and Game (CDFG) will convene a meeting of representatives of each signatory to the Conservation Agreement for an annual review of the agreement.

In cooperation with and approval by all involved parties, the CDFG will complete an annual report describing the status of the species, actions accomplished during the year, and goals for the ensuing year.

VI. BACKGROUND

A. AREA DESCRIPTION - The upper McCloud River watershed encompasses approximately 574 square miles and is characterized by a mix of relatively flat to mountainous terrain. The basin lies mostly within Siskiyou County, California (Figure 1). The upper river flows generally westerly for approximately 24 miles from its origin near Colby Meadows to Middle Falls. Elevations range from 6,224 feet at Mushroom Rock to 2,905 feet at Middle Falls. The landownership pattern is mixed with approximately 40 percent in private holdings and 60 percent Federal. Timber management is the predominate land use. The vegetation type is primarily second growth mixed-conifer and white fir-ponderosa pine forests. Portions of the upper river basin are grazed on an annual basis. There are many recreational uses in the area including fishing, camping, hunting, hiking, mountain biking, mushroom picking and, in the winter, snowmobiling and cross country skiing.

B. SOILS AND GEOLOGY - The majority of the land area lies to the north of the river and consists of very gently sloping, recent lava flows and outwash deposits from Mt. Shasta and the Medicine Lake Volcano. This portion of the basin has very limited surface water and features only one perennial tributary to the McCloud River. The southern portion of the drainage is a smaller area but contributes most of the surface flows into the river.

From the headwaters near Colby Meadow to the confluence of Cow Creek, the river flows across a broad, gently sloping, tertiary (i.e., relatively older) lava flow. The river crosses tertiary lava flows from the headwaters to a point near the confluence of Raccoon Creek. All of the basin south of the river is also underlain by tertiary lava flows. The terrain is gently to moderately sloping with numerous intermittent and perennial streams. Soils on these lava flows are typified by ashy, sandy loams over very gravelly sandy clay loams and exhibit Douglas-fir/mixed conifer forests.

Beyond Curtis Meadow, the river returns to tertiary flows to a point near the confluence of Raccoon Creek where recent, gently sloping lava flows and outwash deposits from Mt. Shasta abut the tertiary upland to the south. The McCloud River follows a course along this contact all the way to Lake McCloud. The lava flows are very recent and have limited soil development. The outwash deposits and terraces from Mud Creek are typified by deeper, very sandy soils. Both soil types support a Ponderosa pine forest with an understory component of bitterbrush.

C. RECREATIONAL ANGLING - Historically, many anglers came to the upper McCloud River to camp, fish and enjoy the outdoors. Numerous children and adults caught the hatchery-stocked trout. Angling success was largely dependent on the regular summer season stocking of hatchery trout in the main stem McCloud River at numerous access points. However, this opportunity to catch hatchery fish above Middle Falls no longer exists due to the restrictions on the stocking of non-indigenous hatchery fish above Middle Falls. This restriction was imposed to eliminate the potential for hybridization between the hatchery fish and native McCloud redband

trout. Without the regular summer stocking of hatchery trout, many anglers including children catch few trout and angler use has been much reduced.

The cessation of stocking of hatchery trout in the upper McCloud above Middle Falls is believed to have also reduced other recreational uses such as camping along the upper river which, in turn, has affected the local economy. For example, steady annual increases in visitor use at Fowlers Campground was noted through 1995, a year in which a peak of 13,100 recreational visitor days (RVDs) was recorded (Ed Hatakeda, personal communication.). Fowlers Campground is a popular camping site and was used by anglers who fished the entire upper river when it was stocked with hatchery trout. By 1996, (the second year following the cessation of the stocking of hatchery trout) RVDs at Fowlers Campground decreased significantly to 8,300 recovering only partially to 9,400 RVDs in 1997 [US Forest Service memo dated January 8, 1998, from Ed Hatakeda (Recreation Forester) to Joe Zustak (Fishery Biologist)]. The decline in use of Fowlers Campground is believed to be a result of the cessation of stocking of the upper river even though stocking still takes place in proximity to the campground.

The heaviest angling and recreational activities have been on the main stem of the upper river while tributary streams and those isolated from the river in the upper McCloud River basin have experienced very limited angling activities even before hatchery stocking was terminated in 1994. The tributaries have not been stocked with hatchery trout in recent years except for Trout Creek which was last stocked in 1976. A one-quarter mile section of the main stem McCloud River at Fowlers Campground between Lower Falls and Middle Falls plus Lake McCloud Reservoir located approximately 8 miles below Upper Falls continue to receive annual stocking of catchable trout from State hatcheries.

D. FISH AND WILDLIFE RESOURCES - The river and its associated riparian area provides habitat for over 200 wildlife species. Seventeen of these have been identified as species of special concern . This designation denotes that these species have been placed on one or more of the following lists: Federal or State threatened or endangered species; species that are proposed or are candidates for listing as threatened or endangered; survey and manage species as identified by the United States Department of Agriculture Forest Service (USFS) Record of Decision (ROD), State species of concern; or finally, USFS sensitive (Table 1). While these species are not part of this Conservation Agreement, they may potentially benefit from the proposed actions.

There are five fish species found within the upper river above Middle Falls but only one native species, the upper McCloud River redband trout (*Oncorhynchus mykiss* ssp.; McCloud redband, henceforth). McCloud redband is the only fish species in the upper McCloud River basin presently designated as a candidate species for listing under the Federal Endangered Species Act and is listed by the State as a "Species of Special Concern". The nonnative trout in the basin are a result of hatchery introductions that began in the late 1800s and include coastal rainbow trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta*), and brook trout (*Salvelinus fontinalis*). A single golden shiner (*Notemigonus crysoleucas*) has been found in the impoundment behind Lakin Dam.

The native redband trout in the upper McCloud River drainage are thought to be a relict subspecies of non-anadromous rainbow trout adapted to harsh, fragmented environments. The

phylogenetic position of the McCloud redband with *Oncorhynchus mykiss* has been the subject of debate for over 50 years. In 1994, due to concerns regarding hybridization with hatchery fish, habitat reduction during an extended drought, and potential hydropower development, the McCloud redband was listed as a Category 1 species under the Endangered Species Act (Federal Register, Vol. 219, Nov. 15, 1994, page 58982). In 1995, Category 1 designation was changed to "Candidate" (Federal Register, Vol. 61, February 28, 1996, page 7596). This change was not a change in status but a change in nomenclature only. Presently, this fish is believed to be restricted to several small streams in the upper river basin as well as to the main stem of the McCloud River above Middle Falls.

There is some uncertainty regarding the status of redband trout as a listable taxonomic unit under the Endangered Species Act. Largely, this is a question of whether populations of McCloud redband persist which are genetically distinct from hatchery rainbow. Molecular genetics investigations in progress may provide guidance to resolve this issue. To the extent that the disagreement arises over the definition of "distinct population segment," resolution of the issue may be more elusive.

Table 1. Species of Special Concern within the Upper McCloud River Basin

Species	Status
Pacific fisher	USFS sensitive (Federal)
Pacific western big-eared bat	Species of concern (Federal)
Pallid bat	Survey and manage (Federal)
California wolverine	Species of concern (State)
Silver-haired bat	Survey and manage (Federal)
Northern spotted owl	Threatened (Federal)
Bald eagle	Threatened (Federal)
Willow flycatcher	USFS sensitive (Federal)
Northern goshawk	USFS sensitive (Federal)
North Western pond turtle	USFS sensitive (Federal)
Cascade frog	Species of concern (State)
Foothill yellow-legged frog	USFS sensitive (Federal)
Redband trout	Candidate species (Federal)
Tailed frog	Species of concern (State)
Western spadefoot toad	Species of concern (State)
Juga sp. snail	Survey and manage (Federal)
Fluminicola sp. snail	Survey and manage (Federal)

VII. GOVERNING DOCUMENTS AND EXISTING POLICIES

A. Management Practices on Federal Lands - The Shasta-Trinity Land and Resource Management Plan and the ROD govern USFS land management activities. The Aquatic Conservation Strategy (Appendix A) within the ROD establishes the guidelines for management direction regarding riparian areas on Federal lands. The Aquatic Conservation Strategy strives to maintain and restore ecosystem health at watershed and landscape scales to protect habitat for fish and riparian dependent species and resources within these riparian area reserves.

B. State Policies and Regulations that Protect Fish and Fish Habitat

1. Management Practices on Private Forest Lands - Originally, instituted under the auspices of the Z'berg-Nejedly Forest Practice Act of 1973, the Forest Practice Rules (FPRs), in current amended form, are considered the most stringent protection measures in the nation governing the management of privately owned forest lands. The FPRs have been evolving over the last 23 years in response to more stringent environmental considerations. This has resulted in numerous rule changes during that time and additional future restrictions are possible if the need is demonstrated. Protection standards embodied in the FPRs are designed for all resources at risk related to logging operations. Measures designed to protect (and in some cases "restore" and "enhance") soil productivity, air and water quality, fisheries, wildlife (including rare, threatened and endangered species) long-term timber production, archaeological and historic sites are all addressed by these rules and the timber harvesting plan review process. Due to the variety of individual circumstances of timber harvesting in California the rules are not strictly prescriptive. Opportunities to increase protection, if necessary, exist based on site-specific circumstances.

The California Forest Practice Rules contain resource protection requirements via two avenues. First they set prescriptive standards for minimum protection levels for all activities. These are then used as a floor for additional site-specific mitigations, which the Registered Professional Forester and the multidisciplinary review team must agree will culminate in a project that does not result in a significant adverse impact to any forest resource.

For a more detailed discussion of the Forest Practices Act and the provisions for protecting aquatic resources see Appendix B.

2. Fish Stocking Policy - The California Fish and Game Commission (CFGF) also develops policies that provide guidance to the CDFG. One such policy of the CFGF states in part that: "...Hatchery trout shall not be stocked in waters where they may compete or hybridize with trout which are threatened, endangered or species of special concern. Exceptions may be made for stocking waters which are not part of a species recovery program...." This policy was the impetus for the action taken by the CDFG in 1994 to terminate the stocking of hatchery trout in the upper McCloud River above Middle Falls.

3. Angling Regulations - Fish and Game Code (FGC) Section 200 empowers the CFGF to regulate the taking or possession of fish in California whether on public or private land through the adoption of State angling regulations. These regulations are reviewed every other year to determine if they are protective of the fishery resources of State waters and are changed by the CFGF, when warranted, to protect fish populations requiring protection. The Fish and Game Commission also adopts supplementary regulations each year to make changes that cannot wait for the every other year cycle. This authority was used in 1995 to reduce the threat of angling harvest on putative McCloud redband populations in Moosehead and Sheepheaven creeks which were believed to be at extremely low numbers following several years of below average precipitation. Under authority of Article 1.5. (FGC Section 240) angling regulations may also be adopted or repealed at any time by the CFGF under either set of the following criteria:

- a. when such action is necessary for the immediate conservation, preservation, or protection of fish, including their nests (redds) or eggs.
- b. when such action is necessary for the immediate preservation of the public peace, health and safety, or general welfare.

4. Habitat Protection - Although not specifically targeted for McCloud redband, State laws exist which provide for the protection of McCloud redband and their habitat on private lands. Specifically, these FGC sections deal with maintaining adequate stream flows for fish below dam structures (FGC Section 5937), maintaining unimpeded stream access for fish (FGC Section 5901) and helping to ensure that water quality is protected in California's lakes and streams (FGC Sections 1600-1607, 5650 and 5652) (Appendix C). The regulatory mandates prescribed in the 1600 series FGC sections allow for the California Department of Fish and Game (CDFG) to exercise a level of control over any private and public projects that occur within the normal high-water mark of lakes and streams. For example, FGC Sections 1601 and 1603 require a project proponent to enter into a legally binding agreement with the CDFG wherein the CDFG usually prescribes mitigations including time restrictions intended to eliminate or reduce the threat to water quality parameters including turbidity, settleable solids, and temperature through the protection of riparian vegetation and ensuring streambank and channel stability. Several State Water Codes also exist that provide for the protection of water quality which benefits all fish including McCloud redband. The following FGC sections apply: 1243, 6500, 6501, 7047, 11901, 12845, 12846, and 13140-13147. Others may also apply.

VIII. STATUS AND DISTRIBUTION OF THE SPECIES

A. Origin of the Species Name - In an 1885 report to US Fish Commissioner of Fish and Fisheries, Deputy US Fish Commissioner Livingston Stone used the name "red-banded trout" to describe trout of the lower McCloud River. The term "red-banded trout" was also used by trout taxonomist Dr. Robert Behnke of Colorado State University when he originally studied and reported on native trout of the upper McCloud River in 1973. Mr. David Hoopaugh, a former District Fisheries Biologist for the CDFG, is believed to be the first to use a modified version of the term red-banded trout when he used the term "red-band trout" in his 1974 status report on trout native to the upper McCloud River basin (Eric Gerstung, Associate Fishery Biologist, California Department of Fish and Game , personal communication).

B. Systematics - In general, redband trout constitute a special group of yet undescribed native western North American trout of the genus *Oncorhynchus*. The phylogenetic position of the McCloud redband within *O. mykiss* has been debated for over 50 years beginning with the first discovery of what was reported as a southern Sierra golden trout by Wales (1939) based only on external appearance. Several contemporary geneticists, using electrophoretic genetic analyses, have indicated that McCloud redband appear to be a non-anadromous rainbow trout (*Oncorhynchus mykiss*) of ancient coastal origin which has adapted to harsh, fragmented environments (Behnke 1992, Berg 1994). Recent preliminary investigations (Nielsen, et al., 1996) using microsatellite and mitochondrial DNA sequencing infer not only a close genetic affinity with contemporary coastal trout and steelhead but also with Rio Santo Domingo trout and Little Kern golden trout. However, additional microsatellite loci and trout populations need

to be analyzed to confirm these preliminary results and relationships better described between different upper McCloud River populations and introduced hatchery strains of rainbow trout. Despite the current ambiguity of its phylogenetic or taxonomic status, the McCloud redband is currently classified as a Species of Special Concern by the California Department of Fish and Game.

Much confusion and debate remains regarding the systematics of the McCloud redband. The exact relationship that McCloud redband share with coastal trout, steelhead, golden trout, and redband trout populations from other drainages may never be fully understood since it is unknown whether a genetically pure indigenous population of McCloud redband actually exists. Berg (1994) indicated his concern that the introductions, by stocking, of hatchery rainbow trout strains within the upper McCloud River drainage may have led to some degree of genetic introgression with indigenous trout within the upper McCloud River basin. His concern, which, in part, has prompted the current candidate species status of McCloud redband, has not been validated with the recent preliminary genetic findings (Nielsen et al., 1996). Current belief is that the genetic makeup identified in some of the putative redband populations in the upper McCloud River basin may be sufficiently unique to warrant their protection and conservation. However, as of June, 1998, further studies to determine which of the remaining population segments (some of which are usually isolated from main stem populations by barriers or naturally dry stream channels) are unique versus hybridized with introduced hatchery strains are pending completion.

C. Distribution (Historic and Current) - Wales, in 1939, reported golden trout (generally believed now to be a reference to McCloud redband) present in the headwaters of Tate Creek and from a short, spring-fed creek on Black Fox Mountain, possibly Edson or Sheepheaven Creek. Redband trout have also been reported in isolated tributaries of Goose Lake and in the headwaters of the Pit and Klamath rivers, California (Moyle, 1976). Behnke (1979) suggested that the redband trout was originally native throughout much of the interior reaches of the Columbia River basin, in most of the lakes of the current desert basins of Oregon, in the upper Klamath Lake region and in the Sacramento River drainage including the McCloud River. The upper McCloud redband trout is now believed to be genetically distinct from other redband trout populations in eastern Oregon and northeastern California (Hoopaugh, 1974; Gall, 1981).

In response to drought conditions in 1973 and 1974, the CDFG introduced putative McCloud redband from Sheepheaven Creek into Swamp Creek which was thought to be devoid of fish. In 1977, again in response to severe drought conditions which seemed to threaten the population in Sheepheaven Creek, CDFG chemically treated Trout Creek to kill all fish and restocked it with McCloud redband trout from Sheepheaven Creek.

Beginning in 1978, Dr. Graham Gall and research associates from the University of California at Davis analyzed putative redband trout collected from Tate, Moosehead, Swamp, Trout, Sheepheaven, Raccoon, and Edson creeks within the upper McCloud River system. The analysis compared meristic, chromosomal and electrophoretic traits. The report to the CDFG Threatened Trout Committee stated that the upper McCloud River populations from each system had many characteristics in common with each other but differed from other redband populations including those found at Goose Lake and Pit River, and from Kern River golden trout, plus Kern River and coastal rainbow trout.

Based on survey work by CDFG, USFS and Sierra Pacific Industries from 1978 through 1995, streams which currently contain putative McCloud redband include Trout, Swamp, Edson, Sheepheaven, Blue Heron, Tate, Bull, Moosehead, Dry and Raccoon creeks and the main stem McCloud River above Middle Falls (reference map, Figure 1). For the purposes of this document, these streams should be considered the current range of the McCloud redband.

Within the upper McCloud River drainage, populations in Sheepheaven, Trout, Edson and Swamp creeks are generally isolated from the main stem McCloud River. In the infrequent years when these four streams flow into the main stem river, lack of a defined channel makes fish passage improbable and these populations are, therefore, unlikely to have been affected by hybridization with hatchery fish from the main stem. Swamp Creek was believed to be fishless prior to the introduction of McCloud redband in 1977. If natural circumstances resulted in this fishless condition, the possibility exists that a similar set of circumstances may reestablish a fishless stream.

Trout Creek had been stocked with hatchery trout prior to treatment in 1977 but has not been stocked with hatchery trout since the posttreatment reintroduction of putative McCloud redband from Sheepheaven Creek. Much of the main stem McCloud River and tributaries from the south have established populations of brook and brown trout which appear to have displaced McCloud redband in portions of the main stem McCloud River and some south side tributaries.

A definitive description of the current range of redband is complicated by the inability to clearly identify the extent to which McCloud redband may be hybridized with hatchery strains of rainbow, or its relationship to other populations of interior rainbow trout. This is the case for three reasons:

1. Meristic, protein electrophoresis and molecular systematic descriptions of McCloud redband, to date, provide conflicting information to describe distinct, identifiable population(s) of redband trout in the upper McCloud River basin and those, if any, that are hybridized with rainbow;
2. An informal sampling of streams in the upper McCloud River basin has been conducted to determine those streams bearing *O. mykiss*, redband or otherwise. However, without a clear understanding of how to distinguish a putative redband from other *O. mykiss*, and without a rigorous sampling design to determine absence, precise descriptions of historic or current range are not available.
3. Some McCloud redband populations appear to be of a different genotype from other populations within the upper McCloud River basin based on the preliminary microsatellite analysis although no barriers exist which would prevent these populations from mixing with or interbreeding with other McCloud redband populations within the upper McCloud River. For example, some upper McCloud River basin tributary streams went totally dry and were therefore fishless for some period of time during the most recent extended drought period and now contain "new" McCloud redband populations which could only have been established from putative redband of the main stem McCloud or one of the McCloud River's tributaries. Yet, these newly established populations may be genetically different from all

other populations within the upper McCloud River basin based on a preliminary analysis of a portion of the samples collected using a limited number of DNA microsatellites; more rigorous sampling and analysis that is currently under way may help to resolve these issues.

D. Habitat and Life History - No formal biological study has yet been undertaken regarding the life history or ecology of the McCloud redband; however, some observations have been made.

1. Habitat: The following habitat information is based on stream habitat typing data collected by the USFS in 1990 and the CDFG in 1995 (Appendix D). This information is general in nature and does not reflect the degree of variability that exists within many of the streams surveyed. Note that the years in which this data was collected included several years of below average precipitation and may not reflect average habitat conditions.

Within the smaller streams such as Raccoon Creek, Moosehead Creek, Sheepheaven Creek, Edson Creek and the upper McCloud River's south side tributaries, redband trout habitat was limited by stream size, steep gradient, or low stream flows. Riffles and flatwater habitats such as glides and runs were the most abundant habitat types. Pools were uncommon and usually shallow, often less than a foot in depth. Instream cover was generally poor. Fish habitat associated with large woody debris was uncommon though, when present, provided good cover and stream depth. The stream substrates were dominated by gravel, cobble, and fine sediments. Bedrock was usually absent. Though gravel was abundant, habitat suitable for spawning was uncommon and generally contained a significant amount of fines. Fish habitat condition was considered poor to fair based on generally accepted standards used to describe rainbow trout habitat.

Within the medium-sized and larger streams such as Tate Creek, Trout Creek, and the upper McCloud River, there was a good mix of pools, riffles, and flatwater habitat types. Pools were common and averaged more than a meter in depth. Cover was generally good throughout the range of habitat types. Spawning habitat was common, however, the percent fines and embeddedness levels were highly variable. Habitats associated with large woody debris were more abundant than within the smaller streams and generally provided the best fish habitat. Stream substrates were dominated by cobble, gravel, and boulders. Bedrock was common in the McCloud River. Fish habitat condition in general was good.

2. Reproduction: Like rainbow trout, McCloud redband appear to be spring spawners requiring riffles or runs with gravel substrate in which to spawn (Hoopaugh, 1974). Putative McCloud redband (4-7 inches) were observed spawning in a run pool habitat complex at the head of a small gravel bar in Edson Creek in early June with the females observed excavating their redds in clean pea-sized and finer gravel (Bacon, et al., 1980). A redd located in pea-size and smaller gravels was also noted in Sheepheaven Creek on June 15, 1994, during a field trip excursion involving members of the upper McCloud River Redband Core Group (Redband Core Group) (Julie Kelley, personal communication). Data collected in 1978 from eight upper McCloud River basin streams showed temperatures ranging from 45-500F (7-100C) and is reported by Bacon, et al. (1980). Average daily water temperatures during June and July of 1994-1995 on three of those streams (i.e., Trout, Swamp and Sheepheaven creeks) ranged from 41-570F (SPI file data) and for June 1994 ranged from

44.5-45.80F (6.9-7.70C; SPI file data).

3. Rearing and Cover: Newly emerged fry and juveniles appear to prefer the relatively low velocity, protected, shallow margins of streams. Juveniles, believed to be young-of-the-year ranging in size from 2-2.3 inches in fork length, were electroshocked from stream margins in Trout Creek in 1978. The stream substrate composition noted in these margin areas was fine gravel. During tissue collection sampling activities on the upper McCloud River near Tate Creek during late summer 1997, juvenile and adult putative McCloud redband were also found primarily in shallow, margin areas dominated by small gravel substrate (Dennis Maria, Fisheries Biologist, CDFG, personal observation).

4. Age and Growth: Putative redband trout ranging in age from 1 to 4 years were captured from six upper McCloud River tributary streams during August 1975 (from Bacon, et al., 1980). Mean standard lengths versus age class data taken from 222 putative McCloud redband captured from five of the six streams surveyed (i.e., Tate, Trout, Sheepheaven, Moosehead, Edson, and Swamp creeks) are presented in Table 2.

Table 2. Age class composition of McCloud redband from five upper McCloud River tributaries (from Bacon, et al., 1980)	
Age (Years)	Mean Standard Length (Range)
I	97 - 138mm (3.9 - 5.5 in)
II	123 - 166mm (4.9 - 6.6 in)
III	134 - 194mm (5.3 - 7.8 in)
IV	140 - 222mm (5.6 - 8.9 in)

5. Population Information - Within the upper McCloud River drainage above Middle Falls, up to 98.8 km (61.41 miles) of habitat in the mainstem McCloud and sixteen tributaries may be suitable for McCloud redband. During dry periods, the amount of perennial trout-stream habitat in the upper McCloud River significantly decreases as major reaches of the river main stem and lower reaches of most tributaries become intermittent or entirely subsurface (Table 3). For example, during the 1987 through 1992 drought, the amount of flowing stream habitat in the upper McCloud River drainage decreased from an estimated 96 km (59.7 miles) to 37 km (23 miles) (Eric Gerstung, personal communication).

Estimates of trout density were generated from mark-recapture, visual observation dives, single- or multiple-pass electrofishing surveys during the period of 1975 to 1992 (Table 4). McCloud redband density estimates that were determined from multipass electrofishing methodology ranged from a low of 120 fish per mile in a section of Swamp Creek to a high of 1779 fish per mile in a section of Sheepheaven Creek. Less precise estimates of putative redband collected between 1978 and 1992 using a single-pass electrofishing methodology ranged from a low of 90 fish per mile in Racoon Creek to a high of 864 fish per mile in Trout Creek (Table 4). Electrofishing was used to produce qualitative species composition information from a number of upper McCloud River basin stream sites during 1994 and 1995 (Table 3).

Table 3. Estimated Miles of Suitable Habitat for McCloud Redband Trout in the McCloud River Drainage and Estimated Percent Putative Redband Trout Relative to Other Trout (Brook and Brown Trout).			
Drainage	Miles of Habitat-1		Percent Rainbow/Redband-2 in 1994
	Normal Runoff Year	Dry Year	
Tate Creek	7.0	5.0	100
Raccoon Creek	3.8	--	100
Trout Creek	3.8	3.5	100
Swamp Creek	2.0	2.0	100
Dry Creek	2.6	0.1	100
Edson Creek	1.8	0.3	100
Upper Moosehead Creek	1.0	0.2	100
Lower Moosehead Creek	1.6	0.2	100
Sheepheaven Creek	0.7	0.4	100
Shady Gulch Creek	4.5	1.0	93
Bull Creek	2.5	1.5	92
Upper McCloud River	--	--	--
Above Tate Creek	18.0	2.0	41-90
Below Tate Creek	7.0	6.0	0-38
Blue Heron Creek	1.0	1.0	3/
Cow Creek	1.5	0	0
Bigelow Creek	1.2	0.6	0
Bundoora Spring Creek.	0.6	0.6	0
Whiskey Creek	0.01	0	0
Unnamed Creeks	0.8	0.7	??
TOTAL	61.41	25.1	
1-Based on 1994 and 1995 surveys by CDFG			
2- Based on one-pass electrofishing survey of only a portion of the stream miles in 1994 by CDFG			
3- Visual observation of mostly putative McCloud redband, but percentage was not noted			

Four northern tributaries, including Sheepheaven, Swamp, Trout and Edson creeks have established putative redband populations. These four streams possess about 13.4 linear km (8.3 miles) of habitat that appears to be suitable during good water years. The largest putative McCloud redband populations occur within the main stem McCloud River and in Trout Creek and Tate Creek, two of its largest tributary streams. Introduced brown and brook trout have become established in the main stem of the McCloud River and many of the river's tributaries (Table 3).

Table 4. Trout population estimates in the McCloud River drainage from 1975-1992.						
Stream	Year	Trout species	Trout per mile	Pounds per acre	Technique	Water cycle
Tate Creek						
upper	1975	RB*	393	--	mark-recapture	normal/high
lower	1975	RB	552	--	mark-recapture	normal/high
Sheepheaven Creek						
--	1975	RB	250	--	mark-recapture	normal/high
--	1979	RB	(400+)	--	single-pass electro	start of wet
upper	1986	RB	1779	52	multipass electro	normal/high
middle	1986	RB	400	41	multipass electro	normal/high
lower	1986	RB	668	39	multipass electro	normal/high
lower	1992	RB	(100+)	--	single-pass electro-2	dry
Moosehead Creek						
lower	1975	RB	856	--	mark-recapture	normal/high
middle	1975	RB	810	--	mark-recapture	normal/high
middle	1990	RB	(294-326+)	--	single-pass electro-2	dry
Edson Creek						
Edson Creek	1975	RB	315	--	mark-recapture	normal/high
Edson Creek	1979	RB	57	--	visual	start of wet
Edson Creek	1992	RB	(400+)		single-pass electro- 2	dry
Upper McCloud River (Below Upper Falls)	1986	RB	2820	38	multipass electro	normal/high
Upper McCloud River (Below Upper Falls)	1986	RB	2820	38	multipass electro	normal/high
Upper McCloud River (Below Upper Falls)	1986	brown	1259	34	multipass electro	normal/high
Upper McCloud River (Below Upper Falls)	1986	brook	115	2	multipass electro	normal/high
Lakin Dam (below)	1986	RB	260	16	multipass electro	normal/high
Lakin Dam (below)	1986	brown	1768	61	multipass electro	normal/high
Lakin Dam (below)	1986	brook	312	7	multipass electro	normal/high

Table 4. Trout population estimates in the McCloud River drainage from 1975-1992.						
Stream	Year	Trout species	Trout per mile	Pounds per acre	Technique	Water cycle
Cattle Camp (below)	1986	RB	1009	16	multipass electro	normal/high
Cattle Camp (below)	1986	brook	434	7	multipass electro	normal/high
Trout Creek						
Trout Creek	1981	RB	(755+)	--	single-pass electro- 2	normal/high
Trout Creek	1983	RB	(400+)	--	single-pass electro- 2	normal/high
section 1	1986	RB	1060	17	multipass electro	normal/high
section 2	1986	RB	1067	16	multipass electro	normal/high
section 3	1986	RB	1237	27	multipass electro	normal/high
section 3	1990	RB	(864+)	--	single-pass electro- 2	dry
Swamp Creek						
Swamp Creek	1979	RB	(400+)	--	single-pass electro- 2	start of wet
above upper culvert	1986	RB	248	7	multipass electro	normal/high
between lower and upper culvert	1986	RB	324	7	multipass electro	normal/high
below lower culvert	1986	RB	120	4	multipass electro	normal/high
Bull Creek						
Bull Creek	1978	brown	(264+)	--	single-pass electro- 2	start of wet
Raccoon Creek						
Raccoon Creek	1990	RB	(90+)	--	single-pass electro- 2	dry
* RB = rainbow/McCloud redband						
1 Ricker's mark-recapture method						
2 Number captured in one-pass electroshocking is considered the minimum number of fish in the section. Sections surveyed were several hundred feet long. The number of fish collected in one pass does not necessarily represent the total population, which could be significantly larger than this number						
3 Multipass electroshocking method, 100-meter long sections surveyed						
4 Visual survey from bank of stream, 0.25 - 0.5 detection rate						

IX. PROBLEMS FACING THE SPECIES

In January 1994, the USFWS initiated administrative action to advance the McCloud redband from Category 2 to Category 1 status (presently candidate, as previously discussed) under the

Federal Endangered Species Act of 1973, as amended. In the candidate category assignment form, the USFWS implicated grazing practices, logging practices, the introduction of exotic trout species, and the potential for hydropower project development as threats to the habitat and range of the McCloud redband trout. The threats listed do not necessarily reflect the view of all signatories to this agreement.

The following discussion summarizes the significant threats to McCloud redband that will be addressed by conservation actions identified in this strategy.

A. Present or threatened destruction, adverse modification or curtailment of the species habitat or range

1. Grazing - Grazing in the upper McCloud River Basin began in the mid 1800s when settlers first moved to the area. Grazing during this time had little impact on the area as it was small in scope and was associated with homesteads. The turn of the century saw an increase in grazing as it became an economically viable activity. As grazing use increased in the upper McCloud River Basin and more vegetation was converted to preferred range species, the potential for impacts to the watershed dramatically increased. Grazing use continued to climb until about the 1940s when upwards of 35,000 animals, primarily sheep, were using forest rangelands in the upper McCloud River Basin (USFS files). After the end of World War II, the demand for meat and wool fell sharply and grazing activity declined. As grazing use of the area decreased during the postwar era, watershed conditions likely improved as rangelands slowly recovered (USFS files). Potential impacts consisted of removal of streamside vegetation, bank trampling, loss of instream cover, increased sedimentation and turbidity, loss of pool volume and spawning habitat, increased water temperatures and increased nutrient loads.

Currently on the Shasta-Trinity National Forest, there are three active grazing allotments. Most of the McCloud redband habitat lies outside of the grazing allotment boundaries, however, Trout Creek, Edson Creek, and Sheepheaven Creek lie within the allotments. Of the three active allotments, two are cattle allotments which run a total of 315 cow/calves, and one is a sheep allotment which runs 840 ewe/lambs. Grazing typically begins in mid-May and runs to mid-October.

All grazing in the McCloud drainage is currently governed by allotment management plans that reflect the standards and guidelines established by the Record of Decision (ROD) and Aquatic Conservation Strategy (Appendix A) for this activity. When properly managed, grazing has a minimal impact on aquatic resources. Problems may occur when fences are not maintained and cows have uncontrolled access into riparian exclosures or when range use conditions are exceeded. Presently, the maintenance of fences and other range improvements as well as compliance with grazing standards are the responsibility of the permittee. The USFS monitors grazing activities and makes adjustments in use in order to maintain proper range conditions and to protect riparian areas.

Due to past range improvements, such as the development of off-stream water tanks and the construction of control fences (used here for exclusion of livestock) around Trout Creek,

damage to redband trout habitat has been greatly reduced. Edson and Sheepheaven creeks, which were previously fenced, are currently further protected by having been removed from the grazing allotment. Compliance with the allotment restrictions is enforced through regular field inspections conducted twice monthly during the grazing season. Furthermore, permittee compliance with USFS allotment management plans and strict adherence to the standards and guidelines established within the ROD ensure that grazing does not pose a threat to McCloud redband or their habitat.

2. Logging - Small sawmills were operating in the upper McCloud River watershed starting in the late 1800s. At the turn of the century, railroads facilitated expansion of the sawmill capacity by allowing access to timber on steeper slopes, untapped by the previous horse/oxen era. Railroad-style logging predominated through World War II when truck and tractor operations replaced Shay locomotives and steam donkeys in the woods.

Forest management activities on private land were less stringently regulated before 1973 than currently. Past logging practices were not conducted under today's standards but were conducted according to the law and the accepted standards of the time.

Potential impacts to McCloud redband and their habitat from past logging practices include loss of shade canopy, increased water temperatures, increased sedimentation, reduced recruitment of large woody debris, loss of fish habitat diversity, and increased peak storm flows.

Current practices on USFS lands are regulated by the ROD and the Land and Resource Management Plan for the Shasta-Trinity National Forests. Current practices on private lands are regulated by the California Forest Practices Act (refer to Section VI. B. for more discussion of these management restrictions and regulations).

It should be noted that, in recent years, local private timberland owners have provided watershed protection over and above the protection levels stated in the FPRs. Some of this work was not strictly project related but was done as part of conscientious land management practices. Protection measures benefiting habitat for McCloud redband include but are not limited to the following:

- realignment of 3 miles of road segments away from sensitive sites
- 46.5 miles of roads surfaced with rock, cinders, dust abatement oils and other improvements for erosion control in critical or sensitive areas
- 34 stream crossings upgraded including installation of adequately sized culverts
- 8 stream crossings eliminated
- changing water drafting schedules to minimize effects on low or critical flow conditions
- providing equipment and manpower for in-stream restoration work for habitat improvement, e.g. riparian and channel restoration in Edson Creek.
- collection of specific stream information on water temperature, flow rates, stream habitat and morphology, aquatic biology, etc.

- providing long-term monitoring of land management activities and effects on certain sensitive streams
- fencing of critical or sensitive stream reaches to prevent stream bank degradation

Most of the members of the Redband Core Group concur that the current FPRs provide adequate protection for McCloud redband.

3. Hydropower Development - No hydroelectric projects have been developed in the upper McCloud River basin above Middle Falls and none are currently proposed. Due to the generally very low summer and fall flows in the upper main stem and its tributary streams, hydroelectric power projects in the upper McCloud River basin would probably not be cost effective and therefore are not likely to be developed in the foreseeable future (David Hoopaugh, CDFG, personal communication).

B. Overutilization for commercial, recreational, scientific or educational purposes

1. Commercial Take - There is currently no fish species harvested commercially within the McCloud River drainage and no change in this situation is expected to occur in the foreseeable future.

2. Recreational Take - Sport angling in the upper McCloud River drainage streams is presently allowed from the last Saturday in April through November 15 in all but Moosehead Creek and Sheepheaven Creek under the State Fish and Game Commission's current angling regulations. Based on results of a creel study on the upper Sacramento River under conditions of hatchery trout stocking (Rode, 1994), angling activity removed only a small fraction of the wild trout population (probably less than 15 percent). Such a harvest rate would not be expected to significantly impact the redband population in the main stem McCloud, even if stocking of hatchery trout were resumed above Middle Falls.

Impacts on populations in most of the McCloud River tributary streams can be expected to be substantially less than in the McCloud River because of much lower angling use due to the relatively small size of trout in those streams. Angling impacts are most likely to have significant impacts on populations when reduced by drought, but only if anglers were concentrated there during drought periods. Concentrated angling pressure during past droughts has never been reported and based on this information is not considered a significant impact. If drought or other circumstances dictate, the State Fish and Game Commission can adjust the angling regulations, as appropriate, and recommendations to do so will be considered regardless of their source (i.e., monitoring results from CDFG activities developed pursuant to this UMRRT (Upper McCloud River Redband Trout) Agreement or input from other public or private agency or an individual).

3. Collections for Scientific or Educational Purposes - The collection of putative McCloud redband whether for commercial, recreational, scientific or educational purposes could pose a serious threat to populations that are in very low numbers. The CDFG requires scientific collectors permits to take any fish from any waters of the State including waters of the upper McCloud River drainage. New policies were adopted in 1997 that require

individuals to obtain authorization to collect in each individual lake or stream. The general permits that formerly allowed some collectors to take fish from any water are no longer issued so that depletion from scientific collecting should no longer be a potential problem.

C. Predation, Competition or Disease

In places, native trout may have been displaced by introduced species, e.g., brown, brook and possibly hatchery rainbow trout. Hatchery rainbow trout also pose a potential threat to McCloud redband through hybridization. Refer to the later Section VII., subsection E., titled "Other natural or manmade factors affecting the species continued existence", starting on page 22, for further discussion of this topic.

Past stocking of hatchery trout in the McCloud River main stem could have introduced diseases and increased predation on and competition with the McCloud redband. Although random fish stocking has occurred in the upper McCloud River drainage since at least the late 1800s, it was not until 1957 that annual stocking of catchable-sized rainbow trout from nearby Mt. Shasta Hatchery was conducted throughout the summer months in the main stem McCloud River. Stocking above Middle Falls was discontinued in 1994 when the results of a genetics analysis completed by Berg (1994) suggested that introgression of McCloud redband with hatchery rainbow may be occurring. Berg and a number of fisheries biologists became concerned that the McCloud redband's existence could be jeopardized by the continued stocking of hatchery rainbow trout.

Notwithstanding the cessation of fish stocking in 1994, self-sustaining populations of nonnative brook and brown trout have been established in the upper McCloud River basin since approximately 1910. Brook and or brown trout have been observed in recent past surveys throughout the main stem McCloud River and in a majority of its tributary streams including Bigelow Gulch Creek, Blue Heron Creek, Bundoora Spring Creek, Tate Creek, Shady Gulch Creek, Colby Meadows Creek, Bull Creek, and Cow Creek. Relatively large brook and brown trout are known to be piscivorous (i.e., fish eating), however, the extent of predation by both brook and brown trout on putative McCloud redband is currently unknown. These nonnative trout are in competition for food and space since their populations tend to dominate in some parts of the drainage (e.g., Bundoora Spring Creek, and the McCloud River main stem near Colby Meadows, below Tate Creek, and below Lakin Dam [see Table 3]). The elimination of these species from some or all of the drainage may increase the potential for putative McCloud redband populations to expand.

Outside of brook, brown and rainbow trout, no other nonnative fish have been known to have been officially stocked into the waters of the upper McCloud River basin and, except for reported golden trout (which were probably McCloud redband) by Wales in 1938 and one golden shiner captured behind Lakin Dam in 1995, no other fish species have been reported. CFGC policy precludes the stocking of hatchery fish that may adversely affect threatened, endangered or trout species of special concern.

D. Absence of regulating mechanisms adequate to prevent decline of the species or degradation of its habitat

The absence of regulating mechanisms was identified by the USFWS as one of the five reasons for upgrading the status of the species to "candidate" (formerly Category 1). Specifically, the recreational fishing and grazing regulations were cited as "inadequate or unenforced". After a review of existing Federal and State policies and laws, the Redband Core Group has concluded that there are adequate regulating mechanisms to prevent the decline of the species and the degradation of its habitat. In fact, angling regulation changes recommended by the CDFG to further protect redband populations in the upper McCloud River drainage led to the CFGC adopting regulations that eliminated all fishing in Moosehead and Sheepheaven creeks including their tributaries beginning March 1, 1996. Law enforcement personnel of the CDFG and the USFS have fully enforced these as well as all other angling regulations involving the upper McCloud River basin sport fishery.

E. Other natural or manmade factors affecting the species continued existence

Other factors, both natural and manmade, play a role in the current status of the McCloud redband. Redband trout genetics are affected by hybridization and the founder effect while habitat is affected by drought, fire, forest succession, natural and manmade barriers, and volcanic activity.

1. Genetics - The continued stocking of hatchery rainbow trout on a population of wild trout could have a major impact on the latter especially during drought periods when the population of wild trout is severely depressed. According to Dr. Robb Leary, a professor of fish genetics at the University of Montana, the magnitude of impact of hatchery stocking is determined by the relative proportion of hatchery trout to wild trout present in a stream (personal communication to Eric Gerstung). Even though few stocked hatchery trout survive long enough in the wild to reproduce, the progeny of a single pair of hatchery trout could have significant genetic impacts if wild trout numbers were low, according to Leary.

The repeated introduction of hatchery trout into a wild trout population over time could also result in "genetic swamping" particularly during periods when wild populations were reduced such as during periods of prolonged drought. Genetic swamping could result in further hybridization of native redband trout with nonnative hatchery rainbow trout. Genetic swamping could also introduce harmful alleles to the native population or reduce genetic variability of native trout and thus reduce their ability to adapt to harmful changes in the stream environment. Based on interpretation from protein electrophoresis data, evidence of hybridization between hatchery rainbow trout and McCloud redband populations has been reported by Berg (1994) and has elevated concerns for the genetic integrity of McCloud redband.

An additional concern has been expressed regarding the number of individuals in isolated and relocated population segments of McCloud redband. In response to a severe drought episode in 1977, which jeopardized the existence of the redband trout population in Sheepheaven Creek, actions were taken which involved the capture and relocation of a

number of redband from this stream. Through the cooperation of landowners and land managers involved, the potential for serious jeopardy of the Sheepheaven Creek population was averted (refer to Section VI., subsection C., titled "Distribution (Current and Historic)").

The most recent genetic investigations using mitochondrial DNA and microsatellites (Nielsen, et al., 1996) preliminarily indicate that, while the existing population of McCloud redband in Trout Creek show significant genetic similarity to the current population of McCloud redband in Sheepheaven Creek, these trout populations are nevertheless not genetically identical. Further, the trout population in Swamp Creek is significantly dissimilar from its founder population in Sheepheaven Creek. As discussed in the report, two distinct possibilities are that neither stream was, in fact, fishless before introducing trout from Sheepheaven Creek and/or unauthorized introductions of trout have occurred since the rescue transfers. Another possibility is that the small number of fish transplanted originally may have experienced a founder effect leading to these genetic differences. This last possibility seems likely especially for the Trout Creek fish as it might explain the significant similarity to the putative McCloud redband found in Sheepheaven Creek.

Other possibilities include modification of the genetic composition of the source population from founder effects or a combination of changes in all three populations. To quote the authors "The greatest danger of such a shift in genetic identity between the founder and the refugium fish would be if substantial fitness effects resulted in change in the transferred stock which made it unable to adapt back into founder habitats should disaster eliminate the original source population. Any measure linking genetic diversity and actual changes in fitness in natural populations has been difficult to document. The role of quantitative genetics in the conservation of intraspecific diversity for wild trout has yet to become an applied science." Completion of more definitive genetic studies may help resolve some of these uncertainties.

2. Drought - The McCloud redband was reassigned to "candidate" status in 1994, which was the seventh year of a relatively extreme drought, with water flows that should be expected no more than 5 out of 100 years (USDI 1996). Extreme low flow conditions prominent in that year may have escalated concerns for the long-term viability of the McCloud redband.

The soils of the upper McCloud River basin are primarily of volcanic origin and porous by nature. Most of the annual precipitation is delivered as snowfall. Consequently, annual runoff occurs primarily in the springtime with the few perennial sources associated with natural-spring discharge. After spring runoff, relatively low base flows prevail for the remainder of the year. Many streams of the upper McCloud River watershed including those streams with putative McCloud redband, have long dry or intermittent reaches even in years of average or above average flows. Habitat typing, conducted in summer 1995 by CDFG (CDFG 1996), surveyed 14 possible "McCloud redband" tributary streams for a combined total of 41.74 miles. Of those miles, 50 percent were wetted, 19 percent were intermittent and 31 percent were dry. 1995, the year of these habitat surveys, was an above average precipitation year with flows that should be expected no more than 6 out of 100 years (USDI 1996). An additional 33 miles of five streams including the main stem upper McCloud River

were habitat typed by the USFS in summer 1990--roughly 50 percent of which were dry miles; even 24.0 miles of main stem included 7.5 miles of dry channel. The year 1990 was also a relatively dry year with flows that should be expected no more than 15 out of 100 years (USDI 1996).

Based on records since 1935, McCloud's annual average precipitation, by water year, is approximately 45 inches. Since the 1970s, when the McCloud redband began to be considered as a possible distinct race or subspecies of *O. mykiss*, there have been a number of below average rainfall years. Assuming that the worst droughts occur when total precipitation is less than 35 inches, the following years would stand out from 1974 to present: 1976-77 - 19 inches of precipitation; 1984-85 - 32.2 inches; 1990-91 - 24.2 inches; 1993-94 - 28.7 inches (USFS Records, Shasta-Trinity National Forest).

Drought has and will continue to impact the naturally limited range of the McCloud redband. Some of the small streams may be reduced to a series of isolated pools because surface flows are inadequate for fish passage or flows are subsurface. Fish in those reaches of stream may be decreased in numbers due to the consequences of overcrowding such as increased competition for food and space and depleted dissolved oxygen. Fish in small streams, when further subjected to drought conditions, may also be impacted by loss of habitat making them more vulnerable to predation. Some pools may dry up completely. The long-term effects of habitat conditions, which encompass the range of the McCloud redband, may account for circumstances detected in the molecular genetic studies and hypothesized as being a result of population bottlenecks. Differences between analyses using two types of molecular markers (mitochondrial DNA and microsatellites) were attributed to population bottlenecks. The absence of certain genetic sequences, found in trout from a study in the upper Sacramento River but not in trout from McCloud River, may also be explained by population bottlenecks and/or by lack of hatchery introgression (Nielsen et al., 1996).

In response to drought conditions and through the cooperation of landowners and land managers involved, the following actions were taken by CDFG to mitigate the threatened drying-up of Sheepheaven Creek. In 1973 and 1974 a total of 64 putative McCloud redband were taken from Sheepheaven Creek, then believed to be the purest strain of McCloud redband and introduced into Swamp Creek, a stream believed to be fishless at the time. In 1977, which was the second year of another drought period, Trout Creek was chemically treated to remove all fish and a total of 123 McCloud redband (63 adults and 60 fingerlings), once again from the Sheepheaven Creek population, were transplanted there.

As discussed previously, practices involving the relocation of population segments in response to drought need to be evaluated regarding the minimum numbers of individuals that are needed to maintain the genetic viability of a population.

3. Fires - Fire suppression activities on all ownerships began in earnest in the first decade of the twentieth century, roughly the same period of time as the establishment of the Shasta National Forest. Nevertheless, fires continued to be a significant influence on the landscape as can be attested to by the extent of early forest seral stages in the first aerial photographs

from the 1940s of the watershed.

Current forest conditions, i.e., stems per acre and forest floor to canopy continuum of vegetation, contribute to the size and intensity of wildfires that may still occur. Where fires are of low intensity and much of the organic matter on the forest floor remains intact or where fires affect only a small part of a watershed, changes in soil and water regimes may be nominal. High intensity fires are in distinct contrast. Physical characteristics of the soil may be altered. Severe fires create a hydrophobic soil condition which may exist even years later especially in forests located in drier climates. Due to the decay of root systems, soil strength is reduced increasing the occurrence, or certainly the likelihood, of mass failures.

Peak flows increase after extensive removal of the forest canopy, as by wildfire. Reduced water infiltration rates due to formation of hydrophobic soils, removal of protective vegetative cover and forest floor materials, breakdown in soil structure, or reduction in soil porosity contribute cumulatively to amplify peak flows. Coupled with incineration and destabilization of instream large woody debris and inorganic materials, and soil instability after the decay of root systems, the effects of increased overland water flows can create particularly destructive debris torrents following severe wildfires. Peak streamflow increases following wildfires often exceed typical peak steamflow amounts by forty to sixty percent during the first year or two following a fire (McGreer 1996), which is the period when the effects of vegetation removal are the most conspicuous. Intense precipitation or rain-on-snow circumstances could swell the peak flow increase several hundredfold.

There is strong evidence that fire once was a major ecological process in the watershed with influences on terrestrial and aquatic processes. The success of fire suppression has altered, and will continue to alter, the upper McCloud River ecosystem. To the extent that evaluations of fire and fuel conditions in the Sierra Nevada, reported in the Sierra Nevada Ecosystem Project (1996), can be extrapolated for the upper McCloud River, wildfires are likely to be more uniformly intense than they were historically. This creates the potential for more severe impacts to the quantity and quality of habitat for McCloud redband.

4. Barriers - Generally, barriers to in-stream migration of fish have been considered a negative attribute of any particular stream because potentially suitable habitat may be blocked off, constraining the productivity of that stream for McCloud redband. In addition, populations of fish may become isolated from one another potentially leading to reduction in the diversity of the gene pool if something should happen to cause one or more of the isolated populations to disappear.

In some streams containing putative McCloud redband, barriers during the low streamflow period have been identified. This may be an issue of concern for populations in streams that naturally shorten in length during the dry season. Individuals that move or are flushed downstream during the higher streamflows created by snowmelt in the spring may become stranded if the perennially wet reach supplied by springs is upstream of an impassable barrier. How many of these are also barriers during higher flow periods has, for the most part, only been speculated. In the upper McCloud River, barriers have played a positive role and may be a useful management tool.

In addition, barriers have kept many subpopulations of putative McCloud redband free from direct contact with introduced fish species thereby eliminating the threat of hybridization, competition, disease, and displacement by these exotics. In the upper McCloud River basin, a barrier near the mouth of Moosehead Creek was purposely constructed/augmented to reduce the possibility that hatchery transplants in the main stem could migrate into Moosehead Creek and negatively impact putative McCloud redband in that stream. Some of the purest McCloud redband populations are not situated above barriers of height but instead are isolated by naturally dry stream reaches which may infrequently flow during runoff events of some unknown periodicity. The potential for upstream movement of nonnative fish from the McCloud River needs further investigation. The role of barriers in the upper McCloud River system should be considered on a site-specific basis.

5. Volcanic Activity - These streams are at the foot of a dormant volcano. There is geological evidence to show that at least several of the north-side tributaries have been covered by extensive mudflows within the past 200 to 300 years. There is every reason to think that such events will occur again. Mitigation for the next such event is limited to assuring a viable, well-distributed population of McCloud redband in the upper McCloud River watershed. Given the limited distribution of McCloud redband, it is within the realm of possibility that a natural volcanic episode could eliminate all fish from the drainage and this, of course, cannot be mitigated.

X. CONSERVATION ACTIONS THAT WILL BE CARRIED OUT

This conservation agreement has been initiated to provide for secure populations, long-term viability, and genetic integrity of the McCloud redband while respecting existing land uses, and private property rights.

Conservation measures needed for the McCloud redband focus on the following objectives: (A) establish a McCloud redband refugium, (B) enhance and/or maintain habitat, and (C) maintain genetic integrity. Tables 5 and 6 provide conservation actions to be completed. One of the conservation measures is to establish criteria for determining whether the goals of genetic integrity, secure populations, and long-term viability have been met (Table 6, Activity 1).

TABLE 5. Habitat Conservation Actions to be Implemented Under the Redband Conservation Agreement				
ACTIVITY/PROJECT	LOCATION	RESPONSIBLE PARTY	TIME FRAME	COST ESTIMATE
1. Off-stream water drafting	Trout Creek	USFS; Private Landowners	September 1998	\$20,000
2. Develop plan for road closures	Basinwide	USFS; Private Landowners	December 1998	\$5,000
3. Develop watershed improvement and monitoring plan	Basinwide	Redband Core Group	May 1999	\$2,500
4. Maintain existing fencing around streams where needed	Trout and Sheepheaven Creeks	USFS; CDFG; Private Landowners	Annually as needed	\$3,000 to \$15,000 annually

TABLE 5. Habitat Conservation Actions to be Implemented Under the Redband Conservation Agreement

ACTIVITY/PROJECT	LOCATION	RESPONSIBLE PARTY	TIME FRAME	COST ESTIMATE
5. Off-channel stock water development	Trout Creek	USFS	September 1999	\$15,000
6. Maintain in-stream structures	Trout Creek	USFS	Annually as needed	\$1,000 to \$5,000
7. Maintain stream crossing structures, i.e. culverts and bridges	Basinwide	USFS; Private Landowners	Annually as needed	\$10,000+ annually
8. Ensure compliance with Allotment Management Plans	Within active range allotments	USFS	Annually	\$1,000
9. Develop flood contingency plan	Basinwide	Redband Core Group	October 1999	\$2,500
10. Develop drought contingency plan	Basinwide	Redband Core Group	October 1999	\$2,500

TABLE 6. Population Conservation Actions to be Implemented Under the Conservation Agreement

ACTIVITY/PROJECT	LOCATION	RESPONSIBLE PARTY	TIME FRAME	COST ESTIMATE
1. Establish criteria to determine whether goals of conservation strategy have been met (genetic integrity and long-term viable population)	Basinwide	Redband Core Group	February 1999	\$2500
2. Continue with genetic analysis	Populations from all previously sampled reaches plus adjacent basins	CDFG	Report in 1998	\$28,000

TABLE 6. Population Conservation Actions to be Implemented Under the Conservation Agreement				
ACTIVITY/PROJECT	LOCATION	RESPONSIBLE PARTY	TIME FRAME	COST ESTIMATE
<p>3. Develop action and monitoring plan to remove nonnative fish within the refugium:</p> <p>Priority 1: Recommend angling regulations to target nonnative fish; if not effective, then...</p> <p>Priority 2: Trap and electrofish to remove nonnative fish; if not effective, then...</p> <p>Priority 3: After evaluation of genetic impacts and feasibility, chemical treatment with restocking of McCloud redbands and if needed, construction of isolation barrier</p>	To Be Determined	Redband Core Group	May 1999	<p>P1: \$500</p> <p>P2: \$5,000 - \$10,000</p> <p>P3: \$5,000 - \$250,000</p>
4. Continue to protect putative McCloud redband through the use of angling regulations	Basinwide	CDFG, Redband Core Group	Biennially, or on an emergency basis	N/A
5. Assess whether fish stocking is appropriate within the refugium and then develop an action and monitoring plan	To Be Determined	Redband Core Group	December 1998	\$6,000 - \$10,000
6. Develop a bioenhancement plan for the population recovery in the event of major habitat loss or destruction. The plan will include the conditions that trigger implementation	To Be Determined	Redband Core Group	June 1999	\$6,000 - \$10,000
7. Develop a drought contingency plan to guide future intra-basin transfers of McCloud redband. The plan will include conditions that trigger implementation.	To Be Determined	Redband Core Group	March 2000	\$6,000 - \$10,000

A. Establish a McCloud Redband Refugium - A refugium will be designated within the upper McCloud River basin and will be managed for the protection and enhancement of McCloud redband populations and their habitat. The refugium will include that section of the main stem McCloud and its tributaries above the confluence with Bundoora Spring Creek. Perennial tributaries not currently known to contain putative redband trout will be evaluated on a stream by stream basis for inclusion in the refugium (see Figure 1). The refugium boundary was established upstream of the confluence of Bundoora Spring Creek for the following reasons:

The streams in the McCloud River drainage above Bundoora Spring Creek are generally good redband habitat based on the relatively high numbers of putative McCloud redband estimated in the river and its tributaries (refer to tables on pages 23 and 24). This reach of the McCloud River main stem is characterized by complex habitat, e.g., deep pools, abundant cover, and gravel substrates. The drainage above Bundoora Spring Creek represents 95 percent, or 54.8 of 57.8 miles of stream habitat known to contain putative McCloud redband trout. Even so, this habitat includes reaches currently dominated by brook and brown trout.

A significant portion of the McCloud River from Bundoora Spring Creek downstream to Middle Falls is considered poor habitat based on habitat conditions where putative redband are known to occur in the upper McCloud River basin. This reach is characterized by bedrock channels, high embeddedness of pools and glides, and low riparian vegetation density associated with bedrock where opportunities for habitat enhancement are extremely limited. This segment represents 5 percent, or 3 of 57.8 miles of stream known to contain putative McCloud redband trout.

The main stem McCloud River below the confluence of Bundoora Spring Creek contains a relatively low number of putative McCloud redband based on random electrofishing sampling conducted by CDFG in 1994 and 1995 (CDFG data). In addition, relatively few putative redband were found in the McCloud River between Bundoora Spring Creek and Lakin Dam during an electrofishing survey conducted by CDFG in 1996 (Dennis Maria, personal communication). The results and qualitative observations of the 1994, 1995, and 1996 electrofishing surveys by CDFG indicate that the McCloud River between Bundoora Spring Creek and Middle Falls is currently dominated by brook and/or brown trout.

The segment from the Middle Falls upstream to the pond formed by Lakin Dam (2.5 percent of the fish-bearing stream miles in the range of McCloud redband), i.e., "Lakin Pond", was not included in the refugium because of poor habitat quality in the slack water behind the dam. Its omission will permit the stocking of hatchery fish (non-rainbow), which is desirable because of existing recreational developments, relative accessibility and historical high use of this stream reach.

The reach above the Lakin Pond to Bundoora Springs would then become a one mile Abuffer" reach. This reach also has the only handicapped-accessible fishing access in the area, which is located at Lakin Pond. At least initially, the buffer reach will not be stocked so that any stocked fish, which might migrate upstream, could be readily identified. The reaches below Lakin Pond and above it to Bundoora Springs are segments that can be monitored to evaluate the impacts of stocking. Prior to any stocking beyond the current situation, an evaluation would be conducted by the Redband Core Group.

B. Maintain and Enhance Habitat - Reference Table 5 for actions to maintain and/or enhance habitat for McCloud redband trout.

The maintenance of high quality redband trout habitat is important to the continued existence of this species. Protection of existing habitat and improvement of habitat, in certain areas, are necessary components of this Conservation Agreement. With this consideration, grazing and timber management activities on all lands will be conducted in such a manner as to protect McCloud redband habitat. Grazing and timber management activities are practiced at the time this agreement is signed, according to the Shasta-Trinity Land and Resource Management Plan and the ROD (on USFS lands and joint grazing allotments) and the California Forest Practices Act (on private forest lands). If new information indicates that these practices are inadequate to protect redband trout, alternatives will be evaluated and adopted by the Redband Core Group. Land management activities that would result in the loss of habitat or cause a reduction in long-term habitat quality will be avoided.

An off-stream water site is under construction at Trout Creek. Less than 0.5 cfs will be diverted, part time, into a 20,000-gallon tank which is situated on a flat 300 feet away from the creek. Operators of water trucks, used primarily for road maintenance but also for fire suppression and other activities, can thus quickly fill up their water tanks with essentially no risk of impacting the stream from fuel or motor oil spills, rapid withdrawals, or sedimentation from runoff from overfilled tanks.

A significant amount of habitat improvement work has been completed to date on Federal and private lands including livestock control fencing to protect riparian areas, placement of instream structures to enhance habitat complexity, riparian planting, road closures, and road surface stabilization.

So far, the habitat improvement work has been completed without the benefit of a unifying strategy. Additional opportunities to enhance McCloud redband habitat exist and future work needs to be prioritized under a comprehensive plan. A watershed improvement plan will be developed once this conservation strategy has been approved. The watershed improvement plan will be based on habitat and population survey data already collected and will address limiting factors that have been identified. It is anticipated that habitat improvement work will focus on the reduction of fine sediments, the development of off-site water stations, bank stabilization, barrier development and/or removal (where necessary), riparian restoration, and the enhancement of pools and cover within McCloud redband streams. The watershed improvement plan will be developed by the Redband Core Group. Streams in need of improvements will be prioritized and the treatments identified. The plan will address improvement through a watershed approach by stream drainage and will establish benchmarks to be completed in the next five years or for the life of this agreement. The plan will be developed within one year of the signing of the agreement.

Private landowners will continue to cooperate with USFS personnel and the CDFG to establish the off-stream water tank at Trout Creek and the development/implementation of additional, specific habitat enhancement projects as determined. The USFS and private landowners will cooperate on projects where mixed landownership occurs.

C. Maintain Genetic Viability - Landowners and managers will continue to cooperate with CDFG personnel in further appropriate biological investigations, e.g., sample collections for genetic and population analysis. Reference Table 3 for actions to protect and/or maintain genetic viability of McCloud redband trout.

1. Determine the genetic integrity of the species - It is important that we understand, to the extent possible, the genetic relationships of the putative McCloud redband populations that exist throughout the upper McCloud River drainage in order to apply fisheries management strategies which are tailored to protecting the genetic characteristics and viability of identified McCloud redband populations. The CDFG will work cooperatively with the Redband Core Group in efforts to continue to seek funding for additional genetics work involving McCloud redband. Several grant proposals were submitted in 1997 to fund an expansion of the genetics work involving McCloud redband, which was initiated by Dr. Jennifer Nielsen, in 1994. This expanded study will be a more rigorous analysis which will be statistically defensible in determining the genetic characteristics of McCloud redband. The information acquired from this study is instrumental to improving this Conservation Strategy and Agreement and will be used to refine the strategies identified in this agreement.

All native fish within the refugium that are identifiable physically or meristically as belonging to *Oncorhynchus mykiss* will be managed as though they were McCloud redband regardless of origin until completion of the currently funded portion of the DNA study or until the Redband Core Group determines otherwise. Further DNA analysis will provide information in two areas with different implications for this conservation agreement. Additional work by Dr. Nielsen will further identify the relationship of McCloud redband to populations of redband trout of eastern California and southern Oregon. While this aspect of the investigation will be enlightening, the outcome will have little bearing on this Conservation Agreement and strategy.

Investigations of mitochondrial DNA and microsatellites will have more relevance to this conservation strategy to the extent that they can help identify the relationship of populations of *Oncorhynchus mykiss* within the upper McCloud River drainage. Those that are most closely related to the population in Sheepheaven Creek and populations essentially not influenced by the genetics of hatchery trout will be identified.

Sheepheaven Creek is currently considered the type location for the McCloud redband trout; however, a substantial number of individuals from the population in Sheepheaven Creek have on three occasions been removed and relocated to other streams with unknown impacts to the genetic makeup of the remaining population. The Redband Core Group may, after consultation with genetics experts, determine that the population in another stream may better represent the McCloud redband trout. Whichever subpopulations are selected to represent McCloud redband might then be considered, for instance, the source populations with which to restock, passively or actively, habitat within the refugium as it becomes available after control of non-indigenous species. The reaches of streams occupied by these subpopulations might be determined as highest priority for habitat enhancement projects. However, if further investigations fail to identify distinct within-basin relationships, the Redband Core Group will determine other criteria by which to make many of the same

decisions.

If genetic contamination of the main stem upper McCloud River is determined to be a serious problem and chemical reclamation of the stream is not feasible or acceptable, "genetic swamping" of introgressed populations by repeated stockings of significant numbers of genetically pure McCloud redband trout over a period of years could be considered an alternative. This process might require relocation of wild stocks or captive breeding of fish collected from the purest sources. Captive breeding will be logistically difficult and expensive. In any event, periodic transplants of "pure" fish to the main stem would be desirable following periods of drought in order to increase genetic variability and to reduce the potential for genetic "bottlenecking" and inbreeding depression. Bottlenecking can be a major evolutionary process in populations of small size or very skewed sex ratio and can result in a reduction of local adaptation to environmental change and an increase in the frequency of harmful alleles in a population. Under such consequences, a population could be extirpated before the alleles are removed through natural selection.

2. Selective control of non-indigenous fish - The refugium, as identified on the map (Figure 1), will be managed for McCloud redband. Genetic analysis will improve the determination of the distribution of the populations, or subspecies, of trout unique to the upper McCloud drainage. Once McCloud redband population(s) are identified, the CDFG, working cooperatively with USFWS, landowners, and land managers, will assess any detrimental effects associated with the presence of non-indigenous trout. Where significant conflicts are found between non-indigenous trout and McCloud redband that are related to hybridization or competition for food and space, removal of the non-indigenous trout will become necessary to the extent that the involved reaches are required to maintain viable McCloud redband populations. Management actions to remove or substantially reduce the threats associated with non-indigenous trout will be determined from stream or stream reach-specific data. There are several management actions currently available to deal with control of nonnative species. These range from implementation of a selective sport fishery (whereby nonnative trout would be harvested at a higher rate than McCloud redband trout) to capture and removal of non-indigenous trout, to total eradication of fish populations through chemical treatment in stream reaches where non-indigenous fish are found. McCloud redband trout would be rescued and held temporarily or relocated to another stream reach within the refugium prior to chemical treatment.

Whole tributary systems that are found to contain only nonnative trout and are devoid of significant populations of McCloud redband may be logical candidates for chemical treatment to reclaim the stream for utilization by McCloud redband. Treated streams would be restocked with McCloud redband. Following restocking, trout numbers would remain relatively low for several years following treatment. Established McCloud redband populations within these treated areas could then serve as reintroduction stock in the future. In some locations, fish barriers to prevent re-entry of nonnative species from adjacent waters may be necessary.

Impacts to McCloud redband trout would be evaluated prior to implementation of any control or eradication measures to ensure that actions taken meet the objectives of this

conservation agreement and provide for the maximum protection possible for McCloud redband and their habitat.

3. Stocking Policy and Management - Although fish stocking has ceased in the upper McCloud River above Middle Falls, there is still a substantial demand for put and take stocking of hatchery trout for those anglers who are not usually successful in catching wild trout. To satisfy that demand, limited and closely monitored fish stocking activities will be resumed by the CDFG outside the refugium at Lakin Pond and downstream beginning in 1998. Additionally, the upper McCloud River Redband Core Group, will explore expanded stocking options with the CDFG and USFWS, to determine if, and where, stocking of non-rainbow, hatchery trout within the McCloud redband refugium is a viable option. The justification for taking such action would be to provide increased recreational opportunity and to increase tourism and its positive impact on the local economy without significant impacts on McCloud redband.

The CDFG's current policy is to protect and preserve all native species of fishes and their habitats which are threatened with extinction or experiencing significant population decline which if not halted would lead to a threatened or endangered designation. Any proposed stocking program would be closely monitored and flexible enough to allow for changes in stocking strategies as warranted by significant changes in the status of the McCloud redband population(s). Any future stocking of non-rainbow trout within or in proximity to the refugium will be scientifically based and will not compromise the intent of this CDFG policy. Stocking would only occur where there is no chance for hybridization to occur with unhybridized McCloud redband trout populations in the upper McCloud River drainage. It may be necessary to adjust a stocking program if McCloud redband populations are affected by drought conditions or other factors. The CDFG will work cooperatively with the Redband Core Group to determine when information from monitoring efforts indicates that changes in the stocking program are appropriate.

4. Angling Regulations - Angling regulations can be an effective fishery management tool to protect fish, if necessary. Currently, angling regulations prohibit angling all year in both Moosehead and Sheepheaven creeks, two streams of the upper McCloud River drainage that appeared to have critically small populations following the 1987 to 1992 drought period. With the exception of Moosehead and Sheepheaven creeks, angling is allowed in the upper McCloud River basin in streams above McCloud Reservoir from the first Saturday in April through November 15 with a daily bag and possession limit of five (5) and 10 (ten), respectively. Angling regulations may be altered to provide further protection of McCloud redband trout populations in the main stem McCloud and other waters within the upper McCloud River drainage, if necessary. Angling regulations may also be changed to allow an increase in the daily bag and possession limit of non-indigenous trout to reduce competition with and predation on McCloud redband although such changes may not significantly reduce brook and brown trout populations. A total ban on all fishing in selected streams bearing McCloud redband could be enacted to eliminate angling activities that threaten the viability of any McCloud redband population. Angling regulation changes would be proposed when such changes are deemed necessary to reduce threats to McCloud redband due to angling. Such actions to be taken are outlined as activity items #3 (priority 1) and #4

as noted in the action plan outlined in Table 6 below. Population monitoring, noted as activity item #3 of the "Monitoring Plan" outline (Table 7), will help provide some of the information necessary to determine whether future changes to the State's angling regulations are warranted to protect McCloud redband populations.

TABLE 7. Monitoring Actions to be Completed under the Conservation Agreement				
ACTIVITY	LOCATION	RESPONSIBLE PARTY	TIME FRAME	COST ESTIMATE
1. Compliance Monitoring of the Conservation Agreement	Basinwide	Redband Core Group	During the life of the Conservation Agreement	\$500 to \$5,000, annually*
2. Habitat Condition Monitoring for Effectiveness of Conservation Actions	Trout, Edson, Sheepheaven, Moosehead, and Tate Creeks and the McCloud River at Bundoora Springs, Camp 4, Algoma, and Colby Meadows	USFS, CDFG, and Private Landowners	Biennially during the summer or after a catastrophic event	\$3,000
3. Population Trend Monitoring for Effectiveness of Conservation Actions	Same locations as the habitat monitoring (to the extent feasible)	CDFG	Biennially during the summer or after a catastrophic event	\$3,000
* Funding amounts shown followed by an asterisk indicate monies which are already allocated or encumbered or part of an existing O&M budget. All other funding amounts will be sought internally or from outside sources as needed.				

Fishing was prohibited in Sheepheaven and Moosehead creeks to prevent harvest of the few fish that remained as a result of the low flow drought conditions. Those regulations may not be necessary after populations there recover or if they should be determined to not be genetically representative of the McCloud redband.

5. Prohibited Species - All non-indigenous aquatic species currently prohibited by law, or non-indigenous (nonnative) fish or other aquatic species which pose a significant threat to McCloud redband populations in the upper McCloud River basin will continue to be excluded from the established McCloud redband refugium by authority provided under both State and Federal statutes or embodied under existing State and Federal policy.

6. McCloud redband population enhancement (bioenhancement)

a. Artificial propagation programs - Artificial spawning and rearing could be used to assist in the more rapid recovery of depressed populations. This process could involve the capture of adult (brood) McCloud redband stock for the purpose of collecting eggs and placing them in a controlled environment for incubation and hatching (i.e., using hatch boxes or egg incubators), and rearing (i.e., hatchery troughs, circular tanks, etc.). Resultant juvenile fish produced could be released into their stream of parental origin or placed in other waters to supplement existing McCloud redband populations or establishing populations in suitable nonfish bearing waters.

Artificial spawning in combination with the use of near natural incubating and rearing conditions is a

variation of the above and an alternative that can reduce labor needs and costs. Under this scenario, eggs could be collected from captured McCloud redband trout and placed in Whitlock-Vibert (W-V) boxes, which would then be buried in gravel substrate of targeted streams or stream segments. Using W-V boxes would allow biologists to gauge the success of their efforts by allowing hatching success to be evaluated. However, the potential to have genetic impacts, even under near natural conditions, needs to be evaluated prior to initiation of any such program.

Should all other measures prove unsatisfactory, use of artificial propagation techniques has not been eliminated but is considered a less practical alternative at this time for the following reasons. In addition to being relatively costly, the procedures carry a risk of inadvertently altering the genetics of the McCloud redband through unnatural genetic selection processes and by potential mixing of McCloud redband with other hatchery fish if McCloud redband are placed in a hatchery with other strains. The potential for disease to affect such production or to be introduced into the McCloud River system is also a hazard. Clearly, any bioenhancement alternative would have to be carefully evaluated.

b. Spawning/rearing channels and rearing ponds - Natural rearing within enhanced or semicontrolled habitat is another practice that has been used to increase survival of early life stages of salmonids. This method could involve the development of side channels or offsite ponds which could be used for spawning and/or rearing under controlled conditions. These channels could be constructed utilizing clean spawning gravels and cover structures (large and small woody debris) to improve hatching and rearing success thereby improving McCloud redband trout production.

XI. MONITORING

There are three areas that will be monitored under this Conservation Agreement: (1) compliance monitoring, (2) habitat condition and (3) status of the McCloud redband population. Table 7 lists the monitoring actions that will be completed to ensure that the objectives of this Conservation Agreement are met. Selection of monitoring sites for the effectiveness segments was based on one or more of the following criteria:

- The selected site is a previously established monitoring site which provides baseline information
- Initially sites containing the most genetically pure McCloud redband populations within the upper McCloud River basin
- The McCloud redband population of the selected stream is highly vulnerable to drought conditions making monitoring of their numbers a high priority (e.g., Sheepheaven, Edson, Swamp and Moosehead creeks)
- Ease and/or availability of access
- To facilitate the sampling effort, habitat and population monitoring sites will be combined whenever feasible.

A. Compliance with Conservation Agreement - The Redband Core Group will monitor compliance with conservation actions established by this agreement. The Redband Core Group will review the progress of conservation actions on an annual basis through reports, field visits, meetings, etc.

When an action is found to be ineffective or contrary to the objectives presented in this document, the action will be modified so that the desired result can be obtained. Once an action

has been implemented, effectiveness monitoring will provide the data to guide actions to ensure that the desired condition is maintained. New actions will be identified by the Redband Core Group when necessary to achieve the objectives of this agreement.

B. Habitat Condition Monitoring - The Redband Core Group will meet annually to assess the progress of all work related to improvement of McCloud redband and their habitats. The Redband Core Group will select a subcommittee to evaluate the progress of the work completed in the upper McCloud River basin. Specific streams to be monitored include portions of the upper McCloud River, Trout Creek, Edson Creek, Sheepheaven Creek, Moosehead Creek, Tate Creek, and may include other streams as needed. The data collected within the index reaches of these streams will be used to monitor conditions and trends in McCloud redband habitat. Information gathered will be documented in an annual progress report to the full Redband Core Group membership which includes the USFWS.

Monitoring to assess possible effects of land management activities on McCloud redband habitat will also be conducted. The USFS will conduct monitoring of land management activities that involve McCloud redband trout habitat on Federal lands. Private landowners will conduct monitoring of effectiveness of habitat conservation actions on private lands (Table 7, Activity 2).

C. Population Monitoring - The CDFG is responsible for the monitoring of McCloud redband trout populations. To reduce bias in McCloud redband trout population estimates, selected lengths or reaches of active stream channels that contain a representative selection of habitat types (i.e., runs, riffles, pools) and other stream habitat characteristics including water quantity, quality, habitat complexity, slope, channel morphology, substrate composition, etc., of a particular stream will be identified. Selection of index stream reaches, identified in Table 4, will be finalized in coordination with the Redband Core Group. These index reaches will be used to monitor population trends and to evaluate changes in species composition. The frequency of monitoring may be affected by unanticipated events or circumstances including drought, habitat changes, management changes, funding availability and will be designed to avoid adverse impacts on McCloud redband populations. Since the potential of mortality from repeated or frequent electrofishing is of primary concern, visual population monitoring may be used in some locations instead of, or in combination with, any electrofishing that is deemed necessary. The CDFG will work cooperatively with the USFWS, USFS, involved timber companies and other private landowners to conduct fish population surveys. The fish population sampling protocols to be employed will be developed by the Redband Core Group.

XII. MITIGATION PLAN AND PROTOCOL FOR FUTURE ACTIVITIES

The watershed improvement plans contained in this document are not intended, nor expected, to remain static but will be changed or updated, as necessary, to reflect changing conditions, new information (e.g., genetic data), or situations that may occur or when new or innovative technologies are developed that could be used to attain the goals or objectives of this agreement in a more efficient and effective manner.

A. Fire Contingency Plan - In the event of a wildfire where unacceptable resource damage is expected, quick suppression action is needed. In the past some resource values were

compromised in the effort to suppress fires. The USFS and CDF are the agencies responsible for fire control and suppression in the upper McCloud River watershed. All wildfire that occurs within the range of the McCloud redband during the normal fire season will be immediately suppressed with available fire suppression resources. CDF responsibility is generally south of Highway 89 and USFS responsibility is generally north of Highway 89. Through the State Master Mutual Aid Agreement each agency has agreed to adhere to each other's policies, resource considerations, and special mitigation measures when suppressing fire of the other agency. Coordination with landowners is sought whenever private land is involved.

On lands administered by the USFS, where fire escapes initial attack and is not successfully controlled during the first burning period, a Wildfire Situation Analysis (WFSA) will be prepared. The WFSA will address various alternative suppression strategies and will provide opportunities to display special resource mitigation measures. The selection of the final suppression strategy is based on such criteria as firefighter safety, costs, and fire effects on resources. In order to minimize suppression damage to streams and riparian areas, the following guidelines have been established for riparian areas in the USFS ROD for national forests within the territory of the northern spotted owl, which includes the range of the McCloud redband.

1. Locate incident bases, camps, helispots, staging areas, and other centers for incident activities outside of riparian reserves. Use an interdisciplinary team to predetermine suitable locations.
2. Minimize delivery of chemical retardant, foam, or additives to surface waters. Immediate safety imperatives are an exception.
3. Water drafting sites should be located and managed to minimize adverse effects on riparian habitat, water quality and quantity.
4. Design fire suppression strategies and activities to minimize disturbance of riparian ground cover and vegetation.
5. Immediately establish an emergency team to develop a rehabilitation treatment plan needed to attain aquatic conservation strategy objectives whenever riparian reserves are significantly damaged by wildfires.

When the lead fire suppression agency is the CDF, the following will apply. In May 1994, the CDFG and Board of Forestry adopted the "Commission-Board of Forestry Interim Joint Policy on Pre, During and Post Fire Activities and Wildlife Habitat." This Policy stipulates that representatives from the respective departments will work together in prefire planning of vegetation management activities, in the Incident Command System during large fires or burns that threaten important wildlife or plant communities, and in the postfire rehabilitation of watersheds.

B. Drought Contingency Plan - Drought is a part of the ecology of the McCloud redband. Despite the recent periods of drought, records indicate that this century has been relatively wet. A severe or extended period of drought could, however, jeopardize the existence of some subpopulations of McCloud redband trout. Many streams in the upper McCloud River basin experience very low summer flows even following normal winter precipitation (snow) amounts within the upper McCloud River drainage and many more reaches were dry toward the end of the 1987-92 drought. Fourteen tributary streams inventoried (habitat typed) in 1995 by CDFG along

with habitat information collected by the USFS and Sierra Pacific Industries on other McCloud River basin streams provide information regarding where adequate stream flows existed during the driest period of the year during the years surveyed and general information is available on those streams that sustained trout habitat during the drought. Some actions might be considered that could improve the likelihood that known subpopulations of McCloud redband would survive an extended drought.

1. Treat "drought-proof" habitat within the refugium to remove competing, non-indigenous trout where necessary to maintain viable McCloud redband populations. To the extent that drought impacts are predictable, the potential for complete elimination of competing non-indigenous trout should be evaluated and the evaluation and any appropriate actions completed prior to a major drought event.
2. Isolate treated "drought-proof" habitat, if necessary, to prevent re-establishment of non-indigenous trout.
3. Reintroduce McCloud redband trout into selected, suitable, and unoccupied habitat within the refugium.
4. Rescue and relocate putative McCloud redband threatened by drought conditions after careful consideration of the genetic impacts of the action and alternatives.
5. The Redband Core Group will develop an action and monitoring plan to protect and/or rescue and relocate putative McCloud redband trout threatened by drought including conditions that trigger implementation of the plan.
6. The Redband Core Group will evaluate opportunities to improve habitat such as pool deepening and enhancement where necessary to create more drought-proof habitat.

C. Flood Contingency Plan - The McCloud redband have likely endured severe flooding over hundreds of thousands of years. When large floods occur, there is little that man can do to stop the damage associated with severe flood flows. The use of best management practices related to roads and stream crossings including proper design, planning and construction or installation of roads, bridges and/or culverts at stream crossings is the best way to minimize flood damage.

1. Size culverts to accommodate large flow events. Where feasible, bridges or low water fords should be used instead of culverts.
2. Protect riparian zones through the use of best management practices in order to provide stable streambanks and functioning flood plains.
3. Redband Core Group will develop a flood damage assessment and action plan. Any further mitigation for flood is probably most appropriately made through assurances that sustainable subpopulations of McCloud redband are well distributed throughout the upper McCloud River basin.

GLOSSARY

Alleles: One gene of a pair that imparts a particular character or quality to a plant or animal.

Bioenhancement: Using artificial spawning techniques and controlled rearing methods to increase or enhance survival of the species

Candidate Species: Those plant and animal species that in the opinion of the US Fish and Wildlife Service (USFWS) or the National Marine Fisheries Service (NMFS) may qualify for listing under the Federal Endangered Species Act of 1974 (as amended).

Category 1: This term, pursuant to the Federal Endangered Species Act, refers to those species for which the USFWS has on file sufficient information on biological vulnerability and threat(s) to support issuance of a proposed rule to list, but issuance of the proposed rule is precluded. This classification is no longer in use as of 1995. (Federal Register, Vol. 61, Feb. 28, 1996, p. 7596)

Embeddedness: The degree that larger particles (boulders, rubble, or gravel) are surrounded or covered by fine sediment. Usually measured in classes according to percentage of coverage of larger particles by fines (see definition of fines below).

Fines: The fine-grained particles of sand and silt in stream banks and substrate. These are defined by particle sizes with diameters varying downward from 0.85 mm (0.03 inches).

Founder effects: The principle that when a small sample of a larger population establishes itself as an isolated entity, its gene pool carries only a fraction of the genetic diversity represented in the parental population. The evolutionary fates of the parental and derived populations are thus likely to be set along different pathways because the different evolutionary pressures in the different areas occupied by the populations will be operating on different gene pools.

Genetic swamping: The process by which a native stock becomes introgressed with hatchery stock generally as a result of stocking relatively large numbers of hatchery fish in waters supporting smaller numbers of native fish. As used in this document, genetic swamping refers to the stocking of large numbers of native fish in a stream reach currently supporting a hybridized hatchery/McCloud redband population in order to increase the genetic purity of McCloud redband.

Genome: The total genetic composition of the individual or population, which is inherited with the chromosomes.

Glide: A segment of flowing stream that consists of a relatively wide-channel bottom and where the flow is of low to moderate velocities, lacking pronounced turbulence. The substrate usually consists of cobble, gravel and sand.

Indigenous: Originating in the region or country where found, native.

Introgression: The overlapping and interbreeding of two distinct plant or animal species.

Iterative: Repeating; full of repetitions; frequentative.

Meristics: Of or having to do with the number or arrangement of body parts or segments (e.g.,. Use of fin ray counts, lateral line scale counts, gill raker counts, or other external physical measurements to help differentiate taxonomic classifications.

Microsatellite-DNA sequencing: Tandem repetitive elements found throughout the vertebrate genome that consist of reiterated short sequences (particular di-, tri- and tetra-nucleotides) tandemly arrayed, with variations in repeat copy number accounting for a profusion of distinguishable alleles.

Mitochondrial-DNA: The mitochondrial genome consists of a circular DNA duplex that exists outside of the nucleus of the cell in organelles. Mitochondrial DNA (mtDNA) is maternally inherited, therefore mtDNA is contributed by the female parent to the next generation without recombination. For this reason, it is simpler to trace mutation events through evolutionary time with mtDNA than with genomic DNA.

Native: an animal or plant living in the place where it originated, synonymous with indigenous.

Nucleotides: a compound of sugar, phosphoric acid, and a nitrogen base. It is the principal constituent of nucleic acid and determines the structure of genes.

Non-indigenous: Not originating in the region or country where found.

Phylogenetic: of or having to do with the origin and development of a kind of animal or plant

Putative: supposed, reputed.

Recombination: a crossover.

Record of Decision (ROD): Also known as the President's Plan or the Northwest Forest Plan. A planning document for federally managed lands within the range of the northern spotted owl that establishes land allocations and standards and guidelines for the management of habitat for late successional and old-growth forest related species.

Refugium: An area of relatively unaltered climate that is inhabited by plants and animals during a period of continental climatic change (as a severe drought or glaciation) and remains as a center of relict forms from which a new dispersion and speciation may take place after climatic readjustment (plural:refugia).

Relict: A sub-population or group that is surviving in an area isolated from the main area of distribution due to intervention of environmental events such as glaciation or development of an impassable falls.

Run: A swiftly flowing segment of stream characterized by little surface agitation and no major flow obstructions. Often appears as flooded riffles. Typical substrate consists of gravel, cobble, and boulders.

Systematics: The subject or study of taxonomic classification systems of plants or animals.

Taxonomy: Classification, especially of plant and animal species.

REFERENCES

Bacon, M., P. Brouha, M. Rode, and C. Staley. 1980. Redband Trout (*Salmo* sp.) Shasta-Trinity National Forest, California Comprehensive Habitat Management Plan. USFS Shasta-Trinity N.F., Redding, CA. 57 pp.

Berg, W.O. 1994. Introgressive Hybridization of McCloud River Redband Trout by Hatchery Rainbow Trout. unpublished paper 4 pp.

California Department of Fish and Game. 1995. Records of tissue sample collections for genetics analysis. Available at Northern California-North Coast Region (Region 1) Headquarters, Redding, CA. 1 p.

California Department of Fish and Game. 1996. Habitat Typing Summary of Upper McCloud River Basin Tributary Streams (unpublished). Available at Region 1 Headquarters, Redding, CA. 1 p.

Gall, G., M. Bannon, R. Smith, B. Bentley. 1981. Progress Report: Native Trout of California. California Department of Fish and Game, Threatened Trout Committee. 46 pp.

Hoopaugh, D.A. 1974. Status of the Redband Trout (*Salmo* sp.) in California.

California Department of Fish and Game, Inland Fisheries Div. Admin. Rpt. No. 74-7. 11 pp.

McGreer, D.J. 1996. Considerations in Development of Riparian Management Strategies: Potential Consequences of Wildfire on Riparian and Aquatic Systems (a prepublication manuscript). Western Watershed Analysts, Lewiston, Idaho, 37pp.

Nielsen, J., K. Crow, M. Fountain. 1996. Molecular Systematics of a Relic Trout Population: The McCloud River Redband Trout. Unpublished report to California Department of Fish and Game. Available at Region 1 Headquarters, Redding, CA. 61 pp.

Rode, M. 1994. Upper Sacramento River Electrofishing and Reward Tag Studies.

Administrative Report, California Department of Fish and Game. Sacramento, California.

Sierra Nevada Ecosystem Project, Final Report to Congress, Vol. I, Assessment Summaries and Management Strategies, 1996. Davis, University of California, Centers for Water and Wildlife Resources, 209 pp.

SPI data located at Sierra Pacific Industries, Forestry Division office in Anderson, California.

USFS data located at the Supervisor's Office, Shasta-Trinity National Forests, Redding, California.

USDI. 1996. Bureau of Reclamation Water Flow Data for Selected River Systems in California, 1905-1996. Bureau of Reclamation, Redding, California.

Wales, J.H. 1939. General report of investigations on the McCloud River Drainage in 1938. California Fish and Game 25(4): 272-309

Personal Communications

David Hoopaugh, Environmental Specialist III, Environmental Services Division, California Department of Fish and Game, Region 1, Redding, California

Robb Leary, Professor of Fish Genetics, University of Montana, Missoula, Montana

Dennis Maria, Fisheries Biologist, Inland Fisheries Division, California Department of Fish and Game, Region 1, Yreka, California

Julie Kelley, Wildlife Biologist, Sierra Pacific Industries, Anderson, California

APPENDIX A: Aquatic Conservation Strategy

The Aquatic Conservation Strategy was developed to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within them on public lands. The strategy would protect salmon and steelhead habitat on federal lands managed by the Forest Service and Bureau of Land Management within the range of Pacific Ocean anadromy. This conservation strategy employs several tactics to approach the goal of maintaining the "natural" disturbance regime. Land use activities need to be limited or excluded in those parts of the watershed prone to instability. The distribution of land use activities, such as timber harvest or roads, must minimize increases in peak stream flows. Headwater riparian areas need to be protected so that when debris slides and flows occur they contain coarse woody debris and boulders necessary for creating habitat farther downstream. Riparian areas along larger channels need protection to limit bank erosion, ensure an adequate and continuous supply of coarse woody debris to channels, and provide shade and microclimate protection. Watersheds currently containing the best habitat or those with the greatest potential for recovery should receive increased protection and receive highest priority for restoration programs.

Any species-specific strategy aimed at defining explicit standards for habitat elements would be insufficient for protecting even the targeted species. The Aquatic Conservation Strategy must strive to maintain and restore ecosystem health at watershed and landscape scales to protect habitat for fish and other riparian-dependent species and resources and restore currently degraded habitats. This approach seeks to prevent further degradation and restore habitat over broad landscapes as opposed to individual projects or small watersheds. Because it is based on natural disturbance processes, it may take decades, possibly more than a century, to accomplish all of its objectives. Some improvements in aquatic ecosystems, however, can be expected in 10 to 20 years.

The important phrases in these standards and guidelines are "meet Aquatic Conservation Strategy objectives", "does not retard or prevent attainment of Aquatic Conservation Strategy objectives," and "attain Aquatic Conservation Strategy objectives." These phrases, coupled with the phrase "maintain and restore" within each of the Aquatic Conservation Strategy objectives, define the context for agency review and implementation of management activities. Complying with the Aquatic Conservation Strategy objectives means that an agency must manage the riparian-dependent resources to maintain the existing condition or implement actions to restore conditions. The baseline from which to assess maintaining or restoring the condition is developed through a watershed analysis. Improvement relates to restoring biological and physical processes within their ranges of natural variability.

The standards and guidelines are designed to focus the review of proposed and certain existing projects to determine compatibility with the Aquatic Conservation Strategy objectives. The standards and guidelines focus on "meeting" and "not preventing attainment" of Aquatic Conservation Strategy objectives. The intent is to ensure that a decision maker must find that the proposed management activity is consistent with the Aquatic Conservation Strategy objectives. The decision maker will use the results of watershed analysis to support the finding. In order to make the finding that a project or management action "meets" or "does not prevent attainment" of the Aquatic Conservation Strategy objectives, the analysis must include a description of the

existing condition, a description of the range of natural variability of the important physical and biological components of a given watershed, and how the proposed project or management action maintains the existing condition or moves it within the range of natural variability. Management actions that do not maintain the existing condition or lead to improved conditions in the long term would not "meet" the intent of the Aquatic Conservation Strategy and thus, should not be implemented.

Aquatic Conservation Strategy Objectives

Forest Service and BLM-administered lands within the range of the northern spotted owl will be managed to:

1. 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.
2. Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.
3. Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.
4. 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.
5. 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.
6. Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.
7. Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.
8. Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.
9. Maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species.

Components of the Aquatic Conservation Strategy

1. **Riparian Reserves:** Lands along streams and unstable and potentially unstable areas where special standards and guidelines direct land use.
2. **Key Watersheds:** A system of large refuges comprising watersheds that are crucial to at-risk fish species and stocks and provide high quality water.
3. **Watershed Analysis:** Procedures for conducting analysis that evaluate geomorphic and ecologic processes operating in specific watersheds. This analysis should enable watershed planning that achieves Aquatic Conservation Strategy objectives. Watershed analysis provides the basis for monitoring and restoration programs and the foundation from which Riparian Reserves can be delineated.
4. **Watershed Restoration:** A comprehensive, long-term program of watershed restoration to restore watershed health and aquatic ecosystems, including the habitats supporting fish and other aquatic and riparian-dependent organisms.

These components are designed to operate together to maintain and restore the productivity and resiliency of riparian and aquatic ecosystems. Late-Successional Reserves are also an important component of the Aquatic Conservation Strategy. The standards and guidelines under which Late-Successional Reserves are managed provide increased protection for all stream types. Because these reserves possess late-successional characteristics, they offer core areas of high quality stream habitat that will act as refuges and centers from which degraded areas can be recolonized as they recover. Streams in these reserves may be particularly important for endemic or locally distributed fish species and stocks.

Riparian Reserves

There are an estimated 2,627,500 acres of Riparian Reserves interspersed within the matrix. (Acres for matrix listed elsewhere in these standards and guidelines do not include Riparian Reserves.) Riparian Reserves and their appurtenant standards and guidelines also apply where these reserves overlap with any other land allocations. Acres of Riparian Reserves within other land allocations is not calculated but is estimated to encompass 40 percent (based on a sample) of those allocations. The percent of area in Riparian Reserves varies markedly among administrative units, from a high of approximately 74 percent on the Siuslaw National Forest, to a low of approximately 4 percent on the Deschutes National Forest.

Riparian Reserves are portions of watersheds where riparian-dependent resources receive primary emphasis and where special standards and guidelines apply. Standards and guidelines prohibit and regulate activities in Riparian Reserves that retard or prevent attainment of the Aquatic Conservation Strategy objectives. Riparian Reserves include those portions of a watershed directly coupled to streams and rivers, that is, the portions of a watershed required for maintaining hydrologic, geomorphic, and ecologic processes that directly affect standing and flowing water bodies such as lakes and ponds, wetlands, streams, stream processes, and fish habitats. Riparian Reserves include areas designated in current plans and draft plan preferred alternatives as riparian management areas or stream side management zones and primary source areas for wood and sediment such as unstable and potentially unstable areas in headwater areas and along streams. Riparian Reserves occur at the margins of standing and flowing water,

intermittent stream channels and ephemeral ponds, and wetlands. Riparian Reserves generally parallel the stream network but also include other areas necessary for maintaining hydrologic, geomorphic, and ecologic processes.

Under the Aquatic Conservation Strategy, Riparian Reserves are used to maintain and restore riparian structures and functions of intermittent streams, confer benefits to riparian-dependent and associated species other than fish, enhance habitat conservation for organisms that are dependent on the transition zone between upslope and riparian areas, improve travel and dispersal corridors for many terrestrial animals and plants, and provide for greater connectivity of the watershed. The Riparian Reserves will also serve as connectivity corridors among the Late-Successional Reserves.

Interim widths for Riparian Reserves necessary to meet Aquatic Conservation Strategy objectives for different waterbodies are established based on ecologic and geomorphic factors. These widths are designed to provide a high level of fish habitat and riparian protection until watershed and site analysis can be completed. Watershed analysis will identify critical hillslope, riparian, and channel processes that must be evaluated in order to delineate Riparian Reserves that assure protection of riparian and aquatic functions. Riparian Reserves are delineated during implementation of site-specific projects based on analysis of the critical hillslope, riparian, and channel processes and features. Although Riparian Reserve boundaries may be adjusted on permanently-flowing streams, the prescribed widths are considered to approximate those necessary for attaining Aquatic Conservation Strategy objectives. Post-watershed analysis Riparian Reserve boundaries for permanently-flowing streams should approximate the boundaries prescribed in these standards and guidelines. However, post-watershed analysis Riparian Reserve boundaries for intermittent streams may be different from the existing boundaries. The reason for the difference is the high variability of hydrologic, geomorphic and ecologic processes in a watershed affecting intermittent streams. At the same time, any analysis of Riparian Reserve widths must also consider the contribution of these reserves to other, including terrestrial, species. Watershed analysis should take into account all species that were intended to be benefitted by the prescribed Riparian Reserve widths. Those species include fish, mollusks, amphibians, lichens, fungi, bryophytes, vascular plants, American marten, red tree voles, bats, marbled murrelets, and northern spotted owls. The specific issue for spotted owls is retention of adequate habitat conditions for dispersal.

The prescribed widths of Riparian Reserves apply to all watersheds until watershed analysis is completed, a site-specific analysis is conducted and described, and the rationale for final Riparian Reserve boundaries is presented through the appropriate NEPA decision-making process.

Riparian Reserve Widths

Riparian Reserves are specified on page C-30 of these standards and guidelines for the following five categories of streams or waterbodies:

- Fish-bearing streams
- Permanently flowing nonfish-bearing streams

- Constructed ponds and reservoirs, and wetlands greater than 1 acre
- Lakes and natural ponds
- Seasonally flowing or intermittent streams, wetlands less than 1 acre, and unstable and potentially unstable areas

Standards and guidelines specific to Riparian Reserves begin on page C-31.

Intermittent Streams

Intermittent streams are defined as any nonpermanent flowing drainage feature having a definable channel and evidence of annual scour or deposition. This includes what are sometimes referred to as ephemeral streams if they meet these two physical criteria. Including intermittent streams and wetlands within Riparian Reserves is important for successful implementation of the Aquatic Conservation Strategy. Accurate identification of these features is critical to the correct implementation of the strategy and protection of the intermittent stream and wetland functions and processes. Identification of these features is difficult at times due to the lack of surface water or wet soils during dry periods. The following discussion provides guidance on steps to identify these features for inclusion within Riparian Reserves.

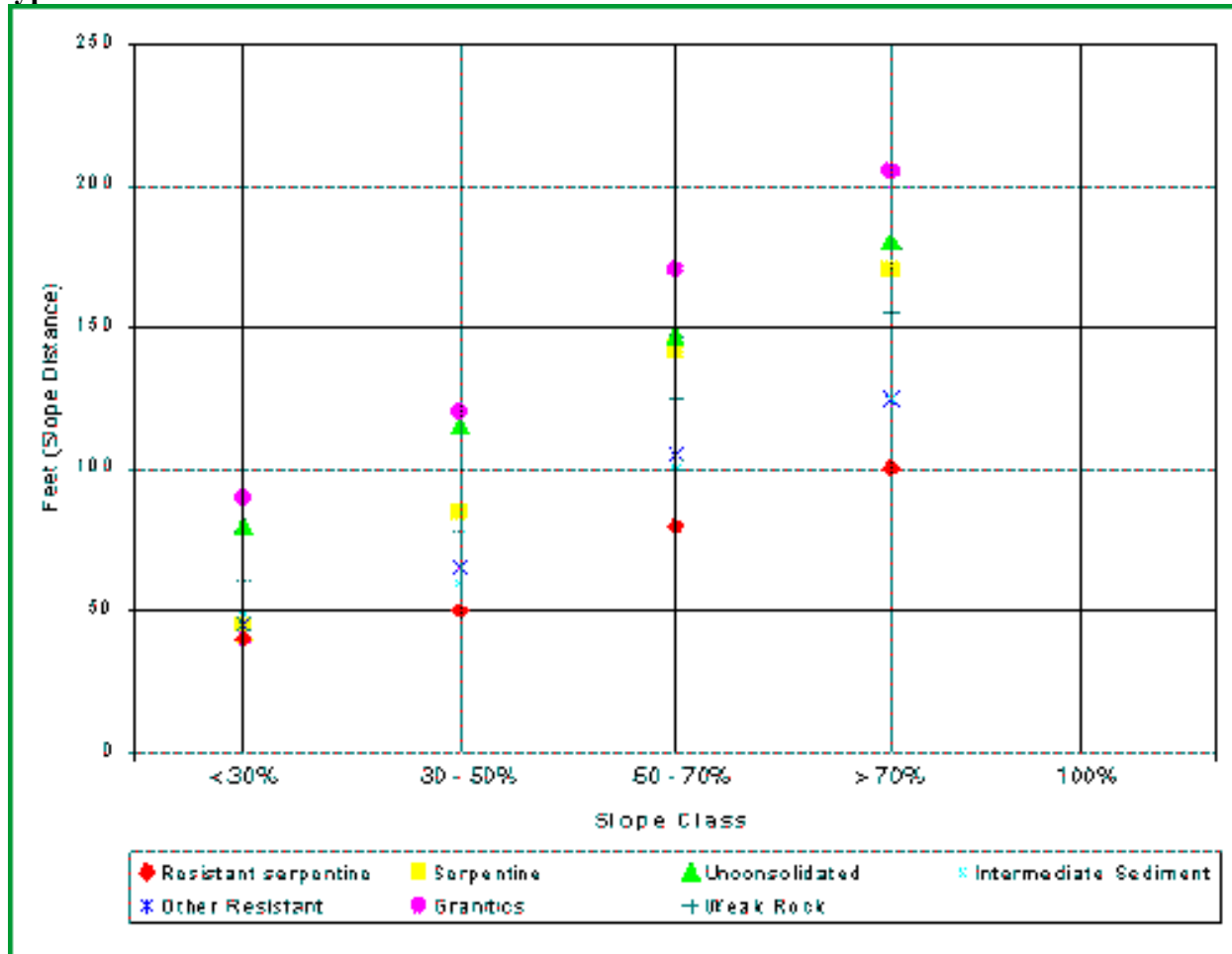
Fish-bearing streams are distinguished from intermittent streams by the presence of any species of fish for any duration. Many intermittent streams may be used as spawning and rearing streams, refuge areas during flood events in larger rivers and streams or travel routes for fish emigrating from lakes. In these instances, the standards and guidelines for fish bearing streams would apply to those sections of the intermittent stream used by the fish.

The following discussion pertains to Riparian Reserve widths on intermittent streams and wetlands necessary to meet Aquatic Conservation Strategy objectives. Other Riparian Reserve objectives, such as providing wildlife dispersal corridors, could lead to Riparian Reserve widths different than those necessary to protect the ecological integrity of the intermittent stream or wetland. These other objectives could yield wider Riparian Reserves than those necessary to meet Aquatic Conservation Strategy objectives. There can never be instances where Riparian Reserves would be narrower than the widths necessary to meet Aquatic Conservation Strategy objectives.

The width of Riparian Reserves necessary to protect the ecological integrity of intermittent streams varies with slope and rock type. Figure A-1 shows the estimated size of Riparian Reserves necessary to protect the ecological values of intermittent streams with different slope and rock types. It shows width, measured as slope distance, needed for stream side protection for reasons other than slope stability. These widths were estimated by an interagency team of scientists based on professional judgment and experience. Protection needs included surface erosion of stream side slopes, fluvial erosion of the stream channel, soil productivity, habitat for riparian-dependent species, the ability of streams to transmit damage downstream, and the role of streams in the distribution of large wood to downstream fish-bearing waters. These estimates were made by geomorphologists, hydrologists, and fish biologists from the Bureau of Land Management, Forest Service, and the Environmental Protection Agency. These distances are consistent with the height of one site-potential tree used to define Riparian Reserve widths (see

page C-30 of these standards and guidelines). Watershed analysis provides the ecological and geomorphic basis for changing the size and location of Riparian Reserves.

Figure A-1. Ecological protection needs for intermittent streams by slope class and rock type.



Ecological Protection Width Needs

Intermittent streams (no mass movement)

The prescribed widths for Riparian Reserves apply to all streams, lakes, ponds and wetlands on lands administered by the Forest Service and BLM within the range of the northern spotted owl until a watershed analysis is completed. Watershed analysis is expected to yield the contextual information needed to define ecologically and geomorphically appropriate Riparian Reserves. Analysis of site-specific characteristics may warrant Riparian Reserves that are narrower or wider than the prescribed widths. Thus, it is possible to meet the objectives of at least the Aquatic Conservation Strategy portion of these standards and guidelines with post-watershed analysis reserve boundaries for intermittent streams that are quite different from those conforming to the prescribed widths. Regardless of stream type, changes to Riparian Reserves must be based on scientifically sound reasoning, and be fully justified and documented.

Wetlands

The combinations of hydrology, soils, and vegetative characteristics are the primary factors influencing the development of wetland habitats. There must be the presence of surface water or saturated soils to significantly reduce the oxygen content in the soils to zero or near zero concentrations. These low or zero soil oxygen conditions must persist for sufficient duration to promote development of plant communities that have a dominance of species adapted to survive and grow under zero oxygen conditions. These wetland characteristics apply when defining wetlands for regulatory jurisdiction or for technical analysis when conducting inventories or functional assessments. Seeps and springs can be classified as streams if they have sufficient flow in a channel or as seasonal or perennial wetlands under the criteria defined in the 1987 Corps of Engineers Wetlands Manual. The standards and guidelines for wetlands, which are based on the hydrologic, physical and biologic characteristics described in the manual, apply to seeps and springs regardless of their size.

Formal definition for implementing section 404 of the Clean Water Act, adopted by the Environmental Protection Agency, is as follows:

The term wetlands means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas.

Detailed technical methods have been developed to assist in identification of wetlands that meet the above definition. Currently, the field manual being used for implementing the Clean Water Act is the "1987 Corps Manual."

For purposes of conducting the National Wetland Inventory, the Fish and Wildlife Service has broadly defined both vegetated and non vegetated wetlands as follows: Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes, (2) the substrate is predominantly undrained hydric soil, and (3) the substrate is non soil and is saturated with water or covered by shallow water at some time during the growing season of each year.

Wetlands typically occur within and adjacent to riparian zones. It is frequently difficult to differentiate wetlands from riparian areas based on the definitions. Most typically, and particularly in forested landscapes, the riparian zone is defined by its spatial relation to adjacent streams or rivers. However, riparian zones are also commonly considered to be lands integrally related to other aquatic habitats such as lakes, reservoirs, intermittent streams, springs, seeps, and wetlands.

Because of such conceptual and definitional vagaries, there is spatial overlap between wetlands and riparian zones. This then results in only a portion of the riparian zone associated with rivers and streams being considered as wetlands. The extent of that portion will depend on the specifics

of hydrologic, vegetation, and soil features. The functions of the wetland portion may also be distinct from the non wetlands. For example, wetlands may provide habitat for specialized plant species or reproductive habitat for amphibians or other organisms that would not be provided by riparian areas.

Once the Riparian Reserve width is established, either based on existing widths or watershed analysis, then land management activities allowed in the Riparian Reserve will be directed by standards and guidelines for managing Riparian Reserves (see page C-31). The standards and guidelines for Riparian Reserves prohibit or regulate activities in Riparian Reserves that retard or prevent attainment of the Aquatic Conservation Strategy objectives

Summary of Aquatic Conservation Strategy for Riparian Reserves

- Involves portions of the landscape where riparian-dependent and stream resources receive primary emphasis.
- Riparian Reserves are designated for all permanently-flowing streams, lakes, wetlands, and intermittent streams.
- Riparian Reserves include the body of water, inner gorges, all riparian vegetation, 100-year floodplain, landslides and landslide prone areas.
- Reserve widths are based on some multiple of a site-potential tree or a prescribed slope distance, whichever is greater. Reserve widths may be adjusted based on watershed analysis to meet Aquatic Conservation Strategy objectives.
- Standards and guidelines prohibit programmed timber harvest, manage roads, grazing, mining and recreation to achieve objectives of the Aquatic Conservation Strategy (see page C-31).

APPENDIX B: Forest Practice Rules and Regulations

California Department of Forestry and Fire Protection

The Department of Forestry and Fire Protection's mission is to protect the people of California from fires, respond to emergencies, and protect and enhance forest, range and watershed values which provide social, economic and environmental benefits to rural and urban citizens. In addition to its direct responsibility for wildlands fire protection on over 32 million acres of California's privately-owned watershed lands, CDF also provides full fire service protection to an additional 11 million acres under agreements with other governmental entities at the local, state and federal levels. The department also protects resources through its vegetation management program, which uses prescribed fire and other means of vegetation management to reduce hazardous fuel build-ups in areas at risk to wildlife, and through the regulation of timber harvesting on over 8 million acres of state and private lands. In this latter role, the Department's foresters examine each timber harvesting plan (THP) to evaluate whether the plan may have a significant impact on the environment and to determine its compliance with the Forest Practice Act, the California Environmental Quality Act and other state and federal laws.

Timber Harvest Regulation on State and Private Timberlands

Regulation of timber harvesting on private and state-owned lands in California occurs under the Z'berg-Nejedly Forest Practice Act of 1973 (FPA) and the California Environmental Quality Act (CEQA). The nine-member Board of Forestry adopts regulations under authority of the FPA and CDF administers those rules.

The Forest Practice Act is intended to regulate timberlands to achieve two goals: (1) to enhance, restore and maintain the productivity of timberland wherever feasible and (2) to achieve maximum sustained production of high quality timber while giving consideration to values relating to recreation, watershed, wildlife, range and forage, fisheries, regional economic vitality, employment and aesthetic enjoyment.

The California Environmental Quality Act requires that public agencies not approve projects as proposed if there are feasible alternatives or feasible mitigation measures available which would substantially lessen the significant environmental effects of such projects. The applicant must disclose and identify the significant effects of a project for state agency and public review.

The FPA emphasizes decision making based on the rules. The Forest Practice Rules (FPR) have been evolving over the last 23 years in response to changing environmental considerations (see Table B-1 as an example of the FPRs). CEQA, in contrast, emphasizes case-by-case, open-ended analysis of environmental impacts, alternatives, and mitigation measures. The review of timber harvesting plans is a melding of the two processes.

Board of Forestry

The Board of Forestry is a nine-member part-time board appointed by the governor. The board consists of five public members with no financial interests in the forest products industry, three

timber industry members and one member with a range and livestock interest. The board's general powers include the development and maintenance of an adequate forest policy for the state and setting policy for CDF. The board establishes the forest practice regulations after public hearings.

Registered Professional Forester (RPF)

California's Professional Forester's Law (PFL) became effective on March 7, 1973. The PFL outlines the guiding principles and responsibilities of the RPF, and provides the state with professionals who are knowledgeable in developing and carrying out timber harvesting plans. General requirements to become an RPF are seven years experience in forestry related work of which three years must be under the supervision of an RPF, passing a comprehensive examination administered by the Professional Foresters Examining Committee (PFEC) with a score of 75% or more. The Board of Forestry has authority to take disciplinary action against an RPF failing to abide by good forestry practices.

Licensed Timber Operator (LTO)

The Forest Practice Act requires all timber operators to obtain an annual timber operator's license. A first time applicant must have completed an education program approved by the department that covers the statutes and regulations governing timber operations in the state and have completed 3000 hours of work experience in two or more areas of employment in timber operations. The department may revoke or deny the license for a record of noncompliance with the forest practice rules.

Timber Harvesting Plan Review

Under the FPA, a timber harvesting plan (THP) must be prepared and signed by a registered professional forester (RPF) and submitted to CDF for review and approval for each timber harvest. CDF submits the THP to an interdisciplinary review involving the Regional Water Quality Boards, the Department of Fish and Game, and the Division of Mines and Geology. Other agencies, such as the Department of Parks and Recreation, may participate when the harvest has the potential to affect resources they are responsible for. The Department is the chair of the review team and has the final decision on the THP. The other agencies may nonconcur in writing and may appeal CDF's decision to the Board of Forestry.

A THP must include a description of the site to be harvested, the types of timber operations to be conducted and mitigation measures to be used consistent with the board's rules. Information concerning silvicultural systems, yarding methods, reforestation methods, erosion control methods, stream protection, road building and erosion hazard potential and erosion control measures must be included in the THP. The RPF must conduct a field investigation to apply the rules with respect to watercourse classification and protection measures, location of sensitive terrain and the development of appropriate mitigation measures or alternatives.

Each THP is subject to a preharvest inspection during the review process. All agencies are invited to attend. After the inspection each attending agency will write a report and, if necessary,

will ask for mitigation for any activity that threatens to cause a significant effect on any forest resource or would violate any other state or federal law, such as the California Endangered Species Act or the Porter-Cologne Water Quality Act. The THP is also subject to public review; CDF will consider all comments by the agencies and the public before making a decision on the plan. CDF's records indicate the majority of the plans incorporate additional mitigation measures before final approval as a result of this review process.

The foundation for the regulation of forest practices in California is the forest practice rules. Due to the variety of individual circumstances of timber harvesting in California, the rules are not strictly prescriptive. Flexibility is allowed to cover a wide variety of site specific circumstances. However, the underlying principle and goal is to achieve the timber harvesting objective without causing a significant adverse impact to any forest resource.

As an example of the flexibility in the rules, the department issued a directive on considerations that the private and public foresters should be giving to the coho salmon under the forest practice rules. The April 29, 1997 document titled "Coho Salmon Considerations of Timber Harvests Under the California Forest Practice Rules" (CSC) covers coho salmon biology, timber harvest impacts, possible conservation measures and encourages the RPF to seek input from knowledgeable fishery biologists when preparing their plans. A full text of this document is available by contacting CDF in Sacramento, California.

The following table gives a sample of the forest practice rules that provide protection to forest resources. The table lists the five major resources that affect fisheries and what the rules provide as a minimum and what the rules provide in actual practice. The actual practices are taken from the results of the department and board's on-going monitoring and auditing program and the results the department is experiencing with the CSC. This table is presented to show that one must not look solely at the rules to assess the protection that the rules are affording forest resources. California's forest practice rules have minimum standards which can be adjusted to provide additional protection on a site-specific basis, it should be noted that most THPs have been designed to exceed the minimum standards.

Table B-1. A Sampling of California's Forest Practice Rules		
KEY WATERSHED PRODUCTS	RULE MINIMUM	RULE AS APPLIED
Shade and Temperature	Class I (fish bearing) retain at least 50% of the overstory and 50% of the understory canopy covering the ground and adjacent waters in a well distributed multi-storied stand.	Hillslope Monitoring Program and CDF audit programs shows >70% overstory canopy remaining following harvest, on average*. (Measured with a spherical densiometer.) Ranges from 25' - to full WLPZ width.
	Class II (intermittent nonfish bearing fish within 1000' downstream) retain at least 50% of the total canopy covering the ground in a well distributed multi-storied plan.	Same as above. *Note this number reflects correction for the QA/QC work done for the hillslope monitoring program.

Table B-1. A Sampling of California's Forest Practice Rules

KEY WATERSHED PRODUCTS	RULE MINIMUM	RULE AS APPLIED
	Class III (ephemeral) where needed to protect the beneficial uses of water as determined by professional judgment. Percentage leave canopy based on-site specific basis.	Audit program work has shown an average equipment exclusion for Class III watercourse of about 70 feet.
	Alternative or in lieu prescriptions may be developed by the RPF or Director on-site specific basis. Prescription must provide equal or greater protection for the quality and beneficial uses of water.	Alternative rarely used. In lieu is used more often. CDF Foresters do not approve if the in lieu does not provide equal or better protection than the standard rule.
Large Woody Debris	Retain at least two living conifers per acre at least 16" DBH and 50' tall within 50' of all Class I and II watercourses.	Audit work surveys show an average of 29 trees over 16 inches within 50 feet of a Class I watercourse. Some landowners are permanently designating specific large leave trees for LWD Recruitment. Individual trees with high probability of falling instream in near future are marked for leave.
	Shade canopy retention standards for Class I and II waters.	Landowners encourage to place LWD in watercourse with Dept. of Fish and Game concurrence. There high percentage of canopy retention on Class I and II watercourses means there will likely be many LWD recruitment trees left after harvest and any subsequent harvest.
Sediment	Watercourse and Lake Protection Zones for tractor logging: Class I: <30% slope, 75'; 30-50% slope, 100', >50% slope, 150'. Class II: <30% slope, 50'; 30-50% slope, 75'; >50% slope, 100'.	Implementation of WLPZ widths met or exceeded FPR requirements for about 90% of hillslope monitoring transects, with minor departures from the Rules about 10% of the time.
	Class III: determined on-site specific basis.	Applied on-site specific basis.
	WLPZ operations and Protection:	
	* Removal of trees to limit of shade canopy retention standards.	Canopy 70%+ being retained on Class I and II.
	* No construction or reconstruction of roads, tractor roads, or landing unless specifically approved by Director.	Monitoring program found 100% compliance for FPR prohibiting road construction of tractor roads and landing in WLPZ, except as specified in THP.
	* Trees cut in WLPZ felled away from watercourse.	For the Rule requiring trees to be felled away from watercourses, Monitoring Program only found minor departures on about 3% of the WLPZ transects.
	* Where less than 50% canopy exists prior to timber operations, only sanitation-salvage may occur.	Rarely are blowdown trees salvaged from the WLPZ through exemption process.

Table B-1. A Sampling of California's Forest Practice Rules		
KEY WATERSHED PRODUCTS	RULE MINIMUM	RULE AS APPLIED
	* At least 75% surface cover and undisturbed area shall be retained.	Hillslope Monitoring Program WLPZ transects had an average of about 94% surface cover in zones.
	* No heavy equipment use in timber felling, yarding or site preparation unless specifically approved.	This Rule was met or exceeded 99% of the time.
	* Areas of mineral soil exceeding 800 square feet exposed by timber operations treated for reduction of soil loss.	Limited sample had 100% compliance with Rules. Most THPs are designating areas as small as 100 square feet will be treated. All crossings are being required to be treated.
	* Where necessary to protect the beneficial uses of water any amount of area can be required to be seeded, mulched or replanted.	Limited sample had 100% compliance with Rules.
	* Broadcast burning prohibited.	Some minor incursions have occurred
	Road and Landing Construction:	
	* Road construction on slopes over 65% requires full bench construction.	Limited sample showed that this Rule was being met or exceeded 80% of the time.
	* Through fills constructed in one-foot lifts.	Being met.
	* Drainage facilities required to pass 50-year storm event.	Limited sample showed that this Rule is being met or exceeded about 90% of the time.
	* Trash or debris racks required when necessary.	Hillslope Monitoring Program road transects had an average of about 85% of transects meeting or exceeding this Rule.
	* Drain facilities shall not discharge erodible fill or other erodible material. Energy dissipaters to be used.	Inspections show being met.
	* Drainage facilities in place by October 15 each year.	Inspections show being met.
	* No road construction under saturated soil conditions.	Under certain conditions, no road construction allowed after October 15.
	* Roads used for hauling in winter period shall be surfaced with rock in depth and quantity sufficient to maintain a stable road surface.	Insufficient rocking of road wet areas were found about 17% of the time. Getting less plans with winter operations. Those plans that do have winter operations have enforceable standards on when to shutdown.
	* Permanent watercourse crossings shall be constructed or maintained to prevent diversion of stream overflow down the road.	Hillslope Monitoring Program showed about 70% of crossings evaluated met or exceeded the FPR preventing diversion potential at crossings.
	* All roads and tractor roads except those with permanent drainage facilities are waterbarred by October 15.	Adequate numbers of drainage structures to minimize erosion on the roadbed were found to occur about 80% of the time.

Table B-1. A Sampling of California's Forest Practice Rules

KEY WATERSHED PRODUCTS	RULE MINIMUM	RULE AS APPLIED
	* During timber operations, road running surfaces shall be treated for stabilization to prevent excessive loss of road surface materials.	Inspections show being met.
	* Drainage structures shall be maintained to allow free flow of water and minimize soil erosion.	Hillslope Monitoring Program showed that 17% of road transects evaluated did not meet or exceed the FPRs requiring drainage ditches be maintained to allow free flow of water.
	* Maintain for erosion controls in roads, tractor roads and landing is at least 1 year and can be increased to 3 years.	One year is the norm, 2-3 years is required when necessary because of highly erodible conditions.
	* Tractor operations prohibited on slopes over 65%; slopes over 50% with a high or extreme erosion hazard rating; slopes over 50% which lead with flattening to sufficiently dissipate water flow and trap sediment.	Hillslope Monitoring Program showed that tractor roads were limited in number and width to number needed on about 90% of skid trail transects observed. Hillslope Monitoring Program showed 100% compliance with the FPR dealing with unstable areas. Hillslope Monitoring Program showed 100% compliance with the FPR limiting tractor use on steep slopes.
Flow	Stream crossing shall allow for unrestricted passage of fish and water.	Inspections show being done. Majority of time drafting from streams required to modify the rate of drafting or diversion to assure no visible drop in volume of water downstream.
Nutrients	Green slash is required to be removed from the stream if deposited by timber operations.	Inspections show being met majority of time.
Cumulative Impacts	Requires an assessment of on-site and off-site interactions of proposed project activities with the impacts of past and reasonably foreseeable future projects.	Each THP is evaluated on an on-site specific basis. THP not approved if cumulative effect analysis inadequate.

Sustained Yield Plans

The Sustained Yield Plan (SYP) is a long-term timber management plan that addresses long-term sustained yield of timber resources, and a cumulative effects analysis which includes issues of fish, wildlife and watershed impacts on a large landscape basis. The SYP may be submitted at the option of the landowner and is intended to supplement the THP process. The SYP is similar to a program EIR or EIS. It covers a broad spectrum of issues on a landscape basis. Regardless, whether the landowner prepares an SYP, individual THP's must be submitted for individual harvest areas. However, a THP may tier to the SYP and need not address issues already discussed and mitigated in the SYP.

Presently CDF has received six SYPs for 709,000 acres. The department expects 20 more over the next three years. Several landowners are combining the SYP with a Habitat Conservation Plan for listed species. The advantage to the landowner is the certainty and stability both documents bring to the management of their timberland. Timber, fish, wildlife and watershed issues will have all been addressed on a landscape basis.

Exemptions from Timber Harvesting Plan Requirements

While, certain minor timber harvesting operations are exempted from the preparation and review of a THP, these operations are still subject to the operational portions of the rules. Furthermore, exempted operations must meet ten additional requirements to be considered not having a significant adverse impact on forest resources. The exemptions are for Christmas tree cutting, harvesting dead, dying and diseased trees and fuelwood in amounts less than 10% of the average volume per acre, fire safe harvests of trees within 150' of a dwelling and a one-time conversion of three acres to some other use than the growing and harvesting of timber. The ten additional conditions include:

1. No tractor operations on slopes over 50%.
2. No new construction of tractor roads on slopes over 40%.
3. No tractor operations on known slides and unstable areas.
4. No new road construction or reconstruction.
5. No heavy equipment operation in a watercourse protection zone, except for maintenance of roads and drainage facilities.
6. No known sites of rare, threatened or endangered plants or animals will be disturbed, threatened or damaged.
7. No timber harvesting in a watercourse and lake protection zone except for sanitation-salvage harvesting.
8. No timber operations in a buffer zone of a species of special concern.
9. Operations in a Special Treatment Area will conform to special rules of the Special Treatment Area.
10. No timber operations on any significant archaeological or historical site.

Under certain emergency conditions, timber operations may begin without an approved THP. However, a Notice of Emergency Operations is required. This notice is submitted by an RPF with a declaration, under penalty of perjury, that a bona fide emergency does exist and that immediate harvesting of trees is warranted. Timber operations may begin 5 days after the department receives the notice and may not extend more than 120 days unless a THP is submitted to and approved by the department. Emergency timber operations must comply with all operational forest practice rules. The department places a high priority on field inspections of emergency operations because, unlike the exemption harvesting, emergency harvesting can be a full blown timber operation with potential for environmental damage. The following types of conditions constitute emergencies:

1. Dead, dying trees as a result of insects, disease, parasites or animal damage.
2. Fallen, damaged, dead or dying trees as a result of wind, snow, freezing weather, fire, flood, landslide, earthquake or air and water pollution.

3. Cutting or removing trees required for the emergency repair of roads.
4. Potential financial loss of timber that was previously inoperable or unmerchantable because of access, location, condition, or timber volume, if the harvest of this timber has become unexpectedly feasible, and the opportunity to harvest will not be economically feasible for more than 60 days, provided that the operations will have only minimal impact on timber resources.

Enforcement of the Forest Practice Regulations

After the THP has been approved, CDF will make periodic compliance inspections of the harvesting operations. The operation must not only comply with the forest practice rules, but also any special provisions in the THP. The timber operations are done by a licensed timber operator. The operator's license may be suspended, revoked or denied for violations of the forest practice rules. Violations of the regulations are misdemeanors and punishable by a fine of not more than \$1,000 or by imprisonment in the county jail for not more than 6 months. The department has authority through the FPA to issue stop work orders, file Notices to Take Corrective Action and issue liens on property if corrective action has to be done by the state. Registered Professional Foresters may also be censured through the Professional Foresters Licensing Committee of the Board of Forestry. The department conducts an average of 8400 inspections of timber operations yearly. An average of 1100 Notices of Violation are issued. Approximately 125 misdemeanor cases are taken to the District Attorney for prosecution.

Regulatory Changes

The Board of Forestry recently adopted additional rules for watercourse and lake protection. Specific rules adopted were:

- Extending the winter operating period to May 1 for installing erosion control structures on roads, landings and skid trails concurrent with operations.
- Provide for 50-foot Equipment Limitation Zones (ELZ) on most Class III watercourses. This will offer greater protection from the introduction of sediment into these ephemeral watercourses. Such sediment would have a potential of reaching the higher order streams and causing sediment problems.
- Prohibit the use of roads under saturated soil conditions.
- Require stabilization of approaches to watercourse crossings.

The Board of Forestry in 1998 will be reviewing the exemption and emergency notice regulations for their impacts on forest resources, including fisheries. The department will be asking the board to require more RPF responsibility for oversight of timber harvesting on THPs they submitted.

Continuing Education

Both private and state foresters need additional training on the needs of salmon and other fisheries and how they can provide protection when developing and proposing a timber harvesting plan. A Watershed Academy has been developed cooperatively between the

department and the Department of Fish and Game. The academy stresses fish biology, watershed analysis and mitigation. The watershed assessment portion includes road assessment techniques that are designed to catalog road problems and prioritized their corrective work. This week long program will continue to be given through the University of California Extension Service. Furthermore, additional training is provided through private organizations such as the California Licensed Foresters Association, Associated California Loggers and the California Forestry Association.

Policy Changes

The department and board do not anticipate the changing of any policies at this time.

Organizational Changes

The organizational structure of the department is not expected to change. The preliminary results of the monitoring program points out some areas of the rules that need to be emphasized in the department's inspection program. The department's audit foresters will use the data place greater emphasis in areas of the rules that are showing a 10-30% noncompliance.

Funding

Funding for the forest practice program comes mainly from state forest timber sales. The present budget is approximately \$9.5 million annually.

Monitoring of Forest Practices on State and Private Timberlands

State Monitoring Programs

The Monitoring Study Group (MSG) was formed by the Board of Forestry in 1989 to develop a Long Term Monitoring Program (LTMP) for assessing the effectiveness of the forest practice rules in protecting water quality. The group is made up of members of the public, resource agencies and the timber industry. Several projects have been carried out over the past five years that has allowed the LTMP to proceed.

The primary objective of the LTMP is to provide an ongoing assessment of the effectiveness of the Forest Practice Rules, as implemented, in protecting the most sensitive beneficial uses of water, i.e., coldwater fisheries and domestic water supplies) through implementation, effectiveness, and project monitoring.

The LTMP results will be provided to the BOF and the public in a timely manner to contribute

effectively to BOF's program for reviewing and, where necessary, strengthening the Rules' performance as best management practices (BMPs).

The LTMP has an in-stream and hillslope component. The first year of data collection on the hillslope component was completed in 1996 on 50 timber harvesting plans. The data collection continues on another 50 THPs in 1997. A summary of the 1996 data should be available later this year.

In addition to the hillslope monitoring efforts the Department of Fish and Game has produced an Instream Monitoring Handbook describing in detail how to develop and implement an instream monitoring program. In addition, the department is working with the North Coast Regional Water Quality Board and the Mendocino County Resource Conservation District in developing an instream monitoring plan for the Garcia River Watershed. The department has approximately \$250,000 yearly for monitoring projects.

APPENDIX C: California Water Code and California Department of Fish and Game

Water Code Section 1243 - The use of water for recreation and preservation and enhancement of fish and wildlife resources is a beneficial use of water. In determining the amount of water available for appropriation for other beneficial uses, the board shall take into account, whenever it is in the public interest, the amounts of water required for recreation and the preservation and enhancement of fish and wildlife resources.

The State Water Resources Control Board shall notify the Department of Fish and Game of any application for a permit to appropriate water. The Department of Fish and Game shall recommend the amounts of water, if any, required for the preservation and enhancement of fish and wildlife resources and shall report its findings to the board. This section shall not be construed to affect riparian rights.

Water Code Section 6500 - Whenever an application for approval of plans and specifications for a new dam, or for the enlargement of any dam, in any stream in this State, is filed pursuant to Part 1 of this division, a copy of the application shall be filed with the Fish and Game Commission as required by the Fish and Game Code.

Water Code Section 6501 - The provisions for the installation of fishways over or around dams and for the protection and preservation of fish in streams obstructed by dams are contained in Chapter 3 (commencing with Section 5900~, Part 1, Division 6 of the Fish and Game Code.

Water Code Section 7047 - No person may alter, divert or deflect the course of any non-navigable stream in any surface mining dredging operation without first obtaining the approval of the board of supervisors of the county in which dredging is being done. Nothing in this section shall be construed as conflicting with the powers of the State Reclamation Board or the California Debris Commission or contractors or permittees carrying out flood control projects under authority of either board or commission,

Water Code Section 11901 - It is the purpose of this chapter to provide for the planning and construction of water storage, conservation, and regulation facilities and associated fish and wildlife and recreation features consistent with this declaration and to make provision for funds therefor on a continuing basis, and to provide for the operation and maintenance of such fish and wildlife and recreation features.

In enacting this chapter, however, it is not the intent of the Legislature to diminish any existing powers of the Department of Water Resources, the Department of Parks and Recreation, or the Department of Fish and Game, but rather to provide specifically for the preservation and enhancement of fish and wildlife resources and for a system of public recreation facilities at state water projects as part of a coordinated plan for multipurpose use of these projects.

Water Code Section 12845 - In order to realize the full potential of such projects for fish and wildlife enhancement and for recreational development, state agencies having resource management responsibilities affected by the project are authorized to cooperate with federal and local sponsoring agencies through all stages of the project formulation and planning process, and to develop such data as, in their judgment, may be necessary to carry out the intent and purpose

of this chapter.

Such physical features as may be necessary to permit full public utilization of the completed project for recreational purposes shall be constructed and such lands as may be necessary for recreational purposes and for fish and wildlife enhancement shall be acquired at the same time and in the same manner as lands for other project purposes .

Water Code Section 12846 - The Department of Fish and Game shall be responsible for the management of all fish and wildlife resources at any project subject to the provisions of this chapter.

Water Code Section 13140 - The state board shall formulate and adopt state policy for water quality control. Such policy shall be adopted in accordance with the provisions of this article and shall be in conformity with the policies set forth in Chapter 1 (commencing with Section 13000).

Water Code Section 13141 - State policy for water quality control adopted or revised in accordance with the provisions of this article, and regional water quality control plans approved or revised in accordance with Section 13245, shall become a part of the California Water Plan effective when such state policy for water quality control, and such regional water quality control plans have been reported to the Legislature at any session thereof. However, prior to implementation of any agricultural water quality control program, an estimate of the total cost of such a program, together with an identification of potential sources of financing, shall be indicated in any regional water quality control plan.

Water Code Section 13142 - State policy for water quality control shall consist of all or any of the following:

- a) Water quality principles and guidelines for long-range resource planning, including ground water and surface water management programs and control and use of recycled water.
- b) Water quality objectives at key locations for planning and operation of water resource development projects and for water quality control activities.
- c) Other principles and guidelines deemed essential by the state board for water quality control.

The principles, guidelines, and objectives shall be consistent with the state goal of providing a decent home and suitable living environment for every Californian.

Water Code Section 13143 - State policy for water quality control shall be periodically reviewed and may be revised.

Water Code Section 13144 - During the process of formulating or revising state policy for water quality control the state board shall consult with and carefully evaluate the recommendations of concerned federal, state, and local agencies.

Water Code Section 13145 - The state board shall take into consideration the effect of its actions pursuant to this chapter on the California Water Plan as adopted or revised pursuant to Division 6 (commencing with Section 10000) of this code, and on any other general or coordinated governmental plan looking toward the development, utilization, or conservation of the waters of the state.

Water Code Section 13146 - State offices, departments and boards, in carrying out activities which affect water quality, shall comply with state policy for water quality control unless otherwise directed or authorized by statute, in which case they shall indicate to the state board in writing their authority for not complying with such policy.

Water Code Section 13147 - The state board shall not adopt state policy for water quality control unless a public hearing is first held respecting the adoption of such policy. At least 60 days in advance of such hearing the state board shall notify any affected regional boards, unless notice is waived by such boards, and shall give notice of such hearing by publication within the affected region pursuant to Section 6061 of the Government Code. The regional boards shall submit written recommendations to the state board at least 20 days in advance of the hearing.

California Department of Fish and Game Codes

CHAPTER 6. FISH AND WILDLIFE PROTECTION AND CONSERVATION

F&G Code Section 1600. Purpose of Chapter. The protection and conservation of the fish and wildlife resources of this state are hereby declared to be of utmost public interest. Fish and wildlife are the property of the people and provide a major contribution to the economy of the state as well as providing a significant part of the people's food supply and therefore their conservation is a proper responsibility of the state. This chapter is enacted to provide such conservation for these resources.

F&G Code Section 1601. Construction That Adversely Affects Wildlife Areas

a) Except as provided in this section, general plans sufficient to indicate the nature of a project for construction by, or on behalf of, any state or local governmental agency or any public utility shall be submitted to the department if the project will (1) divert, obstruct, or change the natural flow or the bed, channel, or bank of any river, stream, or lake designated by the department in which there is at any time an existing fish or wildlife resource or from which these resources derive benefit, (2) use material from the stream beds designated by the department, or (3) result in the disposal or deposition of debris, waste, or other material containing crumbled, flaked, or ground pavement where it can pass into any river, stream, or lake designated by the department.

If an existing fish or wildlife resource may be substantially adversely affected by that construction, the department shall notify the governmental agency or public utility of the existence of the fish or wildlife resource together with a description thereof and shall propose reasonable modifications in the proposed construction that will allow for the protection and continuance of the fish or wildlife resource, including procedures to review the operation of those protective measures. The department's description of an existing fish or wildlife resource

shall be specific and detailed and the department shall make available upon request the information upon which its conclusion is based that the resource may be substantially adversely affected. The proposals shall be submitted within 30 days from the date of receipt of the plans, except that the time period may be extended by mutual agreement. Upon a determination by the department and after notice to the affected parties of the necessity for an onsite investigation or upon the request for an onsite investigation by the affected parties, the department shall make an onsite investigation of the proposed construction and shall make the investigation before it proposes any modifications.

(b) Within 14 days from the date of receipt of the department's proposals, the affected agency or public utility shall notify the department in writing whether the proposals are acceptable, except that the time period may be extended by mutual agreement. If the department's proposals are not acceptable to the affected agency or public utility, the agency or public utility shall so notify the department. Upon request, the department shall meet with the affected agency or public utility within seven days of receipt of the notification, or at a time mutually agreed upon, for the purpose of developing proposals that are acceptable to the department and the affected agency or public utility.

If mutual agreement is not reached at the meeting held pursuant to paragraph (1), a panel of arbitrators shall be established. The panel of arbitrators shall be established within seven days from the date of the meeting, or at a time mutually agreed upon, and shall be composed of one representative of the department, one representative of the affected agency or public utility, and a third person mutually agreed upon, or if no agreement can be reached, the third person shall be appointed in the manner provided by Section 1281.6 of the Code of Civil Procedure. The third person shall act as chair of the panel. The panel may settle disagreements and make binding decisions regarding the fish and wildlife modifications. The arbitration shall be completed within 14 days from the date that the composition of the panel is established, unless the time is extended by mutual agreement. The expenses of the department representative shall be paid by the department; the expenses of the representative of the governmental agency or the public utility shall be paid by the governmental agency or the public utility; and the expenses of the chair of the panel shall be paid one-half by each party.

(c) A governmental agency or public utility proposing a project subject to this section shall not commence operations on that project until the department has found that the project will not substantially adversely affect an existing fish or wildlife resource or until the department's proposals, or the decisions of a panel of arbitrators, have been incorporated into the project. The department shall not condition the stream bed alteration agreement on a project subject to this section on the receipt of another state or federal permit.

(d) The department shall determine and specify types of work, methods of performance, or remedial measures that are exempt from the operation of this section.

(e) With regard to any project that involves the routine maintenance and operation of water supply, drainage, flood control, or waste treatment and disposal facilities, notice to, and agreement with, the department is not required subsequent to the initial notification and agreement, unless the work as described in the agreement, is substantially changed or conditions

affecting fish and wildlife resources substantially change, and the resources are adversely affected by the activity conducted under the agreement. This subdivision applies in any instance where notice to, and agreement with, the department has been attained, prior to January 1, 1977.

(f) This section does not apply to any of the following projects except that notification by the agency or public utility performing any of the following projects shall be made to the department within 14 days from the date of the commencement of the project:

(1)(A) Immediate emergency work necessary to protect life or property.

(B) Immediate emergency repairs to public service facilities necessary to maintain service as a result of a disaster in a disaster-stricken area in which a state of emergency has been proclaimed by the Governor pursuant to Chapter 7 (commencing with Section 8550) of Division 1 of Title 2 of the Government Code.

(2) Emergency projects undertaken, carried out, or approved by a public agency to maintain, repair, or restore an existing highway, as defined in Section 360 of the Vehicle Code except for a highway designated as an official state scenic highway pursuant to Section 262 of the Streets and Highways Code, within the existing right-of-way of the highway, damaged as a result of fire, flood, storm, earthquake, land subsidence, gradual earth movement, or landslide, within one year of the damage. This paragraph does not exempt from this section any project undertaken, carried out, or approved by a public agency to expand or widen a highway damaged by fire, flood, storm, earthquake, land subsidence, gradual earth movement, or landslide.

(g) The department may enter into agreements with applicants for a term of not more than five years for the performance of operations on projects subject to this section. The terms of the agreement may be renegotiated at any time by mutual consent of the parties. Each agreement shall be renewed automatically by the department at the expiration of its term unless the department determines that there has been a substantial change in conditions. If there is a disagreement between the department and the applicant as to whether there has been a substantial change in conditions the department and the applicant shall proceed to arbitration pursuant to subdivision (b). The department may charge a fee when the agreement is entered into and for each renewal but may not charge an annual fee for this purpose.

(Amended Statutes 1996 Chap. 825)

F&G Code Section 1602. Obstruction Notice; Arbitration. In addition to the provisions of Section 1601, the department following submission of the modifications referred to in Section 1601, shall by mutual agreement with any state agency proposing such project, establish such procedures that the parties deem necessary to provide adequate review of the proposed modifications and consideration of alternative conditions designed to protect existing fish and wildlife resources. If no agreement can be reached between the department and the state agency proposing the project, the procedures for arbitration specified in Section 1601 shall then apply.

F&G Code Section 1603. Diversion or Obstruction of Waters (a) It is unlawful for any person to

substantially divert or obstruct the natural flow or substantially change the bed, channel, or bank of any river, streams or lake designated by the department, or use any material from the stream beds, without first notifying the department of that activity, except when the department has been notified pursuant to Section 1601. The department within 30 days from the date of receipt of that notice, or within the time determined by mutual written agreement, shall, when an existing fish or wildlife resource may be substantially adversely affected by that activity, notify the person of the existence of that fish or wildlife resource together with a description of the fish or wildlife, and shall submit to the person its proposals as to measures necessary to protect fish and wildlife. Upon a determination by the department of the necessity for onsite investigation or upon the request for an onsite investigation by the affected parties, the department shall notify the affected parties that it shall make an onsite investigation of the activity and shall make that investigation before it proposes any measure necessary to protect the fish and wildlife. The department's description of an existing fish or wildlife resource shall be specific and detailed and the department shall make available upon request the information upon which its conclusion is based that the resource may be substantially adversely affected.

(Amended Statutes 1996 Chap. 825)

CHAPTER 2. POLLUTION

Article 1. (General)

F&G Code Section FG 5650. Pollute Waters; Hazardous Substances List

Except as provided in subdivision (b), it is unlawful to deposit in, permit to pass into, or place where it can pass into the waters of this state any of the following:

- Any petroleum, acid, coal or oil tar, lamp black, aniline, asphalt, bitumen, or residuary product of petroleum, or carbonaceous material or substance.
- Any refuse, liquid or solid, from any refinery, gas house, tannery, distillery, chemical works, mill factory of any kind.
- Any sawdust, shavings, slabs, edgings.
- Any factory refuse, lime, or slag.
- Any *cocculus indicus*.
- Any substance or material deleterious to fish, plant life, or bird life.

This section does not apply to a discharge or a release that is expressly authorized pursuant to the terms of a permit, license, or waiver issued by the State Water Resources Control Board or a regional water quality control board, or that is expressly authorized pursuant to a federal permit or license for which the State Water Resources Control Board, or a regional water quality control board has issued a water quality certification pursuant to Section 13160 of the Water Code. This section does not confer additional authority on the State Water Resources Control Board a regional water quality control board or any other entity.

It shall be an affirmative defense to a violation of this section if the defendant proves, by a preponderance of the evidence, all of the following:

1. The defendant complied with all applicable state and federal laws and regulations requiring that the discharge or release be reported to a government agency.
2. The substance or material did not enter the waters of the state or a storm drain that discharges into the waters of the state.
3. The defendant took reasonable and appropriate measures to effectively mitigate the discharge or release in a timely manner.

The affirmative defense set forth in subdivision (a) shall not apply and may not be raised in an action for civil penalties or injunctive relief pursuant to Section 5650. 1. (Amended Statutes 1996 Chap. 1122)

F&G Code Section 5651. Report of Water Pollution by Department. Whenever it is determined by the department that a continuing and chronic condition of pollution exists, the department shall report that condition to the appropriate regional water quality control board, and shall cooperate with the board in obtaining correction or abatement in accordance with any laws administered by the board for the control of practices for sewage and industrial waste disposal. (Amended by statutes 1985 Chap. 1429)

F&G Code Section 5652. Refuse Disposal Into Waters; Exceptions. It is unlawful to deposit, permit to pass into, or place where it can pass into the waters of the state, or to abandon, dispose of, or throw away, within 150 feet of the high-water mark of the waters of state, any cans, bottles, garbage, motor vehicle or parts thereof, rubbish, or the viscera or carcass of any dead mammal, or the carcass of any dead bird.

The abandonment of any motor vehicle in any manner which violates the provision of this section shall constitute a rebuttable presumption affecting the burden of producing evidence that the last registered owner of record, not having complied with the provisions of Section 5900 of the Vehicle Code, is responsible for such abandonment and is thereby liable for the cost of removal and disposition of the vehicle. This section shall not prohibit the placement of a vehicle body on privately owned property along a stream bank by the property owner or tenant for the purpose of preventing erosion of the streambank.

This section does not apply to a refuse disposal site which is authorized by the appropriate local agency having jurisdiction or to the depositing of such materials in a container from which the materials are routinely removed to a legal point of disposal.

The provisions of this section shall be enforced by all law enforcement officers of this state.

F&G Code Section 5900. Dam; Conduit; Owner; United States

As used in this chapter:

(a) "Dam" includes all artificial obstructions.

(b) "Conduit" includes pipe, millrace, ditch, flume, siphon, tunnel, canal, and any other conduit or diversion used for the purpose of taking or receiving water from any river, creek, stream, or lake.

(c) "Owner" includes the United States (except that for the purpose of Sections 5901, 5931, 5933, and 5938, "owner" does not include the United States as to any dam in the condition the dam existed on September 15, 1945), the State, a person, political subdivision, or district (other than a fish and game district) owning, controlling or operating a dam or pipe.

(d) "United States" means the United States of America, and in relation to any particular matter includes the officers, agents, employees

F&G Code Section 5901. Prevent or Impede Fish from Passing in Streams; Unlawful. Except as otherwise provided in this code, it is unlawful to construct or maintain in any stream in Districts 1, 1½, 2, 2½, 2¾, 3, 4, 4½, 23, and 25, any device or contrivance which prevents, impedes, or tends to prevent or impede, the passing of fish up and down stream.

F&G Code Section 5937. Sufficient Water for Fish Existing Below Dams.

The owner of any dam shall allow sufficient water at all times to pass through a fishway, or in the absence of a fishway, allow sufficient water to pass over, around or through the dam, to keep in good condition any fish that may be planted or exist below the dam. During the minimum flow of water in any river or stream, permission may be granted by the department to the owner of any dam to allow sufficient water to pass through a culvert, waste gate, or over or around the dam, to keep in good condition any fish that may be planted or exist below the dam, when, in the judgment of the department, it is impracticable or detrimental to the owner to pass the water through the fishway.

APPENDIX D: Completed Habitat Surveys and Genetic Studies for McCloud River Redband Trout

Stream	Habitat Typing Surveys	Genetic Analysis Status
Upper McCloud River	STNF 1	
Above Tate Creek	CDFG 2	M*
Below Tate Creek		A**, M
Tate Creek	CDFG	A, M
Upper Moosehead Creek	STNF	A, M
Lower Moosehead Creek	CDFG	
Cow Creek	CDFG	
Dry Creek	CDFG	M
Bull Creek	CDFG	A, M
Raccoon Creek	STNF	
Shady Gulch Creek	CDFG	M
Whiskey Creek	CDFG	
Blue Herron Creek	CDFG	M
Bundoora Spring Creek	CDFG	
Bigelow Creek	CDFG	
Sheepheaven Creek	STNF	A, M
Edson Creek	CDFG	A, M
Swamp Creek	SPI 3	A, M
Trout Creek	STNF	A, M
Unnamed creeks	CDFG	M
* M = Microsatellite DNA (Nelson 1996)		
** A = Allozyme Analysis (Berg 1987)		
1 Shasta-Trinity National Forest		
2 California Department of Fish and Game		
3 Sierra Pacific Industries		